R.S.T. VALVE MAIL ORDER CO.

Tel: MITcham 6202
Open Daily to Callers

211a STREATHAM ROAD, MITCHAM, SURREY.

All Valves Brand New and Fully Guaranteed — Obsolete valves a speciality.
Quotations given on any type not listed. Send S.A.E.

Special 24 Hour Express Mail Order Service

AC2/PEN	21/-
AC2/PEN DD	21/-
AC/TP	32/-
AC/VP1-5-7	17/6
AZ1	15/-
AZ31	10/-
B36	9/-
C1C	10/-
CBL31	21/6
CCH35	21/-
CL33	15/-
CY1	15/-
CY31	15/-
D77	4/-
DAC32	9/6
DAF91	6/6
DAF96	8/-
DCC90	12/6
DF33	10/-
DF91	4/-
DF92	7/2
DF96	8/-
DF97	11/6
DH63	6/-
DH77	7/-
DK32	11/6
DK91	7/3
DK92	8/6
DK96	8/6
DL33	8/6
DL35	10/6
DL91	8/0
DL92	6/6
DL93	7/0
DL94	7/6
DL96	8/0
EA50	2/-
EABC80	5/-
EAC91	4/-
EAF42	9/6
EB34	2/6
EB41	5/-
EB91	4/-
EBC3	21/-
EBC33	4/6
EBC41	8/6
EBC81	10/-
EBF80	8/6
EBF83	8/6
EBF89	8/-
EBL1	21/-
EBL21	21/-
EBL31	21/6
ECC35	8/-
ECC40	15/-
ECC81	5/-
ECC82	5/-
ECC83	7/6
ECC84	8/6
ECC85	7/6
ECC88	12/6
ECC91	3/-
ECF80	7/6
ECF82	8/6
ECH3	21/6
ECH21	21/-
ECH35	10/-
ECH42	9/6
ECH81	8/-
ECH83	8/6
ECL80	8/-
ECL81	10/-
ECL82	9/6
ECL83	10/6
ECL86	10/6
EF6	21/-
EF9	21/6
EF22	14/-
EF36	4/-
EF37	8/-
EF37A	8/-
EF39	4/-
EF40	15/-
EF41	8/-
EF42	10/-
EF50A	3/6
EF50E	3/-
EF80	5/-
EF85	5/-
EF86	9/-
EF89	9/-
EF91	4/-
EF92	4/-
EF95	5/-
EF93	10/-
EF183	10/6
EF184	10/6
EK32	8/6
EL2	25/-
EL3	21/6
EL6	21/-
EL32	4/6
EL33	10/-
EL34	15/-
EL35	10/-
EL37	17/6
EL38	19/6
EL41	10/-
EL42	10/-
EL81	12/6
EL84	6/9
EL85	10/-
EL90	8/6
EL91	4/-
EL95	10/6
EM80	8/6
EM81	8/6
EM84	9/6
EM85	10/-
EY51	8/6
EY81	8/6
EY83	12/6
EY86	7/-
EY91	3/-
EZ35	6/-
EZ40	7/-
EZ41	7/-
EZ80	6/6
EZ81	6/6
EZ90	7/-
E1148	2/-
FC2	15/-
FC2A	17/6
FC4	15/-
FC13	15/-
FC13C	17/6
FW4/500	9/-
FW4/800	9/-
GZ30	10/6
GZ32	10/6
GZ33	19/3
GZ34	13/6
GZ37	19/3
HABC80	10/-
HL41	8/-
HL41DD	8/6
HL92	8/6
HL133DD	9/6
HN309	26/6
IW4/350	10/-
IW4/500	10/-
KT33C	8/-
KT36	17/6
KT55	17/6
KT61	9/6
KT66	15/-
KT76	10/-
KT81	15/-
KTW61	8/-
L63	5/-
LN152	8/-
LN309	11/6
LZ319	12/6
MKT4	17/6
MS4B	17/6
MVS/PEN	17/6
MVS/PENB	17/6
MU14	9/-
MX40	15/-
N13	8/-
N37	14/-
N78	17/6
N108	15/-
N308	20/-
N339	30/-
N369	10/6
OD3	5/-
OZ4	5/6
P2	10/-
PABC80	13/-
PCC84	8/6
PCC85	9/6
PCC88	12/6
PCC89	8/6
PCF80	9/-
PCF82	7/-
PCF84	12/6
PCF86	12/6
PCL82	9/-
PCL83	11/6
PCL84	10/6
PCL85	10/6
PCL86	12/6
PENA4	17/6
PENB4	17/6
PEN4DD	24/-
PEN4VA	17/6
PEN36C	20/-
PEN45	10/-
PEN45DD	25/-
PEN46	5/-
PEN453DD	20/-
PENDD4020	20/-
PL33	15/-
PL36	12/6
PL38	21/-
PL81	11/6
PL82	8/-
PL83	10/6
PL84	8/6
PL820	18/-
PM24M	13/6
PX4	15/-
PX25	25/-
PY31	15/-
PY32	12/6
PY33	12/6
PY80	7/6
PY81	7/6
PY82	7/-
PY83	8/-
PY88	10/-
PY800	10/-
PZ30	15/-
QS95/10	10/-
QS150/15	10/-
R2	10/-
R3	10/-
R16	17/6
R19	16/-
R20	16/-
SP41	3/6
SP61	3/6
T41	15/-
TDD4	12/6
TDD13C	17/6
TH41	27/6
TY86F	12/6
U10	9/-
U12	9/-
U14	9/-
U22	8/-
U24	21/-
U25	12/6
U26	12/6
U31	9/-
U35	17/6
U37	17/6
U43	8/6
U47	12/6
U50	7/-
U52	4/-
U76	7/6
U78	4/6
U145	10/6
U191	15/6
U251	15/6
U281	15/-
U282	19/6
U301	22/6
U329	12/6
U339	15/-
U403	10/-
U404	10/-
U801	19/9
UABC80	7/-
UAF42	8/6
UB41	7/6
UBC41	8/6
UBC81	10/-
UBF80	8/6
UBF89	7/6
UBL21	20/-
UCC84	10/6
UCC85	7/6
UCF80	13/6
UCH21	20/-
UCH42	9/6
UCH81	8/-
UCL82	10/-
UCL83	13/6
UF41	7/6
UF42	7/6
UF80	7/-
UF85	7/6
UF86	12/6
UF89	6/6
UL41	8/-
UL44	20/-
UL46	14/6
UL84	7/-
UL85	7/6
UM80	10/6
URIC	15/-
UU6	17/-
UU8	15/-
UU9	7/6
UYIN	12/6
UY21	15/6
UY41	7/6
UY85	7/-
VMS4B	12/6
VP4	15/-
VP4A	15/-
VP4B	15/-
VR105/30	7/-
VR150/30	7/-
W61	11/-
W76	5/-
W77	4/-
W81	6/-
W81M	6/-
X41	15/-
X61M	10/-
X65	12/6
X76	12/6
X76M	12/6
X78	24/-
X79	42/6
X81	10/-
Y61	10/-
Y63	10/-
Z63	7/6
Z66	10/-
Z77	4/-
Z152	5/-
OZ4	5/-
1A7	11/6
1C5	10/6
1D5	8/6
1D6	10/-
1H5	9/6
1L4	5/-
1LN5	4/6
1N5	9/6
1R5	7/3
1S4	8/-
1S5	6/6
1T4	4/-
1U5	5/9
2P	24/9
3A4	5/-
3A5	10/6
3Q4	8/-
3Q5	9/-
3S4	7/-
3V4	7/6
5U4	4/-
5V4G	7/9
5Y3G	7/-
5Y3GT	8/6
5Z4G	9/6
5Z4GT	12/6
6A7	9/-
6A8G	8/6
6A8GT	13/6
6AC7	6/-
6AK5	5/-
6AK8	7/6
6AL5	4/-
6AM5	5/-
6AM6	4/-
6AQ5	6/6
6AQ8	9/3
6AT6	6/-
6AU6	9/-
6B8G	3/-
6BA6	6/-
6BE6	6/-
6BG6G	15/-
6BH6	8/-
6BJ6	6/-
6BQ7A	12/6
6BR7	10/6
6BS7	12/6
6BW6	8/-
6BW7	5/-
6C4	3/6
6C5GT	8/-
6C6	6/6
6C9	12/6
6CD6G	27/6
6CH6	10/-
6D2	4/-
6D6	5/6
6E5	10/-
6F1	10/6
6F6	6/9
6F12	4/-
6F13	10/-
6F14	10/-
6F15	12/6
6F19	12/6
6F23	10/6
6F25	16/6
6F26	13/6
6F33	5/6
6H6	2/-
6J5	5/6
6J5G	4/6
6J5GT	5/-
6J7	7/6
6J7G	5/-
6J7GT	7/6
6K7	7/6
6K7G	2/-
6K7GT	7/6
6K8	9/6
6K8G	5/-
6K8GT	9/6
6K25	18/-
6L1	10/-
6L6	7/6
6L7	10/-
6L18	10/-
6L19	15/-
6L34	9/6
6N7GT	9/6
6P25	10/6
6P28	12/6
6Q7	9/6
6Q7G	6/6
6Q7GT	8/6
6SA7	7/-
6SC7	8/6
6SF5	10/-
6SG7	7/-
6SH7	6/-
6SJ7	6/6
6SK7	5/6
6SL7GT	6/-
6SN7GT	5/6
6SQ7	8/6
6U4GT	10/-
6U5G	7/6
6V6G	4/6
6V6GT	8/-
6X4	4/6
6X5G	6/-
6X5GT	8/6
6/30L2	10/-
7B5	12/6
7B6	10/-
7B7	8/6
7C5	8/-
7C6	8/6
7D5	15/-
7D6	15/-
7D8	15/-
7H7	7/6
7R7	10/-
7S7	10/-
7Y4	7/6
8D3	4/-
9BW6	12/6
10C1	12/6
10C2	17/6
10F1	10/-
10F3	12/6
10F9	12/6
10LD11	15/-
10P13	15/-
10P14	19/-
11D5	23/6
12A6	6/6
12AH8	9/-
12AT6	7/6
12AT7	5/-
12AU6	17/6
12AU7	5/-
12AX7	5/-
12BA6	7/6
12BE6	7/6
12BH7	10/-
12C8	8/6
12J5GT	4/-
12J7GT	8/6
12K7GT	5/-
12K8GT	10/-
12Q7GT	6/6
12SA7	8/6
12SJ7	8/-
12SK7	6/-
12SL7	8/-
12SN7	10/-
12SQ7	8/6
14H7	10/-
14R7	10/-
14S7	16/-
19AQ5	8/-
19BG6G	15/-
20D1	10/-
20D2	21/-
20F2	17/6
20L1	24/-
20P1	15/-
20P3	24/-
20P4	23/6
20P5	24/-
25A6	8/-
25L6	8/-
25Y5	8/-
25Y5G	8/-
25Z4	7/6
25Z5	8/-
25Z6	8/6
27SU	19/6
30C1	9/-
30C15	12/6
30F5	10/-
30FL1	10/6
30L1	8/6
30L15	11/6
30P4	20/-
30P12	10/-
30P16	9/-
30P19	21/-
30PL1	15/-
30PL13	12/6
30PL14	16/6
35A5	17/6
35L6GT	8/6
35W4	7/6
35Z3	16/-
35Z4	7/6
35Z5	8/6
40SUA	15/-
41STH	21/-
42	12/6
50C5	10/-
50CD6G	27/6
50L6	8/6
53KU	12/6
75	8/-
78	7/6
80	9/-
85	17/6
85A2	12/6
185BT	30/-
305	13/-
807B	5/-
807A	6/-

METAL RECTIFIERS

RM1	5/3
RM2	7/6
RM3	7/9
RM4	14/-
RM5	19/6
14A86	17/6
14A97	25/-
14A100	27/-
14RA 1-2-8-2	17/6 (FC301)
14RA 1-2-8-3	19/- (FC31)
16RC 1-1-16-1	8/6
16RD-2-2-8-1	12/-
16RE 2-1-8-1	8/6
18RA 1-1-8-1	4/6
18RA 1-1-16-1	6/6 (FC116)
18RA 1-2-8-1	11/-
18RD 2-2-8-1	15/- (FC124)

TRANSISTOR BARGAINS

OC44	6/-
OC45	7/-
OC71	5/-
OC74	6/-
OC75	6/-
OC77	6/-
OC81	6/-
OC81D	6/-
OC82	8/-
OC82D	8/-

SILICON RECTIFIERS

400 volts 350 mA ... ... 12/6 each

TERMS OF BUSINESS C.W.O. or C.O.D.
3/2 PACKING CHARGE ON ALL C.O.D. ORDERS. POSTAGE 6d. per VALVE

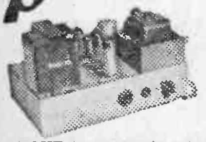
SETS OF VALVES

IR5, IS5, IT4, 3S4, 3V4	Set of 4, 19/6
DAF91, DF91, DK91, DL92, DL94	Set of 4, 19/6
DAF96, DF96, DK96, DL96	Set of 4, 27/6

Stern's MULLARD DESIGNS

COMPLETE KITS OF PARTS

MULLARD "5-10" MAIN AMPLIFIER



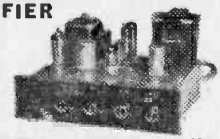
For use with MULLARD 2-stage pre-amplifier with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS AND MULLARD VALVES including PARMEKO MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer.

COMPLETE KIT (Parmeko Output Trans.) **£10.0.0**

ASSEMBLED AND TESTED **£11.10.0**

ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.

THE MULLARD 510/RC AMPLIFIER

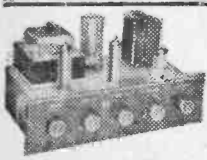


The popular complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Specified components and new MULLARD VALVES. Includes PARMEKO MAINS TRANSFORMERS and choice of PARMEKO or PARTRIDGE Output Transformers.

COMPLETE KIT **£11.10.0** Dep. £2.6.0 12 mths. 17/-

ASSEMBLED AND TESTED **£13.10.0** With PARTRIDGE OUTPUT TRANS. £1.6.0 ex.

THE MULLARD 33/RC



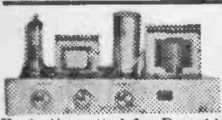
A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN.

KIT OF PARTS **£7.10.0**

ASSEMBLED AND TESTED **£8.19.6**

Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

THE "MONO-GRAM"



A small Amplifier of genuine high quality performance. Incorporates new MULLARD ECL86 Valve. separate BASS and TREBLE controls and produces up to 3 watts undistorted output.

Kit of Parts **£4.5.0** Assembled and Tested **£4.19.6**

Perfectly suited for Portable Installations for which purpose we offer PORTABLE CASE (£3.10.0), the AMPLIFIER (Kit) and 8" x 5" SPEAKER (£1.0.0).

All for **£8.5.0**

Alternatively with ASSEMBLED AMPLIFIER **£9.0.0**

The Case quoted above will accommodate some 4-speed Single Record Units. A larger model is available for extra 10/-. With this Equipment a COMPLETE PORTABLE RECORD PLAYER can be built for **£13.10.0**

MULLARD FOUR CHANNEL MIXING UNIT

Self powered Cathode follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.

KIT OF PARTS **£8.8.0** ASSEMBLED AND TESTED **£10.0.0**

Alternative Model I/L provides for one input matched for moving coil or ribbon mike £1.17.0 extra.

! ! SENSATIONAL BARGAINS ! !

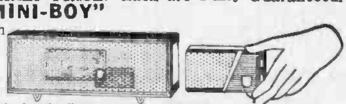
A BULK PURCHASE ENABLES US TO OFFER THESE TWO GRUNDIG MODELS AT APPROX. HALF PRICE. Each are Fully Guaranteed.

THE GRUNDIG "MINI-BOY"

THE "LITTLE" SET with "BIG" PERFORMANCE

LIST PRICE IS £26.5.0

OUR PRICE ONLY **£10.10.0** INCLUDING SPEAKER ENCLOSURE



A six Transistor (plus two Diodes) Portable covering the Medium Waveband. Small enough to slip into Handbag or Pocket (4" x 2¾" x 1") but when at home "big set" performance is obtained simply by slipping the set into the companion Speaker Enclosure (size 9¾" x 3¾" x 1¾").

GRUNDIG T.M.60 TAPE UNIT

For Stereophonic or Monophonic Operation. Beautifully Styled with Finger Tip Controls. Consisting of Tape Deck incorporating High Quality Preamplifier. List Price is £94.10.0

PRICE ONLY **£49.10.0**

Deposit £9.16.8 and 12 months at £3.15.10

A completely self contained, self powered Unit designed to add full TAPE RECORDING facilities to existing sound reproducing equipment. Will operate with the majority of high qualityaudio installations and ideally suited for our MULLARD AMPLIFIERS. When ordering please state the make and type of Amplifier or Radiogram to be used with the Unit.

MULLARD'S 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER but also perfectly suitable for other makes.

- ★ 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.

KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

PRICE REDUCTIONS

(a) THE KIT OF PARTS to build both the "5-10" **Main Amplifier and the 2-Stage Pre-Amplifier** **£15.15.0**
Deposit £3.7.0 and 12 months at £1.2.9.

(b) The "5-10" and the 2-Stage Pre-Amplifier both **Assembled and Tested** **£18.18.0**
Deposit £3.16.0 and 12 months at £1.7.8.

With PARTRIDGE OUTPUT TRANSFORMER £1.6.0 extra.

HIGH FIDELITY LOUDSPEAKERS

WE STOCK THE COMPLETE RANGE BY GOODMANS, WHARFEDALE and W.B. STENTORIAN.

A few recommended examples

8 INCH TYPES	
GOODMANS "AXIETTE"	£5.17.7
W.B. HF 816	£6.13.9
WHARFEDALE "SUPER 8/RS/DD"	£7.9.5
10 INCH TYPES	
GOODMANS "AXIOM 10"	£7.0.0
W.B. MODEL HF 1016	£7.16.0
WHARFEDALE "GOLDEN 10/RS/DD"	£8.15.5
12 INCH TYPES	
GOODMANS "AXIOM 201" 15 watts	£10.7.0
GOODMANS "AXIOM 301" 20 watts	£14.10.0
W.B. MODEL HF 1214 15 watts	£10.5.6
WHARFEDALE "W12/RS"	£10.10.0
WHARFEDALE "Super 12/RS/DD"	£17.10.0

LEAK AND QUAD AMPLIFIERS ARE IN STOCK

LEAK "TL/12 PLUS" POWER AMPLIFIER with the "POINT ONE PLUS" PRE-AMPLIFIER. 14 watts rated output.. **£31.10.0**

LEAK "TL/25 PLUS" with the "POINT ONE PLUS" PREAMPLIFIER. 28 watts rated output **£37.16.0**

LEAK "STEREO 20" POWER AMPLIFIER with the "VARISLOPESTEREO" PRE-AMPLIFIER. 22 watts (11 watts per channel) **£55.9.0**

QUAD II POWER AMPLIFIER with QUAD II CONTROL UNIT. 15 watts output...... **£42.0.0**

RECORD PLAYERS

THE COLLARO "JUNIOR" 4-speed single player with separate crystal pick-up.......... **£3.15.0**

THE NEW GARRARD "AUTOSLIM" 4-speed Autochanger with crystal pick-up...... **£8.10.0**

GARRARD "AUTOSLIM DE LUXE" 4-speed Autochanger, incorporates transcription Pick-up Arm **£12.14.6**

THE COLLARO "C60" 4-speed autochanger unit with Studio "O" pick-up **£7.19.6**

B.S.R. Model UA14. a 4-speed Mixer Autochanger with crystal pick-up **£7.19.6**

The new **GARRARD Model 4HF** High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.S. crystal Cartridge **£18.19.0**

GARRARD Model S.R.P. 10 Single Record Player fitted with high output crystal pick-up **£6.6.0**

PHILIPS Model AG1016. A 4-speed Player which can be operated both manually and automatically. Suitable for Mono or Stereo operation.... **£13.13.0**

Carr. and Ins. on each above 5/- extra.

! ! HOME CONSTRUCTORS ! !

A Range of "Easy to Assemble" Prefabricated Cabinets

Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. **FULL RANGE IN STOCK, please enclose S.A.E. for descriptive leaflets.**

IF YOU ARE PLANNING TO INSTALL "Hi-Fi" and UNCERTAIN OF THE TYPE OF EQUIPMENT TO USE—OUR WIDELY EXPERIENCED TECHNICAL STAFF WILL WITH PLEASURE PUT FORWARD RECOMMENDATIONS—STATE TYPE OF INSTALLATION CONTEMPLATED AND APPROX. PRICE LEVEL.

HIRE PURCHASE TERMS are available on all Equipment over £10.0.0.

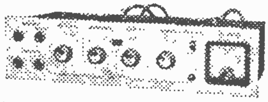
FULLY DESCRIPTIVE LEAFLETS are readily available—please enclose S.A.E.

Stern's

SPECIALISTS IN SOUND EQUIPMENT FOR OVER 25 YEARS

TAPE RECORDING EQUIPMENT

STEREO TAPE PRE-AMPLIFIER



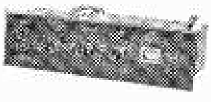
MODEL STP-1. For use with current TRUVOX, BRENELL, or COLLARO "STUDIO" ½ and ¼ track Stereo Decks Incorporates Ferroxcube Oscillator, 4 speed Equalisation Signal Level Meter and separate Gain Controls. Includes separate Power Unit.

KIT OF PARTS **£22.0.0** ASSEMBLED **£28.0.0**

COMBINED PRICE OFFERS

STP-1 (Kit) and "STUDIO" Deck	£35.0.0
STP-1 (Assembled "STUDIO" Deck	£45.0.0
STP-1 (Kit) and Brenell Deck	£61.0.0
STP-1 (Assembled) and Brenell Deck	£67.0.0
STP-1 (Kit) and Truvox Deck	£48.0.0
STP-1 (Assembled) and Truvox Deck	£54.0.0

MULLARD'S TYPE "C" TAPE PRE-AMPLIFIER



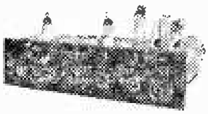
Suitable for most ¼ track. Mono Tape Decks. Incorporates Ferroxcube Push Pull Oscillator and 3 Speed Treble Inductor. Includes separate Power Unit.

KIT OF PARTS **£14.0.0** ASSEMBLED **£17.0.0**

COMBINED PRICE OFFERS

TYPE "C" (Kit) and "STUDIO" Deck	£26.10.0	Assembled £29.10.0
TYPE "C" (Kit) and BRENELL Deck	£43.0.0	Assembled £46.0.0
TYPE "C" (Kit) and TRUVOX D82 Deck	£39.10.0	Assembled £43.0.0
TYPE "C" Assembled and Wearite Deck	£60.10.0	Inc. Head Lift Trans.

MULLARD'S TAPE AMPLIFIER



MODEL HF/TR3
Based on Mullards Type "A" design and suitable for most ¼ track Mono Tape Decks. Incorporates Ferroxcube 3 speed Treble Inductor and Gilsen Output Transformer. Includes separate Power Unit.

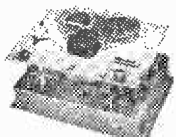
KIT OF PARTS **£13.13.0** ASSEMBLED **£17.0.0**

COMBINED PRICE OFFERS

HF/TR3 (Kit) and "STUDIO" Deck	£26.0.0	Assembled £29.10.0
HF/TR3 (Kit) and BRENELL Deck	£42.0.0	Assembled £45.10.0
HF/TR3 Assembled and Wearite Deck	£60.10.0	Inc. Head Lift Trans.

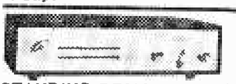
To build a complete TAPE RECORDER we offer HF/TR3 AMPLIFIER STUDIO DECK, PORTABLE CASE, ROLA 10 x 6in. SPEAKER, MICROPHONE and 1,200ft. TAPE ALL FOR £35.0.0.

STERN'S "ADD-A-DECK"



A self contained Unit consisting of Garrard Deck and matched Preamplifier on one chassis. Provides full tape recording facilities and replays through Pick Up Sockets or standard Radio receiver or Amplifier.
PRICE includes Spool of Tape **£18.18.0**

TUDOR AM/FM TUNING UNIT



A SELF-POWERED HIGH FIDELITY TUNER OF OUTSTANDING DESIGN. PROVIDES FULL COVERAGE of the VHF/FM TRANSMISSION and also the LONG and MEDIUM WAVEBANDS PRICE ONLY **£19.19.0** Deposit £4 and 12 months £1.9.4

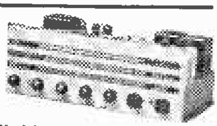
Operates perfectly with the STERN-MULLARD AMPLIFIERS and contains matching FRONT PANEL in Black/Gold or White/Black. Also operates equally well with any Amplifier requiring input of 100 to 350 m/Volts.

Mk. II "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard Amplifiers.

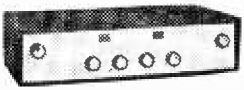
KIT OF PARTS **£10.10.0**
ASSEMBLED AND TESTED **£14.5.0**

ARMSTRONG RADIOGRAM CHASSIS



We have the full range in stock . . . Prices range from £22.18.0
Full details are readily available

THE "TUDOR" STEREO AMPLIFIER



PRICE **£18.18.0**

A self contained Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS.

Stereo Amplifiers

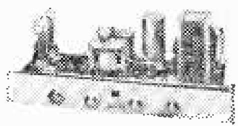
MULLARDS "10+10" STEREO AMPLIFIER

A high fidelity design providing up to 10 watts (per channel). Superb reproduction frequency response flat to within 3db from 3 c/s to 60 Kc/s at 50 mW Total Harmonic Distortion at 10 watts 0.1%

Price (a) ASSEMBLED AMPLIFIER (as illustrated) **£21.0.0**
(b) KIT of PARTS.......... **£18.10.0**

Built to the highest technical standards and presented strictly to MULLARD'S specification. Two specially designed GILSON OUTPUT TRANSFORMERS with 20% taps are used.
We can also supply the assembled MAIN AMPLIFIER only for operation with our DUAL CHANNEL PRE-AMPLIFIER; this provides a more versatile installation and is essential if a low output Magnetic Pick-up is to be used. When ordering specify loudspeaker impedance.
(a) THE ASSEMBLED MAIN AMPLIFIER and ASSEMBLED DUAL CHANNEL PRE-AMP...................... **£30.0.0**
(b) KIT OF PARTS for both Units...................... **£26.0.0**

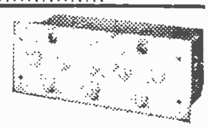
THE "TWIN THREE" STEREO AMPLIFIER



ASSEMBLED AND TESTED
£7.15.0 (Carriage and Insurance 7/6 extra)

Based on a recent design by MULLARD LTD., is ideally suited for use in PORTABLE RECORD PLAYERS for which purpose we offer a specially designed Case: Incorporates MULLARD ECL 86 Valves, separate BASS and TREBLE CONTROLS and produces up to 3 watts per channel. Frequency response is 40 c/s to 30 Kc/s. size is only 11½in. x 3in. x 5in.
To construct a STEREO PORTABLE RECORD PLAYER we offer: Assembled AMPLIFIER with two ROLA 8in. x 5in. LOUDSPEAKERS and PORTABLE CASE for.................. **£16.0.0**

MULLARD DUAL-CHANNEL PRE-AMPLIFIER



A four Valve design for both STEREOPHONIC and MONOPHONIC operation. Operates equally well with any make of Amplifier requiring an input of up to 250 m/v.

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

H.P. ON ALL EQUIPMENT OVER £10

POSTAL ENQUIRIES and MAIL ORDERS TO . . .
STERN RADIO LTD.
6-12, TUDOR PLACE, TOTTENHAM COURT RD. LONDON, W1. TEL. MUSEUM 6128/9

DEMONSTRATION and SHOWROOMS AT . . .

STERN RADIO LTD.
109, FLEET ST. LONDON, EC4
TEL. FLEET ST. 5812/3
OPEN...9 a.m. to 6 p.m. SAT. close 1 p.m.

PREMIER RADIO
23, TOTTENHAM COURT RD.
LONDON, W1. TEL. MUSEUM 6128/9
OPEN...9 a.m. to 6 p.m. THURS. close 1 p.m.

RETURN-OF-POST SERVICE

We offer a really efficient Mail Order Service on all items stocked. All cash orders are dealt with on the day of receipt.

★ **Hire purchase orders are subject to slight delay but this is kept to the absolute minimum.**

● TRANSISTORISE YOUR CRYSTAL SET

We have two new designs for Transistor amplifiers which can be used to greatly improve the signal from any crystal set. RLD4 Kit, one stage 12/-; RLD5 Kit, two stage 21/-; both post free. The kits are easy to build and very detailed instructions are supplied. Leaflet available.

● NEW MULLARD CONDENSERS

We now stock the following range of the new Mullard Miniature Foil and Polyester condensers as used in the latest TV and Transistor sets. Fully detailed list available giving full technical information and dimensions.

Miniature Foil. 30 volt working for Transistor sets. .01mfd 7½d.; .022mfd. 9d.; .047mfd. 9d.; .1mfd. 11d.

Polyester Tubular Capacitors. Moulded outer case designed to withstand accidental contact with the soldering iron. Tolerance 10%. 125v. range: .01mfd. .022mfd. .047mfd. all 9d. each. .1mfd. 1/2; .22mfd. 1/3; .47mfd. 1/6; 1mfd. 3/-.

400v. range: .001mfd. .0022mfd. .0047mfd. .01mfd. .022mfd. all 9d. each. .047mfd. 1/2. .1mfd. 1/3. .22mfd. 1/6. .47mfd. 2/5. Postage extra.

● TAPE RECORDING EQUIPMENT

TAPE DECKS

ALL CARRIAGE FREE	Cash Price	Hire Purchase Deposit	Mthly/Pmts.	
B.S.R. TD2	£8.19.6	£1.16.6	12 of	13/7
Latest COLLARO Studio	£10.19.6	£2.3.6	12 of	16/4

TAPE AMPLIFIERS

We now stock the **Martin Recorder Kits.** These are partly assembled kits for complete tape recorders. The Amplifier Printed Circuit panels are completely wired, but the assembly of this and external components is left to the constructor. Very complete instructions are supplied. Send for leaflet.

MODEL C for Collaro Studio Deck. **£11.11.0.**

MODEL B for BSR TD2 Deck, **£8.8.0.**

CARRYING CASES. Smart carrying cases are available to take the above amplifiers and decks. Fitted with speaker.

For Model C Amplifier and Collaro Deck, **£5.5.0.**

For Model B Amplifier and BSR Deck. **£4.4.0.**

H.P. Terms available for amplifiers, cases and decks.

TAPE PRE-AMPLIFIERS

MULLARD TAPE C PRE-AMPLIFIER. We stock complete kits and all components. Send for list.

MARTIN. Pre-amp kit for Collaro Studio Deck, **£8.8.0.**

● "BRAND FIVE" RECORDING TAPE Post free.

Long Play: 900ft. (5"). 18/6; 1200ft. (5¾"), 23/6; 1800ft. (7"), 35/-.

● JASON F.M. TUNER KITS

Kits supplied complete with every item needed including instruction manuals. Fully detailed list available. Separate items supplied, ask for price list. H.P. Terms available on any kit.

FMT1, £6.12.6; FMT2 (less power), £7.15.0.

FMT2 (with power), £9.12.6; FMT3 (less power), £9.9.6.

FMT3 (with power), £11.7.6. Mercury 2, £10.14.6.

JTV/2, £14.12.6.

● ILLUSTRATED LISTS

Illustrated lists are available on LOUDSPEAKERS, TAPE DECKS, TEST GEAR, GRAMOPHONE EQUIPMENT, AMPLIFIERS. Any will be sent free upon request.

● STEREO COMPONENTS

Morganite ganged potentiometers as specified for the Mullard circuits. ● Log/Anti-Log, 500k, 1 meg., 2 meg. ● Log/Log, 50k, 250k, 1 meg., 2 meg. ● Lin/Lin 250k, 500k, 1 meg. All 10/6 each.

● TRANSISTORS

MULLARD. Reduced prices. Current production types, not rejects. All in makers' boxes. Postage 3d. on each. OC44, 9/3; OC45, 9/-; OC70 and OC71, 6/6; OC72, 8/-; OC72 Matched Pairs 16/-; OC78, 8/-; OC81, 8/-; OC170, 9/6; OC171, 10/6.

● AMPLIFIER KITS

We have full stocks of all components for the Mullard 510, Mullard 3-3, Mullard 2 and 3 Valve Pre-amp. Mullard Stereo, Mullard Mixer, GEC 912 Plus. Fully detailed list on any of these sent upon request.

Instructional Manuals: All Mullard Audio Circuits in "Circuits for Audio Amplifiers", 9/5. GEC912, 4/6. All post free.

● MARTIN STEREO AMPLIFIER KITS

Printed circuit, already wired and tested. Only requires wiring to mains and output transformers. Complete kit with plastic cabinet, escutcheon and full instructions. £6.6.0.

● GRAMOPHONE EQUIPMENT

ALL LATEST MODELS ALL POST FREE	Cash Price	Hire Purchase Deposit	Mthly/Pmts.	
RECORD CHANGERS				
GARRARD AUTOSLIM	£7.19.6	£1.12.6	12 of	12/3
GARRARD AUTOSLIM De-luxe (Mono PU) ..	£12.14.8	£2.11.8	12 of	18/8
GARRARD AUTOSLIM De-luxe (Stereo/Mono PU)	£13.12.9	£2.14.9	12 of	20/-
B.S.R. UA14 (TC8 Mono PU)	£7.17.6	£1.12.6	12 of	12/1
B.S.R. UA14 Monarch (TC8S Stereo/LP/78) ..	£8.17.6	£1.16.6	12 of	13/5
SINGLE RECORD PLAYERS				
B.S.R. TU12 (TC8 Mono PU)	£4.5.0	£1.5.0	3 of	£1.3.4
B.S.R. GU7 (TC8 Mono PU)	£5.11.6	£1.13.6	3 of	£1.19.4
TRANSCRIPTION UNITS				
GARRARD 4HF (GC8 PU)	£17.19.6	£3.11.6	12 of	£1.6.5
PHILIPS AG1016	£13.13.0	£2.15.0	12 of	£1.0.0

Many of the above can be supplied for stereo working. See our Gramophone Equipment List for details.

● LOUDSPEAKERS

GOODMANS: Axiette 8in., £5.17.7; Axiom 10in., £7.0.0; 12in., Axiom 201, £10.7.0; 12in., Axiom 301, £14.10.0; 12in., Audiom 51 Bass, £8.14.0; 12in., Audiom 61 Bass, £13.14.0; Trebax Tweeter, £6.4.0; X05000 Crossover unit, £1.19.0.

WHITELEY: HF1016 10in., £7.16.0; HF1012 10in., £4.17.6; HF816 8in., £6.13.9; T816 8in., £6.6.9; T10 Tweeter, £4.8.3; T359 Tweeter, £1.14.0; CX3000 Crossover unit, £1.11.6; CX1500 Crossover unit, £2.0.0. H.P. Terms available on all speakers.

● P.W. STRAND, MAYFAIR & SAVOY UNITS

We stock parts for the P.W. Strand Amplifier, Mayfair Pre-amplifier and Savoy FM Tuner. Detailed price lists are available.

● "P.W. MERCURY"

P.W. Mercury. (Osmor printed circuit version), including Mullard first grade transistors and instructions manual. Complete set of parts £9.19.6. Instruction manual available separately at 2/6 post free. Separate components supplied. Send for list.

● LATEST TEST METERS

	Cash Price	Hire Purchase Deposit	Mthly/Pmts.	
AVO Model 8 Mark II ..	£24. 0.0	£4.16.0	12 of	£1.15. 2
AVO Model 8 with leather carrying case ..	£27.18.0	£5.12.0	12 of	£2. 0.11
AVO Model 7 Mark II ..	£21. 0.0	£4. 4.0	12 of	£1.10.10
AVO Multiminor	£9.10.0	£1.19.0	12 of	14/4
AVO Multiminor with leather carrying case ..	£11. 9.0	£2. 5.0	12 of	17/-
TAYLOR MODEL 127A ..	£10.10.0	£2. 2.0	12 of	15/8
CABY A-10	£4.17.6	£1. 7.6	3 of	£1. 6.8
CABY B-20	£6.10.0	£2. 0.0	3 of	£1.13.4
CABY M-1	£2.14.0	—	—	—

Full details of any of the above supplied free on request.

The AVO Models 7 and 8 are both latest models from current production—not to be confused with Government Surplus.

● OUTPUT TRANSFORMERS

GILSON: W0696A, W0696B, 50/6, post 2/6. W0710, 55/6, post 2/6. W0892, 62/3, post free; W0767, 27/-, post 1/6. W01796A, 57/6, post 2/6. W01932, 84/-, post free.

PARTRIDGE: P3667, 75/-; P4131, 65/-; P5202, P5203, £5.18.6. All post free.

PARMEKO: P2629, 45/6; P2642, 43/3; P2643, 45/6. All plus post 2/9. P2641, 28/3, post 2/-; P2928, 15/3, post 2/-; P2932, 39/3, post 2/6.

ELSTONE: OT/ML, 45/-, post 2/9; OT/3, 25/-, post 2/6.

● MAINS TRANSFORMERS

GILSON: W0741AB, 63/-, post free; W0839, 48/9, post 2/9; W01328, 58/6, post 3/6; W01288, 58/-, post 3/6; W01566, 80/-, post free; W01341, Choke, 36/-, post 2/-.

PARMEKO: P2631, 33/9, post 2/9; P2630, 52/6, post 3/3; P2644, 73/6, post free; P2930, 39/3, post 3/-; P2931, 54/6, post 3/3.

ELSTONE: MT/MU, 45/-, post 3/3; MT3/M, 35/-, post 3/-; MT/510, 42/-, post 3/3.

● **TERMS OF BUSINESS**

Cash with order or C.O.D. We charge C.O.D. orders as follows: Up to £3, minimum of 3/2. Over £3 and under £5, 1/6. Over £5 and under £10, 1/8. Over £10, no charge. **Postage extra on CASH orders under £3 except where stated. Postage extra on overseas orders irrespective of price.**

WATTS RADIO

(MAIL ORDER) LTD.

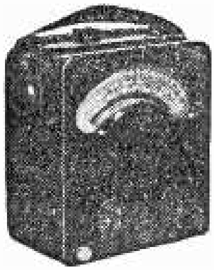
54 CHURCH ST., WEYBRIDGE, SURREY

Telephone: Weybridge 47556

Please note: Postal business only from this address

● **HIRE PURCHASE TERMS** are available on any item. Repayments may be spread over 3, 6 or 12 months. Details as follows: Three months: Deposit 6/- in the £. Service charge 5 per cent, but minimum charge of 10/-. Six and Twelve months: Deposit 4/- in the £. Service charge 10 per cent, but minimum charge 20/-.

UNIVERSAL AVOMETERS



Guaranteed perfect working order. Supplied complete with leads, batteries and instructions.
Model "D" 34 range £8.19.6
Model "7" 50 range £11.0.0
Registered Post 5/- extra.

COSSOR 1035 DOUBLE BEAM OSCILLOSCOPES

Guaranteed perfect working order. £45 each. Carriage £1.

7.5 K.V.A. AUTO TRANSFORMERS

0-115-230 volts. Brand new boxed. £15. Carriage 10/-.

230/250 VOLT A.C. MOTORS

4½ x 3in. dia., 90 watts, 5,000 r.p.m. ½in. spindle. 22/6. P.P. 1/6.

1 K.V.A. ISOLATION TRANSFORMERS

230 v. PRI 230 v. Sec. Boxed. £5 each. Carriage 10/-.

VARIAC TRANSFORMERS

24 amp., 230 volt primary, 185 to 250 volt output, £12.10.0. Carriage 10/-.

TELEPHONES TYPE "L"

Generator Bell Ringing, 2 line connection. With batteries, fully tested, 69/6 per pair. Carriage 5/-.

100 AMP A.C. METERS

Nalder Thompson 6in. scale. Brand new, boxed, 65/-. P.P. 3/6.

3000 WATT AUTO TRANSFORMERS

0-115-230 volts, step-up or step-down. Brand new, boxed ex-U.S.A. £7.10.0 each. Carr. 10/-.

PANEL METERS

100µA	2½"	F.M.	D.C.	42/6
100µA	3½"	F.M.	D.C.	62/6
1 mA	2½"	F.M.	D.C.	25/-
30/0/30 mA	2½"	F.M.	D.C.	9/6
350 mA	2½"	F.M.	D.C.	10/6
2 v.	2½"	F.M.	A.C.	17/6
10 v.	2"	Proj.	A.C.	15/6
300 v.	2½"	Proj.	A.C.	19/6
300 v.	2½"	F.M.	A.C.	25/-
500 v.	2½"	F.M.	A.C.	25/-
120 v.	3½"	F.M.	D.C.	32/6
1500 v.	2½"	Electrostatic		25/-

FIELD TELEPHONES TYPE "F"

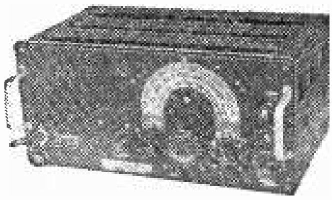
Suitable for many applications. Generator bell ringing, 2 line connection. With batteries and wooden carrying case, fully tested, £4.19.6 per pair. Carr. 5/-.

WANTED. ALL GOOD QUALITY COMMUNICATION RECEIVERS AND TEST EQUIPMENT.

P.C.R. COMMUNICATION RECEIVERS

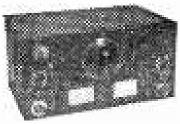
6 valves. Frequency coverage on 3 bands: 850-2,000 metres, 190-550 metres and 6-18 Mc/s. Super slow motion drive. AE trimmer, tone control, built in speaker. AS NEW £6.19.6 each. Carr. 7/6.

P.C.R.2 RECEIVERS



850-2,000 metres, 190-550 metres 6-22 Mc/s. output for phones or 3 Ω speaker. As new £5.19.6. Carr. 7/6. PCR3 as PCR2 but covers 190/550 metres, 2-7 Mc/s, 7-22 Mc/s, including top band. As new. £8.8.0. carr. 7/6. All above models can be supplied with internal power unit to operate on 200/250 v. A.C. at 39/6 extra or alternatively plug-in external power units are 35/-.

NATIONAL H.R.O. RECEIVERS



BRAND NEW! Senior model, table mounting. Complete with a full set of 9 coils covering 50 kc/s to 30 Mc/s. Supplied complete in original transit cases, £25. Carr. 20/-. Power units to operate direct from 200/250 volt. A.C. 59/6 extra.

PRECISION COMBINATION VOLTMETER/AMMETER FOR A.C. AND D.C.

Two separate instruments housed in polished wood case, 6in. scales with knife edge pointers.
Ranges:
Volts A.C. and D.C. 160-300-600 v.
Amps. A.C. and D.C. 25-50-150-200 A.
Supplied complete with all current shunts, leads and leather carrying case. Manufactured by Elliott Bros. Supplied brand new, £9.19.6 each. Carriage 7/6.

MINE DETECTOR No. 4A

Will detect all types of metal. Fully portable. Complete equipment supplied tested with instructions, 39/6. Carriage, 10/6. Battery 8/6 extra.

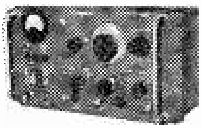
COLLARO STUDIO TAPE TRANSCRIPTOR

Brand new 1962 model, 3 speeds, 3 motors, digital counter, etc. With latest bradmatic heads and interlock button. Supplied with spare spool, instructions, fixings. 10 gns. each. Carr. paid.

FABULOUS TAPE OFFER

Famous American Brand Tapes. Brand new, fully guaranteed. 5in.—600ft., 10/6, 5in.—900ft., 13/6, 5in.—1200ft., 17/-, 7in.—1200ft. 15/-, 7in.—1800ft., 20/-, 7in.—2400ft., 30/-. P. & P. extra. S.A.E. for full tape list.

CT-53 SIGNAL GENERATORS

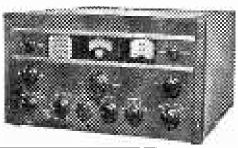


Precision instruments covering 8.9 to 15.5 Mc/s. and 20 to 300 Mc/s. on 6 bands. Variable attenuator from 1 microvolt to 100 millivolts. Operation 110/200/250 volts A.C. Supplied in perfect working order. Complete with calibration charts. 19 gns. each. Carriage 10/6.

PRECISION A.C. AND D.C. VOLTMETERS

Two ranges, 160 and 320 volts, 8 inch mirror scale with knife edge pointer. Housed in polished wooden case. Ideal for schools, labs., etc. Supplied brand new, £5.19.6 each. P.P. 3/6.

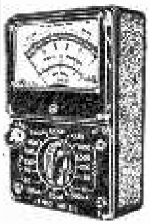
R.C.A. AR.88 LF RECEIVERS



These world-famous 14-valve receivers are offered in excellent condition. Fully tested and checked before dispatch. Frequency coverage on six bands is 75 to 550 Kc/s and 1.5 to 30 Mc/s. Completely self-contained except phones or speaker. Operation for 100-200-250 volt A.C. £32.10.0 each, carriage 30/- ex.

JEMCO 4,000 OHM/VOLT TESTMETER

1% Precision Resistors throughout. Single control system for all ranges. Highly accurate. Sensitivity 4,000 Ω/volt A.C. and D.C.



Ranges:
D.C. volts: 0-10-50-250-500-1,000v.
A.C. volts: 0-10-50-250-500-1,000v.
D.C. current: 0-250 vA 0-25-500mA.
Resistance: 03-0k Ω 0-300k Ω 0-3M Ω
Decibels: —20 to +36 db (2 ranges).
Meter sensitivity: 100 microamp. 62/6 each P.P. 2/6.

JEMCO 20,000 OHM/VOLT TESTMETER

As above but with increased sensitivity and extended resistance range (0-5M Ω). 97/6 P.P. 2/6. Either type brand new. Guaranteed with leads, prods, batteries, instructions.

L.T. METAL RECTIFIERS

All full wave, bridge connected. Brand new, guaranteed.

12/18v.	1.5A,	3/9	24/36v.	4A,	15/6
12/18v.	2.5A,	6/3	24/36v.	15A,	45/-
12/18v.	4A,	8/6	36/48v.	2A,	19/6
12/18v.	6A,	12/3	36/48v.	4A,	29/6
12/18v.	10A,	22/6	36/48v.	6A,	32/6
12/18v.	15A,	37/6	48/60v.	2A,	21/-
24/36v.	1A,	7/3	48/60v.	10A,	82/6

Please add postage.

L.T. TRANSFORMERS

All primaries tapped 200/250 volts.
1 Battery Charging. 3.5, 9 or 17 volt, 1 amp., 9/9. Ditto 2 amp. 14/3. Ditto 4 amp., 16/6. 9 or 17 volt, 6 amp., 26/-.
2 Model Type 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24 or 30 volt, 2 amp., 18/6. Ditto 4 amp., 27/6. Ditto 5 amp., 37/6. Add Postage.

AUTO TRANSFORMERS

Step-up, step-down, tapped 0-115-200-230-250 volts. 15w., 9/-; 60w., 12/6; 150w., 18/6; 200w., 27/6; 300w., 42/6; 500w., 67/6; 1,000w. 99/6; 1,500w., £6.19.6. P.P. extra.

R.C.A. PLATE TRANSFORMERS

Pri. 200/250 v. sec., 2,000-0-2,000 v. 500 mA, tapped 1,500 v. New, boxed, £6.10.0. Carriage 15/-.

DUMONT K1O5IP1 DOUBLE BEAM C.R.T.

Twin Gun. Brand new, boxed, 59/6. P.P. 3/6.

1.2 Ohm 12 Amp RHEOSTAT

Geared slider type, new boxed, 15/6 each. P.P. 3/6.

PAINTON 100KΩ3½ DIA. INSTRUMENT POTS

Fully screened, precision wire-wound, 10/6 each. P.P. 1/3.

CADMIUM SULPHIDE PHOTOCELLS

Very sensitive, full data supplied, 12/6 each. P.P. 6d.

MINIATURE PANEL METERS

For 1½in. dia. panel hole.

0-50 µA	39/6	0-300 v. D.C.	27/6
0-500µA	32/6	"S" meter	35/-
0-1 mA	27/6	"VU" meter	42/6
0-5 mA	27/6		

Hours of Business: **3 LISLE STREET, 9 a.m.—6 p.m. Half Day Saturday**
34 LISLE STREET. 9 a.m.—6 p.m. Half Day Thursday

Send S.A.E. For Bargain Lists

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

R.S.C. (Manchester) Ltd. *MAIL ORDERS to 5 County Arcade, Leeds 1. Terms: C.W.O. or C.O.D. No C.O.D. under £1 Postage 2/9 extra under £2. 4/6 extra under £5. Trade Supplied. S.A.E. with all enquiries please.*

BIRMINGHAM: 6 Gt. Western Arcade (Opp Snow Hill Stn) Half-day Wed.
SHEFFIELD: 13 Exchange St. Castle Market Bldgs.
HULL: 51 Savile St.
Half-day Thurs.
LIVERPOOL: 73 Dale St. (8 mins. from Lime St. or Exchange Stations)
BRADFORD: 56 Morley St. (above Alhambra Theatre)
Half-day Wednesday
LEEDS: 5-7 County (Mecca) Arcade, Briggate
MANCHESTER: 8-10 Brown St. (Market St.) No half-day

SENSATIONAL STEREO OFFER

(4 Gns.)

A complete set of parts to construct a good quality Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Including pair matched 6½in. speakers. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. Stereo Pick-up Head 19/9 extra with above only.

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, GZ34. 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/s. A.C. Mains and has output for 3 and 15 ohm speakers. Complete Kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required perforated cover with carrying handles can be supplied for 19/9. The amplifier can be supplied, factory built with EL34 output valves and 12 months guarantee, for 14 gns.

11 Gns. Carr. 10/-

TERMS: DEPOSIT 33/9 and 9 monthly payments of 33/9.
Suitable microphones and speakers available at competitive prices.

WE STOCK ARMSTRONG, DULCI AND JASON EQUIPMENT GOODMANS AND W.B. SPEAKERS

GARRARD AND GOLDRING T/TABLES

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

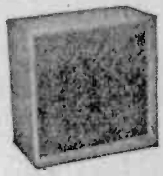
P.M. SPEAKERS. 10in. W.B. "Stentorian" 3 or 15 ohms type HF 1012 10 watts, hi-fidelity type. Recommended for use with our A11 Amplifier, £4.12.9. 12in. R.A. 3 ohms 10 watts (12,000 lines). 59/6.

TWEETERS. Plessey 3Ω 19/9, 15Ω 25/9.

Jason FMT1 V.H.F./F.M. Radio Tuner design. Total costs of parts including valves Tuning dial, Escutcheon, etc., £6.19.9. Other Jason equipment in stock.

LINEAR L45 MINIATURE 4/5 WATT QUALITY AMPLIFIER. Suitable for any record playing unit, and most microphones. Negative feed-back 12 db. Separate Bass and Treble Controls. For mains 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Mullard valves EZ80, ECC83, EL84. Size only 7-5-5½in. high. Guaranteed 12 months. Only £5.19.6. Send S.A.E. for leaflet. Terms: Deposit 22/6 and 5 monthly payments of 22/6.

12in. 10 WATT HIGH QUALITY LOUDSPEAKER



In walnut veneered cabinet. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4.19.6 Carr. 5/-. Terms: Deposit 11/3 and 9 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.

BASS GUITAR LOUDSPEAKER IN CABINET. 15in. 50 watt. highly sensitive unit in rexine covered acoustically lined cabinet. Deposit £3.7.6 and 12 monthly payments of £3.7.6. **29 Gns.** Carr.15/-

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

A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads, in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 db. down 15 db. of Negative feedback is used. H.T. 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 base plate) 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 NOW ON PAGE 883.

AUDIOTRINE HIGH FIDELITY REPRODUCERS

THE DUO/10. Consisting of a 12in. 12,000 line Speaker with heavy four layer voice coil, the Audiotrine cross-over unit, and a 4in. Diameter Tweeter Unit incorporated in the extremely attractive Audiotrine Senior Corner Console Cabinet as described below. Matching impedance 15 ohms. Power handling 10 watts nominal. 14 watts peak. Frequency range 40-18,000 c.p.s. Deposit 27/9 and nine monthly payments of 27/9. ONLY **12 Gns.**

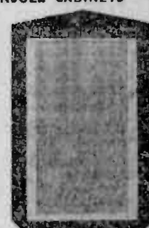
THE DUO/20. Incorporating a 12in. High Flux 20 watt Speaker with 2in. Diameter Speech Coil. (Total Flux 160,000 lines), the Audiotrine cross-over unit, and a highly sensitive Tweeter unit, in the Audiotrine Senior Corner Console Cabinet. Matching impedance 15 ohms. Peak Power Output 25 watts. Frequency range 30-18,000 c.p.s. Deposit 33/9 and nine monthly payments 33/9. ONLY **14 Gns.**

R.S.C. JUNIOR HI-FI REPRODUCER. The very latest Goodmans Axiette 8 High Fidelity loudspeaker (retailing at £5.15.7) fitted in a specially designed Bass, Reflex cabinet size 12in. x 18in. x 10in. Acoustically lined and ported and finished in polished walnut veneer. Matching impedance 15 ohms. Frequency range 40-15,000 c.p.s. Power handling 6 watts nominal. Ideal for Stereo. Limited number. ONLY **£8.19.9** Carr. 4/6

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 Audiotrine Loudspeaker systems. For vertical or horizontal use. £5.19.6. Suitable legs with brass ferrules, 19/6 per set of 4.

R.S.C. CORNER CONSOLE CABINETS



Polished walnut veneer finish. Pleasing design. **JUNIOR MODEL.** Size 20 x 11 x 8in. for 8 x 5in. or 10 x 6in. speakers, £2.9.9. **STANDARD MODEL.** Size 27 x 18 x 12in. for 8 or 10in. speakers, £4.11.9. **SENIOR MODEL.** Size 30 x 20 x 15in. for 12in. Speaker. Suitable Speaker systems below Only 7 gns.

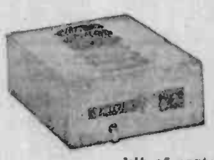
AUDIOTRINE HI-FI SPEAKER SYSTEMS. Consisting of matched 12in. 12,000 line. 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. The smooth response and extended frequency range ensure surprisingly realistic reproduction Standard 10 watt rating £4.19.9. Carr. 5/-. Or Senior 15 watt. 7 gns. Carr. 7/6.

AUDIOTRINE EQUIPMENT CABINETS

Size 36 x 15 x 18in. Beautiful walnut veneered finish. Elegant contemporary design. Robust construction. Uncut removable baseboard Depth above baseboard 5¼". Only 12½ gns. Carr. 15/-.

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 and 90 v.** This includes low consumption types. Complete kit with diagrams. 39/9, or ready to use. 46/6.



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. accumulators. Complete kit of parts with diagrams and instructions 49/9, or ready for use. 59/6.

AUDIOTRON HI-FI TAPE RECORDER KIT 25½ GNS. Carr. 17/6

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

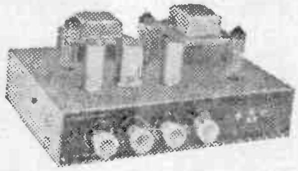
Incorporating the latest Collaro Studio Tape Transcriptor. The Audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best quality Tape and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 14¼ x 15 x 8½in. high, and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS. Deposit £2.13.9** and 12 monthly payments of **44/-**. Cash price if settled in 3 months.

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

SPECIAL NOTE. The Tape Decks we supply are latest models. Where customers already have a Deck or wish to use one of those being offered cheaply we can supply Kit less Deck at 13 gns. carr. 10/-. Or deposit **2 gns.** and 12 monthly payments 23/9. Also if required we can supply in lieu of portable cabinet and 7 x 4in. speaker, the Equipment Cabinet illustrated at foot of opp. page and a high flux 8¼ x 5¼in. speaker for 8¼ gns. extra.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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

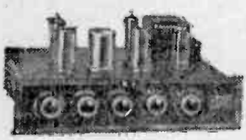


Two input sockets with associated controls allow mixing of "mike" and gram., as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 D.B. 30-30,000 c/s. 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. Speaker. Microphones, etc., with cash and credit terms.

B.S.R. MONARDECK TAPEDECKS. Speed 3¾in. per sec. With high quality recording heads, **£6.19.6.** Carr. 5/-. Cabinets, to take Deck and amplifier 39/6.

R.S.C. TRANSISTORISED GRAM AMPLIFIER. Output 1 watt, for 3 ohm speaker. Transistors Mullard OC71. OC81D. OC81, OC81. Fitted Vol. Control with switch. Assembled and tested. Suitable for any normal crystal pick-up. Only 59/9.

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 Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10-watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3ohm speakers. Point-to-point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-.
Kit can be assembled, ready to use, 59/6 extra.

HI-FI CRYSTAL PICK-UP HEADS. (Cartridges.) Acos Standard replacement for Garrard, B.S.R. and Collaro, **19/9.** Acos Stereo-Monaural **49/9.** Ronette Stereo-Monaural **59/6.** B.S.R. Stereo **39/9.**
BRADMATIC RECORDING HEADS. High Impedance Record/Playback **22/-.** Low Impedance Erase. **12/6.**
PICK-UP ARMS. Complete and with latest Acos/hi-fiTurnover Cartridge **29/11.**
CRYSTAL MICROPHONES. Hand type NP110 **14/9,** R.T.C. **19/9,** Acos Mic 40 **25/9,** Acos Mic 45 **29/9,** Stick type Acos 39-1 **39/9,** BM3 with neck band and heavy table stand **59/9.** Lapel type **35/9.**
COLLARO JUNIOR 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only **£3.19.6.**
COLLARO CONQUEST 4-SPEED AUTO-CHANGER, with high fidelity Studio pick-up. Latest model. For 200-250 v. A.C. mains. **£6.19.6.** Carr. 5/6.
COLLARO RC 457 4-SPEED MIXER AUTO-CHANGERS. Turnover Studio head, for 200-250 v. A.C. **£7.19.6.** Carr. 4/6.
B.S.R. UA14 4-sp'd AUTO-CHANGERS with hi-fi turnover head. **£6.19.6.** Carr. 4/6.
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 11¾ x 2¼ x 2¼in. Controls: Vol. and Tone with switch. Only **59/6.**

R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250v., 50c/s. 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.

CHARGER KIT. 12v. 14 AMP or 24v. 7 amp. Consisting of mains trans. 200-230-250 v. F.W. (Bridge) selenium Rectifier. F Ammeter. Fuses. Variable Resistor and Circuit. Only **6 gns.** Carr. 15/-. Please state if 12v. or 24v. kit required.

SOLDERING IRONS. 230-250 v. 30 watts. First quality. For Radio work. **19/9.** Spare elements and bits available.

Assembled 4-5 amps. 6/12 v.
Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case in stoved blue, hammer finished. Fused and ready for use with mains and output leads. **69/9** Carr. 5/-. Terms: Deposit 13/3 and 5 monthly payments 13/3. 6/12 v. 3a., all facilities as above. Only **59/9,** carr. 3/9.

ASSEMBLED 6/12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Fused, ready for use with mains and output leads **49/9** Carr. 3/9
6/12 v. 1 amp. 27/9 Less meter.

ASSEMBLED 12V. 10 Amp with variable charge rate adjustment, ammeter and strong louvred, stove enamelled case. Ready for use. Only **7 gns.** Carr. 10/- or in Kit Form 5 gns.

BATTERY CHARGER KITS Consisting of Mains Transformer. F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders, Grommets, panels, Heavy Duty Clips, circuit. Carr. 3/6 extra.

6v. or 12v. 1 amp	22/9
As above, with Ammeter	28/9
6 v. 2 amps	19/9
6v. or 12v. 2 amps	25/9
6 v. or 12 v. 2 amps, inclusive of Ammeter	35/9
6 v. or 12 v. 4 amps	45/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector	52/9

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

250-0-250v. 70mA, 6.3v. 2a, 0-5-6.3v. 2a	17/9
350-0-350v. 80mA, 6.3v. 2a, 5v. 2a	18/9
250-0-250v. 100mA. 6.3v. 2a, 6.3v. 1a	21/9
250-0-250v. 100mA. 6.3v. 3.5a C.T.	19/9
250-0-250v. 100mA. 6.3v, 4a, 0-5-6.3v. 3a	25/9
300-0-300v. 130mA. 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier	29/9
300-0-300v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 100mA, 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 150mA. 6.3v. 4a, 0-5-6.3v. 3a	29/9
425-0-425v. 200mA, 6.3v 4a. 5v. 3a	49/9

FULLY SHROUDED UPRIGHT

250-0-250v. 60mA. 6.3v. 2a, 0-5-6.3v. 2a. Midget type 2½-3-3in.	17/11
250-0-250v. 100mA, 6.3v. 4a. 0-5-6.3v. 3a	27/9
300-0-300v. 100mA. 6.3v. 4a, 0-5-6.3v. 3a	27/11
300-0-300v. 130mA. 6.3v. 4a. C.T. 6.3v 1a. for Mullard Amplifier	33/9
350-0-350v. 100mA. 6.3v. 4a. 5v. 3a	27/11
350-0-350v. 150mA. 6.3v. 4a, 5v. 3a	35/9

FULLY SHROUDED (continued)—

425-0-425v. 200mA, 6.3v. 4a. C.T. 5v. 3a	55/-
425-0-425v. 200mA, 6.3v. 4a. C.T., 6.3v. 4a. C.T., 5v. 3a	59/9
450-0-450v. 250mA, 6.3v. 4a, C.T. 5v. 3a	69/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66 : 1 for 3S4, etc.	4/6
Small Pentode, 5000Ω to 3Ω	4/6
Small Pentode 7/8,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 7,000Ω to 3Ω	5/9
10,000Ω to 3Ω	5/9
Push-Pull 8 watts, EL84, or 6V6 to 3Ω or matched to 15Ω	9/9
Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 or 15Ω	19/9

Following types for 3 and 15Ω speakers:

Push-Pull 10-12 watts 6V6 or EL84	18/9
Push-Pull 15-18 watts, 6L6, KT66	22/9
Push-Pull Mullard 510 Ultra Linear	29/9
Push-Pull 20 watts, sectionally wound, 6L6, KT66, EL34, etc.	49/9

MIDGET MAINS Primaries 200-250 v.

50 c/s, 250 v. 60 mA. 6.3 v. 2a	11/9
250-0-250 v. 60 mA, 6.3 v. 2a	12/11

Both above size 2¾ x 2¾ x 2¼ins.

FILAMENT TRANSFORMERS
All with 200-250 v. 50 c/s. primaries 6.3 v. 1.5a. **5/9;** 6.3 v. 2a. **7/6;** 0-4-6.3 v. 2a, **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.**

SMOOTHING CHOKES

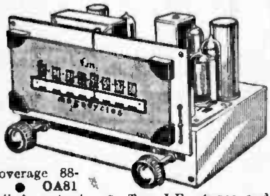
150 mA. 7-10 H H 250 ohms	11/9
100 mA. 10 H 200 ohms	8/9
80 mA, 10 H 350 ohms	5/9
60 mA, 10 H 400 ohms	4/11

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a. **12/9;** 0-9-15 v. 2a, **14/9;** 0-9-15 v. 3 a., **16/9;** 0-9-15 v. 5 a., **19/9;** 0-9-15 v. 6 a., **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.** 250 watts. 39/9; 150 watts. **27/9.**

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

HARVERSON'S F.M. TUNER Mk.I



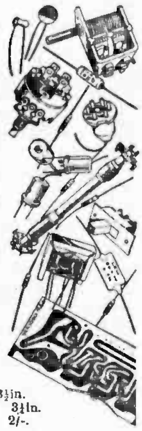
● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. £5.19.6, plus 8/6 P.P. and ins. Circuit diagram and illustrations 1/6 Post free.

Mark II Version as above but complete with magic eye, front panel and brackets. £6.12.6. P. & P. 8/6.

Mark III Version as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6.

Handsome Metal Cabinets. Choice of Grey, Black or Green. To fit Mark 1, 25/-. P. & P. 2/6. To fit Mark II, 17/6, P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET



A first-class 2 waveband transistor superhet in kit form. ● Printed circuit panel (size 8½ x 2½in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● First-grade G.E.C. transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.

All parts sold separately.

ONLY £4.5.0 P. & P. 2/6

2½in. 35 ohms speaker, 10/6; 3½in. 35 ohms speaker, 16/6; 35 ohms 5in. P.M., 18/6; 7 x 4in. 35 ohms speaker, 21/-. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6½ x 3½in. Suitable for above using 3½in. speaker. 25/-. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling), 28/6 complete, post 1/-. 6 transistor printed circuit, board to match, 8/6, post 9d. Circuit diagram 1/6 extra.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume. On/off controls.

PRICE 69/6 P. & P. 3/6

DITTO. Mounted on board with output transformer and 6½in. speaker.

Complete at 89/6, P. & P. 4/6

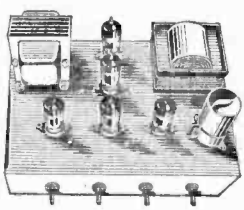
TRANSISTORS

GET15 (Matched Pair) 15/-

OC71	5/-	PXA101 ..	6/6
OC72	6/-	XA103 ..	6/6
OC76	6/-	V15/10p ..	12/6

Set of Mullard 6 transistors 25/-. Set of G.E.C. 1,874; 2873; 3, 81 or GET114, 20/-. All Post Free.

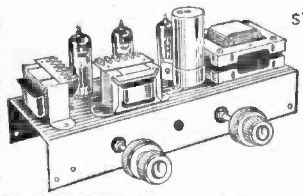
10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded ultra output transformer to match 3-15 speaker) and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.)

All parts sold separately. **ONLY £6.19.6** P. & P. 6/6.

STEREO AMPLIFIER

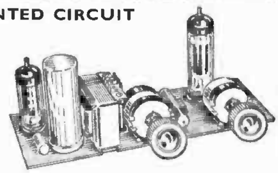


Bargain Offer

★ 4 watts per channel.
★ Full tone and volume controls.
★ Complete with sockets, etc.

89/6
P. & P. 2/6.

AMPLIFIER ON PRINTED CIRCUIT BOARD



Two valve. UY85, UL84 O.P. trans., use with 80 volt tap off motor. 39/6. P.P. 2/6 on above. Dropper res. for filaments if required, 2/6.

B.S.R. AUTO UNITS

160 v. Suitable for use with above. (Slightly soiled.) £5.5.0. P. & P. 5/-.

LARGE CABINET Suitable for above two items. Complete with 3 ohm speaker. £3.9.6. Carr. 5/-.

Superior CABINET Similar to above to take 8 x 5in. speaker, with motor board, will accommodate BSR UA14 or UA16. £3.9.6. Carr. 5/6. Speaker 15/- extra. P. & P. 1/6 extra.

BRAND NEW 3 OHM LOUDSPEAKERS

2½in. 12/6; 5in. 12/6; 6½in. 15/-; 10in. 21/-
12in. 27/6. Goodmans 5in. tweeter 10/6
E.M.I. 2½in. tweeter 10/6
Goodmans 8in. x 5in. middle register speaker 10/6
Goodmans 10in. x 6in. 22/6
E.M.I. 13½in. x 8½in. high flux .. 32/6
Rola Celestion approx. 9in. x 6in. middle register speaker 10/6
Also 15 ohm 12in., 30/-
P. & P. 1/6 per Speaker.

RECORDING TAPE

P.V.C. base, full frequency L.P. tape. 7in., 1800ft. (normally 50/-) 27/6; 5¾in., 1,200ft. (normally 35/-), 18/9. P. & P. 1/- per spool. Ideal for 2 or 4 track recorders.

TAPE DECKS

B.S.R. Monardeck

(Single speed) 3¾in. per sec., simple control, uses 5¾in. spools, £6.15.0, plus 5/6 carr. and ins. (Tapes extra on both).

COLLARO STUDIO DECK
£10.10.0, plus 5/6 carr. and ins.

4-SPEED PLAYER UNIT BARGAINS

SINGLE PLAYERS

TU/12, £3.15.0. Carriage 3/6.

AUTO CHANGERS

B.S.R. UA14, £6.19.6. Latest B.S.R. UA16, £7.19.6. Latest Garrard "Auto-Slim" £7.15.0. Carr. 5/- on each.

RECORD PLAYER AMPLIFIER

2 watt output. Ready built with valves and 6½in. speaker, tone and volume controls. Mounted on panel 13 x 7½.

75/- P. & P. 2/-

SPECIAL OFFERS!

GORLER F.M. TUNER HEADS. 10.7 Mc/s I.F., 15/-, plus 1/9 P. & P. (ECC85 valve 8/6 extra).

ELECTROSTATIC H.F. TWEETERS. Type L.S.H. 75. Size 3 x 3in., 2/6 each, plus 9d. P. & P.

MIDGET 2 GANG CONDENSERS. Capacity 195 and 100 pF. Polystyrene case with built in trimmers. Size ¾ x ¾ x ½in. Not used but removed from P/C Boards. Two for 9/-. Plus 1/- P. & P.

ACOS CRYSTAL MIKES. Hi-imp., 18/6. P. & P. 1/6.

TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output), plus 4 suitable Transistors giving approx. 1 watt output. 30/-. P. & P. 2/-.

MAINS TRANSFORMERS. Tapped Primary. ½ wave or Bridge Rectifier. Secondary 250 v. at 75 mA 6.3 volts at 2 amps. 7/6 each. P. & P. 3/-.

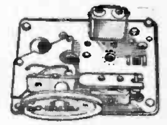
3 PUSH-BUTTON TRANSISTOR SWITCH. D.P.—D.T. Each Switch 5/6 and 1/- P. & P.

SPECIAL PURCHASE! TURRET TUNERS

by famous maker.

Brand new and unused. Complete with PCC84 and PCF80 valves. 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied.
ONLY 25/- each. P.P. 2/6.

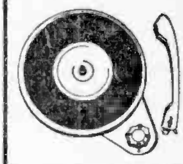
F.M. TUNER HEAD



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) and drum and spindle, 18/6, plus 1/9 P. & P. Valve 8/6 extra. Drum and spindle 3/6 extra.

E.M.I. 4-speed Player and P.U.

FURTHER HUGE PURCHASE enables us to offer these at 69/6, P. & P. 4/6.



Heavy 8½in. metal turntable. Low flutter performance 200/250V shaded motor with tap at 45V for amplifier valve filament if required. Turnover LP/78 head.

GOOD COMPANION RECEIVERS

SPECIAL OFFER FOR ONE MONTH ONLY!

Easy to build, using 6 super transistors and 2 diodes 750 M/W output, full medium and long wave coverage, printed circuit, 5in. speaker, prealigned IFTS & OSC. Very fine tuning, ferrite aerial with car aerial socket, attractive 2-colour cabinet. Simple to follow instructions with circuit, everything complete (less P.P.9 battery).
Standard version £6.19.6
De luxe version £7.19.6
(P. & P. 3/6 extra either type).

LOUDSPEAKER SILKS

54in. wide

Heavily woven in Ivory and gold. Originally 35/- per yard length.
OUR SPECIAL PRICE 13/6 per yard length. P. & P. 1/6. Also Red Rexine, Dark Grey and Oatmeal fabrics for cabinet covering, 54in. wide, 13/6 per yard length. P. & P. 1/6.

BARGAIN OFFER!

TELEFUNKEN HI-FI STEREO AMPLIFIER. 110/250 v. A.C. input. 5 watt undistorted output (10 watts nominal) Size 12 x 9 x 2in. Weight 9 lb. Complete with spec. and instructions.

£5.19.6 Carr. 5/-.

Also Model S82. Similar specification but with balance control. £6.19.6. Carr. 5/-.

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, S.W.19. CHErrywood 3985/6

Open all day Saturday. Early closing Wed., 1 p.m.

A few minutes from South Wimbledon Tube Station.

Please Note: P. & P. charges quoted apply to U.K. only. P. & P. on overseas orders charged extra.

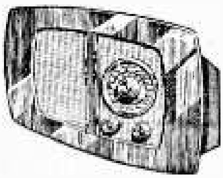
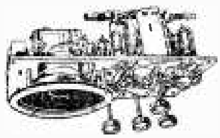


TABLE MODEL TRANSISTOR SET
£9.10.0 (carr. paid)

6 transistors and diode, 5in. circular speaker, superhet circuit. Cabinet 13 x 7½ x 4½in., battery included. Fully tunable L.W. and M.W. Polished walnut front.

MAINS OPERATED RADIO CHASSIS AND AMPLIFIER OF FAMOUS MANUFACTURE



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

TELEFUNKEN

German made F.M. front end, 22/6 (post 2/6), with ECC85 valve. Permeability tuned, 88-99 Mc/s. 4 x 1¾ x 2in. high plus valve 2in. Circuit 2/-.

MULLARD

Permeability tuned F.M. front end 22/6 (post 2/6), with ECC85. 4 x 3 x 3¼in. 88-95 Mc/s.

4 TRANSISTOR MINIATURE PUSH-PULL AUDIO AMPLIFIER

For 3 ohm speaker. 200mW output suitable for intercoms. Portable radios, etc., with free instruction sheet and diagram. For mike or radio input 4 x 1¼ x ⅞. Printed circuit 47/6, post paid.

TRANSISTORS POST FREE

Set of 6 Mullard transistors OC44, 2-OC45, OC81D, 2-OC81 (matched) and OA70 diode 30/-; set of G.C.E. transistors 874, 2-873, 3-82 or 83, 17/6.

PANEL OF 7 POTS
10 x 1¾in.—4 x 1M and 3 x 2M. 4/- (post 1/-).

PERSPEX

12½ x 9¾ x ⅛in. clear, 5/-. Postage on one sheet 2/-, on two or more 3/-

TRANSISTOR COMPONENTS

M.W. and L.W. ferrite rod aerial, with car coupling coil. For 208pF condenser, 8/-; Osc. coil; 1st, 2nd and 3rd I.F.'s, all 5/6 ea.; Driver trans., 7/6; min. 64mF 10v; 10mF 16v; 30mF 6v; all 1/9 ea; Tuning cond. 208mF + 176pF 8/6; post 9d. on all orders.

5 WATT AMPLIFIER

Our price ONLY 56/- (post 4/-); a few hundred only; valves EF91 and EL84 with metal rectifier; 6 x 4 x 1¾in. high (5in. over EL84). Mains trans. and o.p. with vol. and tone controls; on-off; co-ax input.

SPECIAL OFFER OF RECORDER CABINET

Plain boards, polished walnut finish, 38 x 15½ x 23in. high plus 8in. legs. Part delivery charge of £1, as offered elsewhere at over £22, brand new. Fitted with 3 sliding doors.

PRICE **£13**

COMPONENTS FOR "P.W." AMPLIFIER, GENERATOR, ETC.

Tubular condensers 350v 0.01, 0.02, 0.05mFd, 6d. ea; 0.25 and 0.5mFd, 9d. ea; Resistors ¼w 10% 6d. ea, 20% 3d. ea; Contact rectifier 250v, 50mA, 6/6; 16-16mFd Elect. 500v. 3/6; D.P.S.T. toggle switch. 3/-; High stab resistors 1/- ea; Valve holders B7G and B9a with skirt and screen. 1/- ea; Co-ax socket 1/-; 1M and 25k pots with spindle 2/6 ea; SK2, SK4, and SK5 sockets 3/- ea; ditto plugs 3/- ea; add postage. Also many other items specified. S.A.E. enquiries.

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.

EXAMINATION COURSES FOR:—

C. & G. Radio and TV Servicing Certificate (R.T.E.B.)	**C. & G. Radio Amateurs' Exam.** *(Amateurs' Transmitting Licence)* P.M.G. Certificates in Radiotelegraphy

British Institution of Radio Engineers, etc.
C. & G. Telecom. Technician's Cert.

LEARN AS YOU BUILD

Practical Radio Servicing Course

A basic course in radio electronic and electrical theory backed by thorough practical training. You build radio receivers, signal generator and multi-tester.

Post this Coupon TODAY! for FREE book on careers in Radio, and full details of other I.C.S. Courses

INTERNATIONAL CORRESPONDENCE SCHOOLS
(Dept. 171), Intertext House, Parkgate Road, London, S.W.11.

Please send book on ....

Name .... Age ....
(Block Letters Please)

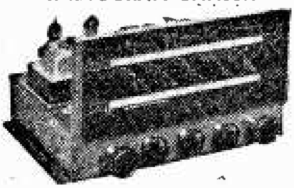
Address ....

....

Occupation 2.63

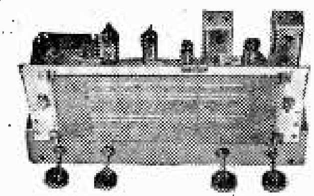
INTERNATIONAL CORRESPONDENCE SCHOOLS

ARMSTRONG AF208AM/FM RADIOGRAM CHASSIS



★ Full VHF Band (87-108 Mc/s and Medium Band, 187-570M) ★ 7 Valves ★ 5Watts Output ★ 15dB Negative Feedback ★ Separate wide range Bass and Treble Controls ★ 2 Compensated Pick-up Inputs ★ Frequency Response 30-22,000 c.p.s. ±2dB ★ Tape Record and Playback Facilities ★ Continental Reception of Good Programme Value ★ For 3, 7½ and 15 ohm speakers. Send S.A.E. for leaflet.

PRICE £22.18.0 *Carr. Free*



1963 RADIOGRAM CHASSIS

THREE WAVEBANDS — **FIVE VALVES**

S.W. 16 m.—50m. M.W. 200 m.—550 m. L.W. 800 m.—2,000 m.

LATEST MULLARD ECH81, EF89, EBC81, EL84, EZ80.

12-month guarantee.

A.C. 200/250 v. 4-way Switch; Short-Medium, Long-Gram. A.V.C. and Negative feedback, 3 ohm output, 5 watts. Chassis 13½ x 5½ x 2¼in. Glass dial, horizontal or vertical wording, size 10in. x 4½in. Aligned and calibrated. Isolated Chassis.

£9.10.0 Carr. & Ins. 4/6

BARGAIN SALE PRICES

New Boxed VALVES 90-day Guarantee

0Z4	5/-	6K7G	5/-	EABC80	8/-	PCL82	10/-
1R5	6/-	6K8G	5/-	EB91	4/-	PCL84	10/-
185	6/-	6L6G	8/-	EBC41	8/-	PL81	10/-
1T4	3/-	6N7M	5/-	EBC81	8/-	PL83	8/-
2X2	2/-	6Q7G	6/-	EBF80	9/-	PY80	7/-
3S4	7/-	6SN7	5/-	ECH42	9/-	PY81	8/-
3V4	7/-	6V6G	5/-	ECH81	9/-	PY82	7/-
3Q5	7/-	6X4	5/-	EF85	6/-	PY83	8/-
5U4	6/-	6X5	6/-	EF89	8/-	PQ25	7/-
5Y3	6/-	12AT7	6/-	EL32	5/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EL84	7/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EY51	9/-	U22	7/-
6AM6	4/-	12BH7	7/-	EY86	9/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EZ40	7/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EZ80	7/-	UBF89	9/-
6BE6	5/-	12Q7	5/-	EZ81	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	E1148	1/-	UCL82	10/-
6C4	5/-	35L6	9/-	HABC80	10/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HVR2A	5/-	UF89	9/-
6G6	4/-	807	5/-	KT33C	8/-	UL41	9/-
6H6	3/-	954	2/-	KT76	8/-	UY41	7/-
6J5	5/-	DAF96	8/-	MU14	7/-	UY85	7/-
6J6	5/-	DF96	8/-	PCC84	8/-	UU9	7/-
6J7G	6/-	DK96	8/-	PCF80	8/-	VR150	7/-
6K6	5/-	DL96	8/-	PCF82	8/-	W81	6/-

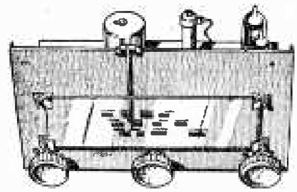
I.F. TRANSFORMERS 7/6 pair
465 K/s Slug Tuning Miniature Can. 2 x ¾ x ¾in. High Q and good bandwidth. Data sheets.

NEW ELECTROLYTICS — FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350V	2/-	50/350V	5/6	16/450V	5/-
2/350V	2/3	100/25V	3/-	32/350V	4/-
4/450V	2/3	250/25V	3/-	47/350V	6/6
8/450V	2/3	500/12V	3/-	100/270V	5/6
16/450V	3/-	1000/12V	3/-	5,000/6V	5/-
32/450V	3/9	8+8/450V	3/6	32+32/350V	5/-
25/25V	1/9	8+16/450V	3/9	32+32/450V	6/-
25/50V	2/-	16+16/450V	4/3	32+32+32/350V	7/-
50/25V	2/-	32+32/350V	4/6	50+50/350V	7/-
50/50V	2/-			64+120/350V	11/6
				100+200/275V	12/6

COMPLETE RADIO CHASSIS £5.19.6. post free

4 Mullard valves, 5in. speaker. Superhet Circuit. BRAND NEW. Size 9 x 6 x 5½in. high. Tested by us ready for use. 200/250 v. A.C.-D.C. Mains.



DE LUXE MODEL as illustrated with illuminated dial. Fully tunable over Medium and Long Wave. 12-month Guarantee. Only **£5.19.6** post free.

MAINS TRANSFORMERS 200/250 v. A.C.
Postage 2/- each transformer.

STANDARD, 250-0-250, 80 mA, 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier, 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350 .. 29/6
MINIATURE 200 v. 20 mA, 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA. 6.3 v. 2 a. .. 15/6
SMALL, 220-0-220, 50 mA, 6.3 v. 2 a. .. 17/6
STD., 250-0-250, 65 mA, 6.3 v. 3.5 a. .. 17/6
HEATER TRANS. 6.3 v. 1½ amp. .. 7/6
Ditto, tapped 1.4, 2, 3, 4, 5, 6.3V .. 8/6
Ditto, sec. 6.3 v. 4 amp. .. 10/6
GENERAL PURPOSE LOW VOLTAGE. 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v. .. 22/6
AUTO TRANSFORMER, 150 w. .. 22/6
0, 115, 200, 230, 250 v., 500 w. .. 82/6
MULLARD "510" Mains transformer .. 30/-
PARMEKO MAINS TRANSFORMER. Made for special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA. L.T. 6.3 v. 1.8 amp. Size 4 × 3½ × 3¼in. Weight 6lb Post 2/6 .. .. 17/6
MAINS POWER PACK. Size 3½ × 4½ × 4 in. with mains transformer, metal rectifier and condensers to provide smoothed H.T. output 220 v. 45 mA. D.C., L.T. 6.3 v. 2 a. Centre tapped. Already built on a strong metal chassis. Brand New. Bargain. Post 2/6 .. .. 29/6

INTERVALVE TRANSFORMERS 3:1 or 5:1, 9/-. **O.P. TRANSFORMERS.** Heavy Duty 50 mA, 4/6. Multiratio, 7/6. Multi-ratio heavy duty push pull, 10 w., 15/6. Miniature, 384, etc., 5/9.
L.F. CHOKES 15/10H. 60/65 mA, 5/-; 10 H., 85 mA, 10/6; 10 H., 150 mA, 14/-.
FULL WAVE BRIDGE SELENIUM RECTIFIER: 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6. 2 amps., 17/6; 4 amps., 22/6. Circuit included.
4 AMP CAR BATTERY CHARGER with amp. meter Leads, Fuse Case, etc., for 6 v. or 12 v., 69/9.
AMMETER. 0 to 5 amp. 9/6.

BOOKS list S.A.E.

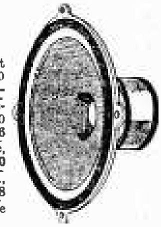
40 Circuits for Germanium Diodes 3/-
"W.W." Radio Valve Data, 6/-.
High Fidelity Speaker Enclosure, 5/-.
Valve and TV Tube Equivalents, 9/6.
TV Fault Finding, 5/-.
Quality Amplifiers, 4/6.
Radio Valve Guide. Books 1, 2, 3 or 4, 5/- each.
Transistor Superhet Receivers, 7/6.
Practical Radio Inside Out, 3/6.
Master Colour Code Chart, 1/6.
Transistor Controlled Models, 7/6.

4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER
Size 3 × 1¾ × ¾.
A ready built miniature push-pull amplifier with input and output transformers, 4 transistors. Ideal for use with record players, intercoms, **BABY ALARMS**, etc. Complete with full instructions and circuit.
Price **52/6** 9v. Batt. 2/3, 2½in. Speaker 15/-

C.R.T. BOOSTER TRANSFORMERS
for heater cathode short circuit, or tubes with failing emission. Full instructions supplied, mains input. Type A optional 25% and 50% boost. 2v. or 4v. or 6.3v. or 10.8v. or 12.6v. State voltage required. PRICE 10/6.

LOUDSPEAKERS P.M. 3 OHM. 2½, 3, 4in., 19/6, 5in. Rola, 17/6; 8in. Plessey, 19/6; 7in. x 4in. Rola 18/-; 6½in. Rola, 18/6; 10 x 6in. 27/6; 10in. Rola, 30/-; 4in. Tweeter, 25/-; 12in. R.A. 30/-. 13½ x 8in., Double Cone E.M.I. 45/-.
STENTORIAN HF1012. 10in. 3 to 15 ohms, 10 w. 95/-: 35 ohm, 7 x 4in., 25/-; 5in., 22/6; 3½in., 19/6.

BAKER SELHURST LOUDSPEAKERS



Details S.A.E.
12in. Baker 15w. Stalwart 3 or 15 ohms, 45-13,000 c.p.s. 90/-
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. .. £6.17.6
12in. Baker Ultra Twelve, 20 c.p.s. to 25 kc/s. £17.10.0
15in. Auditorium, 35 w., Bass. 20 c.p.s. to 12kc/s. £18
Details and Enclosure plans S.A.E.

TWIN GANG TUNING CONDENSERS. 365 pF, miniature 1in. × 1¼in. × 1¼in., 10/-. 500pF Standard with trimmers, 9/-; midget, 7/6; with trimmers, 9/-; 500pF slow motion tuning, standard or midget, 9/-.
SMALL 3 gang 500 pF, 17/-. **SINGLE** 365 pF, 7/6.
SINGLE 25 pF, 50 pF, 75 pF, 100 pF, 160 pF, 5/6. Solid dielectric 100, 300, 500 pF, 3/6.
CONDENSERS. New stock. 0.001 mfd. 7 kV. T.C.C., 5/6; Ditto, 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d.. 0.1, 1/-; 0.25, 1/6; 0.5/500 v., 1/9; 0.1/350 v., 9d.; 0.1/2,000 v. 0.1/1,000 v., 1/9; 0.1 mfd., 2,000 volts, 3/6.
CERAMIC CONDS. 500 v. 0.3 pF to 0.01 mfd., 9d.
SILVER MICA CONDENSERS, 10% 5 pF to 500 pF 9d.; 600 pF to 3,000 pF, 1/-. Close tolerance (±1 pF) 2.2 pF to 47 pF, 1/-. Ditto 1% 50 pF to 815 pF, 1/-; 1,000 pF to 5,000 pF, 1/9.

465 kc/s SIGNAL GENERATOR
Price 15/-. Uses B.F.O. Unit, ZA 30038 ready made with valve IS5. POCKET SIZE 2½ x 4½ x 1in. One resistor to change, full instructions supplied. Battery 8/6 extra. 69V 1½V. Details S.A.E.

WAVECHANGE SWITCHES
8 p. 4-way 2 wafer long spindle 6/6
2 p. 2-way, or 2 p. 6-way long spindle .. 3/6
4 p. 2-way or 4 p. 3-way long spindle .. 3/6
3 p. 4-way, or 1 p. 12-way long spindle .. 3/6
Wavechange "MAKITS", Wafers available: 1 p. 12 way, 2 p., 6 way, 3 p. 4 way, 4 p. 3 way, 6 p. 2 way, 1 wafer switch, 8/6; 2 wafer switch, 12/6; 3 wafer switch, 16/-; additional wafers up to 12, 3/6 each extra.
Toggle Switches. s.p., 2/-; d.p., 3/6; d.p.d.t., 4/-. Rotary s.p., 3/6; d.p., 4/6.

CRYSTAL MIKE INSERT, 6/6
Size 1 x 1¼in., or 1½in. dia.
ACOS MIC. 60, insert 1¼in. dia. 8/6
ACOS 39-1 DE LUXE STICK MIKE 35/-
TSL QUALITY STICK MIKE 25/-

Valveholders. Pax. int. oct., 4d. EA50, 6d. B12A, CRT, 1/3. Engl. and Amer. 4, 5 and 7 pin, 1/-. MOULDED Mazda and int. oct., 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 1/9. Ceramic EF50, B7G, B9A, int. oct., 1/-. B7G, B9A cans, 1/- each.

Quality 2-Stage HI-FI AMPLIFIER
A.C. only, 200-250 v. Valves ECL86 and EZ80. 3 watt quality output. Mullard tone circuits, bass boost, treble and volume controls. Separate engraved front panel with de-luxe finish. Heavy duty output transformer 3 ohm. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. Bargain Price £4.10.0. Circuit supplied.

THE ORIGINAL
RADIO COMPONENT

Our written guarantee with every purchase.
NEW COMPONENT LIST 1/-.

Bus 133 or 68 pass door
S.R. Station Selhurst

Volume Controls

Linear of Log Tracks. Long spindles. Midget 5 K ohms to 2 Meg. L/S, 3/-; D.P., 4/6; Stereo L/S 10/6; D.P. 14/6

80 ohm CABLE COAX

Semi-air spaced ¼in. Stranded core. **6d. yd.**
40 yds. 17/6
60 yds. 25/-
Fringe Quality Air spaced **1/- yd.**

TELESCOPIC CHROME AERIALS. 13in. extending to 43in., 8/6 ea. Coax Adaptor Plug, 1/6 extra.
TRIPLEXERS Bands I, II, III 12/6
COAX PLUG .. 1/- **LEAD SOCKET** .. 2/-
PANEL SOCKETS 1/- **OUTLET BOXES** 4/-
BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
Wirewound Ext. Speaker Control, 10 Ω 3/-, 25 Ω 5/6.
WIRE-WOUND POTS, 3 WATT. Pre-set Min. TV Types. All values to 10 ohms to 25 K., 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K., to 2meg., 3/-).
WIRE-WOUND 4 WATT Pots. Long spindle. Value, 50 ohms to 50 K., 6/6; 100 K., 7/6.
PHILIPS TRIMMERS. 0-10 pF, 3-30 pF, 1/-.
TRIMMERS, Ceramic. 30, 50, 70 pF, 9d.; 100 pF, 150 pF, 1/3; 250 pF, 1/6; 500 pF, 750 pF, 1/9.
TV etc. TRIMMER, 1000 pF, with knobs, 2/-.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. High Stability. ½ w., 1%, 2/-. Preferred values 10 Ω to 10 meg. Ditto 5%, 10 Ω to 22 meg., 9d.

5 watt	WIRE-WOUND RESISTORS 10 ohms—10,000 ohms	1/3
10 watt		2/-
15 watt		2/-
12.5K to 47K 10 w.		3/-

AMERICAN "BRAND FIVE" PLASTIC RECORDING TAPE

			Spare Plastic Reels
Double Play	7in. reel, 2,400ft.	60/-	
	5in. reel, 1,200ft.	37/6	
Long Play	7in. reel, 1,800ft.	35/-	3in. 1/4
	5¾in. reel, 1,200ft.	23/6	4in. 2/-
	5in. reel, 900ft.	18/6	5in. 2/-
Standard	7in. reel, 1,200ft.	25/-	5¾in. 2/-
	5in. reel, 600ft.	16/-	7in. 2/6

"Instant" Bulk Tape Eraser and Head Defluxer, 200/250 v. A.C., 27/6. Leaflet with full details. S.A.E.

CRYSTAL SET BOOKLET, 1/-.
CRYSTAL DIODE G.E.C., 2/-. GEX34, 4/-. OA81, 3/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 15/- pr.
SWITCH CLEANER. Fluid squirt spout, 4/6 tin.

HIGH GAIN TV PRE-AMPLIFIERS

BAND 1 B.B.C.
Tunable channels 1 to 5. Gain 18dB. ECC84 valve. Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred.)
BAND III I.T.A.—Same prices. Tunable channels 8 to 13. Gain 17dB. Circuit and Coils only. 9/6.

1/16in. **Paxolin Panels,** 10 x 8in., 2/-.
Miniature Contact Cooled Rectifiers, 250V 50mA, 7/6; 250V 60mA, 8/6; 250V 85mA, 9/6; 200mA, 21/-; 300mA, 27/6.
TV etc., Silicon Sub-Min. Rectifier. 125V. 300mA, 6/6; 250V. 300mA, 14/6.
Selenium Rect., 300V-85mA. 5/-.
Coils Wearite "P" type, 3/- each.
Osmor Midget "Q" type, adj. dust core, from 4/- each. All ranges. List S.A.E.
Teletron D.W.R. L. and Med. T.R.F. with reaction. 4/-. Med. wave D.R., 3/6.
Ferrite Aerials, M., 8/9; M. and L., 12/6.
Osmor Ferrite Rod Aerials. L. and M. for transistor circuits, 10/- each.
Ferrite Rods, 8 x ⅜in., 3/-.
H.F. Chokes, 2/6. **Osmor QC1,** 6/9.
T.R.F. Coils, A/HF, 7/- pair; HAX, 3/-, Repanco DRR2, 4/-. DRX1, 2/6.
Radio Screwdriver, 5in., 6d.
Neon Mains Tester Screwdriver, 5/-.
Solder Radiograde, 4d. yd., ½lb. 5/-.
Black Crackle Paint. Air drying. 3/- tin.

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

"6 + 1" TRANSISTOR RADIO MEDIUM AND LONG WAVE KIT

First class components to make a 6 transistor 2 wave band superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, *with car aerial coil,* printed circuit, 8¼in. x 2¾in., but EXCLUDING speaker and cabinet. Simple instructions 1/6 (Free with kit).
Speakers, 35 ohm, 7 x 4in. 25/- 5in. 22/6, 3½in. 19/6. **£4.5.0**

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 5/6.
JACKS. English open circuit, 2/6. Closed circuit, 4/3. Grundig type, 3 pin, 1/3. Grundig lead jack, 3/6.
JACK PLUGS. English, 3/-; Screened, 4/-; Grundig, 3 pin, 3/6.
ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in. 10d.
0.3in. **FORMERS** 5937 or 8 cans TV1 or 2, ⅝in. sq. x 2⅜in. or ½in. sq. x 1¾in., 2/- with cores.
SLOW MOTION DRIVES. 6 : 1, 2/3.
SOLON IRON, 25W, 200V or 230V, 24/-.
ANTEX SUB-MIN IRON 15w. 200 or 240 v., 29/6.
BENCH STAND for above, 12/6.

JASON FM TUNER COIL SET

29/-. H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s detector transformer and heater choke. Circuit and component book using four 6AM6, 2/6. Complete Jason FMT1 Kit. Jason chassis with calibrated dial, components and 4 valves, £6.5.0. Model FMT2 with new shelf cabinet. £8.5.0

MAINS DROPPERS. Midget adjustable sliders, 0.3A, 1,000 ohms, 5/-; 0.2A, 1,200 ohms, 5/-; 0.15A, 1,500 ohms, 5/-; 0.1A, 2,000 ohms, 5/-.
MIKE TRANSFORMER. 50-1, 3/9.
P.V.C. Covered Wire, single or stranded, 2d. yd.
Sleeving, 1 or 2 mm., 2d.; 4 mm. 3d.; 6 mm. 5d. yd.
SPEAKER FRET. Gold cloth, 17 x 25in., 5/-; 25 x 35in., 10/-. Tygan, various colours, 52in. wide from 10/- ft.; 26in. wide, from 5/- ft. Samples, S.A.E. Expanded Metal, Gold, 12 x 12in., 6/-.

TELEVISION REPLACEMENTS

Line Output Transformers
from 45/- each, NEW Stock
and other timebase components. Most makes available. S.A.E. with all enquiries

WEYRAD

COILS AND TRANSFORMERS FOR 2-WAVE TRANSISTOR SUPERHETS WITH PRINTED CIRCUIT AND FERRITE ROD AERIAL

Long and Medium Wave Aerial—RA2W On 6in. rod, 208pF tuning, with car aerial coupling coil	12/6
Osc. Coil P50/1AC. 176pF tuning.	5/4
1st and 2nd I.F. Trans.—P50/2CC. 470kc/s 11/16in. dia. by ⅞in.	5/7 each
3rd I.F. Trans.—P50/3CC.	6/-
Spare Cores	6d. each
Driver Transformer—LFDT4.	9/6
Wavechange Slide Switch.	3/6
Printed Circuit—PCA1. Size 2¼ x 8¼in. Ready drilled, and printed.	9/6
Volume Control, 5KDP.	4/6
35 ohm Speakers, 3½in., 19/6; 5in., 22/6; 7 x 4in., 25/-.	
24 Fixed Resistors.	10/6
16 Fixed Condensers.	21/-
Tuning Gang with trimmers.	10/6
6 Mullard Transistors and diode.	42/6
Constructor's Booklet.	2/-
500MW 3 OHM MODIFICATION KIT	12/-

NEW MULLARD TRANSISTORS OC71 6/-, OC72 7/6, OC81D 7/6, OC81 7/6, OC44 8/9, OC45 8/9, OC171 10/6, AF117 9/6

Sub Miniature Condensers. 0.1 mFd. 30v. 1/3. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100 m Fd. 15 volt 2/6 ea. Transistor Holders 1/3.

B.B.C. Pocket 2 Transistor. M.W. and L.W. Radio Kit. 22/6. Miniature earpiece. 7/6. Batt. 2/3. Circuit details, etc. S.A.E.

MONARCH RECORD PLAYER

Kit with ready built amplifier, speaker and cabinet.
carr. and ins. 5/- **£12.10.0**

Garrard deluxe auto-player kit

£12.19.6 Carr. and ins. 5/- details S.A.E.

GARRARD QUALITY AUTO-CHANGER, 4-speed, with plug-in xtal head. Ready built 2-valve amplifier. Loudspeaker and contemporary styled Portable Player Case.

All items guaranteed to fit together perfectly, can be assembled in thirty minutes, full instructions supplied.

MAGNAVOX—COLLARO 4 speed Stereo/Monaural Autochanger, Diamond Stylus and Record Cleaning attachment	£8.10.0
4 Speed Autochanger, B.S.R., U.A.14	£7.10.0
B.S.R., U.A.12 Stereo/Mono	£8.5.0
Garrard Autoslim Changer	£7.19.6
4 SPEED SINGLE PLAYERS:	
E.M.I. with auto stop	£6.5.0
E.M.I. with separate pick-up ..	£3.9.6
Amplifier player cabinets	70/-
2-valve amplifier and 6½in. speaker ..	95/-

Wired and tested ready for use with above.

Replacement sapphire styli available from 6/-.
Replacement Xtals from 21/-; Stereo from 35/-.

SINGLE PLAYER KITS

£8.15.0 post 4/6.

With ready-built, 2 stage, 3 watts output amplifier. High flux 5in. speaker. Handsome portable case 13 x 10¼ x 7¼in. Collaro 4-speed junior motor. LP/Std. xtal pick-up for 7, 10, and 12in. records.

FEW ONLY KITS AS ABOVE but with 3-speed B.S.R. Motor **£7.15.0** complete (Post 4/6)

CABY MULTIMETER

Moving-coil Model M.I. **54/-**

Measures D.C. or A.C. 6 v., 30 v., 120 v. 600 v., 1200 v. D.C. 30 mA, 300 mA. Ohms 0-100K. Leaflet S.A.E.

ARDENTE Transistor Transformers

Type D3035, 7.3 CT; Push-Pull to 3 ohms for OC72, etc., 1 x ¾ x ⅝in. 9/6
Type D3034, 1.75 : 1CT. Push-Pull Driver for OC72, etc., 1 x ¾ x ⅝in. 9/6
Type D3058, 11.5 : 1 Output to 3 ohms for OC72, etc., 1 x ¾ x ⅝in. 9/6
Type D167, 18.2 : 1 Output to 3 ohms for OC72, etc., ¾ x ½ x ½in. 12/-
Type D239, 4.5 : 1 Driver Transformer, 10/-
Type D240, 8.5 : 1 Driver Transformer, 10/-

ARDENTE TRANSISTOR CONTROLS

5K or 1MΩ switched, dia. 0.9in., 5/3
Type VC1760, 5K with switch, dia. 0.7in., 10/6
Deaf aid earpiece xtal or magnetic, 7/6

COMPONENT SHOP

SPECIALISTS

Post 1/-, unless otherwise stated. C.O.D. 2/-

337 WHITEHORSE ROAD WEST CROYDON

Telephone: THO 1665

(Export welcome. Send remittance and extra postage).

Practical Wireless

Vol. XXXVIII No. 672 FEBRUARY, 1963

Editorial and Advertisement Offices:
PRACTICAL WIRELESS
George Newnes Ltd., Tower House, Southampton Street, W.C.2.

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London,
Registered at the G.P.O. for transmission by Canadian Magazine Post.

SUBSCRIPTION RATES
including postage for one year

Inland - - - - £1.9.0 per annum
Abroad - - - - £1.7.6 per annum
Canada - - - - £1.5.0 per annum

Contents

Off Beat

SOME readers might feel that this month's cover subject is a little unusual. Without wishing to be facetious, we agree that it strikes a somewhat unusual note and can, in fact, be described as slightly off beat!

There must be many enterprising readers who have built up similar unconventional pieces of equipment, for there is obviously a limit (physically, at least!) to the number of radio sets one can, or wishes to, build.

While the description of radio sets is one of the main features of PRACTICAL WIRELESS constructional articles, we are fully aware that the advanced constructor may well be satiated with radio sets or has become capable of designing his own.

There is, of course, the associated audio field and it is our policy to provide plenty of material of this kind. But although there is a considerable range of designs to draw upon in radio sets (from the transistor pocket receiver to the multi-stage communications receiver) and a number of new circuit features (such as reverberation—one system is described in this issue and others will follow), it is, perhaps, on the "electronics" side that there is potentially the greatest scope.

So far as the home constructor is concerned, this potential is still largely untapped, but can range from geiger heads to gimmickry. Some of these gadgets, admittedly, may be of more value as construction and design exercises, but many could have very practical applications.

One of these is the metronome shown on the front cover and described in this issue. Most people build or buy radio sets, amplifiers and tape recorders largely for the reproduction of music. And, due partly to the upsurge of interest in hi-fi, there is a growing cult of musical appreciation.

This is reflected in the returning to favour of the erstwhile irreplaceable piano and other instruments. And since many readers of PRACTICAL WIRELESS are no doubt amateur musicians, an electronic metronome is one useful way of combining interests.

If *you* have constructed any practical "off beat" items you feel would interest other readers, we would like to hear about them.

Last Chance

Just a final reminder that this is your last chance to obtain tickets for the PRACTICAL WIRELESS Film Show which has been arranged in collaboration with Mullard Ltd. and will be held at Caxton Hall, Westminster, London, on *February 1st*, starting at 7.30 p.m.

Tickets for this show are free and may be obtained simply by writing to us and enclosing a S.A.E.

Our next issue dated March will be published on February 7th.

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of October, 1962, 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.

	Total
London	631,591
Home Counties	583,634
Midland	424,544
North Eastern	446,308
North Western..	382,114
South Western..	344,362
Wales and Border Counties ..	193,463
Total England and Wales	3,006,019
Scotland..	317,318
Northern Ireland	107,928
Grand Total	3,431,265

First UK Subsidiary of French Firm

THE largest group of electronics companies in France, C.S.F., has recently opened its only British subsidiary. C.S.F. United Kingdom Ltd is designed to extend C.S.F.'s trading interests here on a long term basis. Initially it will be buying everything C.S.F. needs in the United Kingdom and selling everything the group makes.

Electrical Engineers Exhibition 1964

THE 1964 Electrical Engineers Exhibition will be held at Earl's Court from 18th—25th March, 1964. The opening times will be 10 a.m. to 7 p.m. daily except Thursday March 19th when it will be extended to 9 p.m.

For the first time overseas manufacturers will be invited to exhibit, and although a certain amount of additional space has been made available it is anticipated that it will all be taken before the end of 1963.

Acoustic Fault-finding Apparatus

A NEW acoustic fault-finding apparatus which incorporates an AEI type BK24 ignitron is now being used by the North Western Electricity Board.

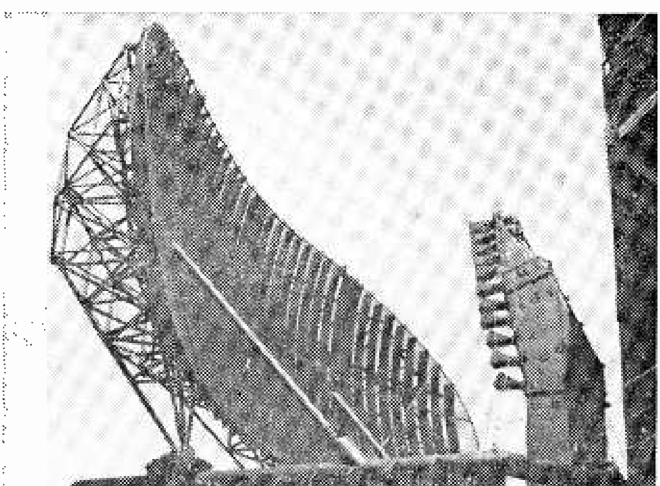
Previously a mechanical contactor was used to discharge two $2\cdot25\mu F$ capacitors, connected in parallel and charged to 25kV, into the faulty cable. This method proved quite successful, but the high-voltage contactor, being very noisy, made detection difficult when the fault was close to the equipment. Furthermore, approximately half of the stored energy was dissipated at the contacts and did not reach the fault.

By using an ignitron instead of the contactor, both these disadvantages have been overcome. The ignitron is an inherently noiseless device and its characteristics are such that the arc voltage drop, and consequent energy loss, is very small.

New Organisation Headquarters in London

THE wholly owned British subsidiary of US General Electric, International General Electric Company of New York Ltd., has announced the formation of an Industrial Electronics Division to market many General Electric industrial electronics products in Europe.

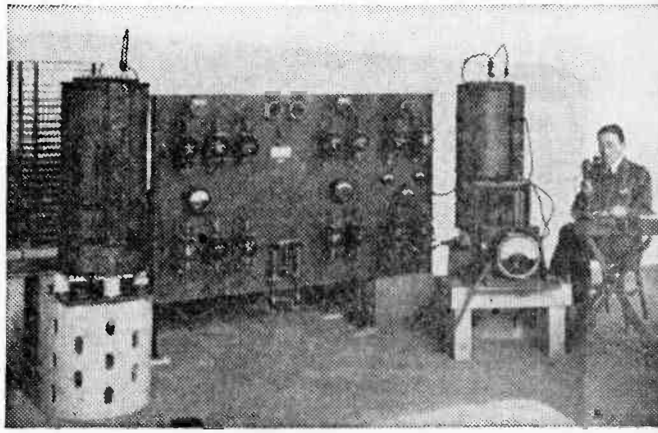
International General Electric Company of New York, Ltd. has



This photograph shows a high-power three-dimensional radar made by C.S.F. of France, who have recently opened their first London office.

been marketing the products of US General Electric in the United Kingdom for many years. The complexity of modern industrial electronics equipment, however, has led to the establishment of this new organisation of much broader scope and capability.

This new organisation will have have headquarters in London at 31 John Street, WC1, and will establish additional facilities in the United Kingdom and on the Continent to meet market requirements.



At the microphone of this 6kW transmitter, which was installed at the Marconi works at Chelmsford in 1920, is W. T. Ditcham, whose voice was the first to span the Atlantic from Europe to Nova Scotia.

British Equipment at Milan Exhibition

FOLLOWING demonstrations of electric equipment during past months in Germany and Switzerland, EMI Electronics Ltd. exhibited equipment in Italy, at the Automation and Instrumentation Exhibition held in Milan.

Chief among the exhibits was a Robotug driverless truck, fitted with electronic guidance equipment, which follows a magnetic field surrounding a wire buried just below the surface of the ground.

Also on show was EMI's oscilloscope type WM16 with a range of plug-in pre-amplifiers. Other exhibits included nuclear health monitoring equipment, the EMIac II analogue computer, and a wide range of special electronic valves and tubes.

I.E.E. Membership reaches 50,000

AT a recent meeting the I.E.E.'s Council admitted to membership of the Institution the man who brings the total to 50,000.

Starting in 1871 with about 70 founder members of the then Society of Telegraph Engineers, numbers grew rapidly to 3,660 in 1900. By the beginning of the second World War, the figure was approaching 20,000, and the striking advance in technological developments in the last 20 years has contributed largely to the fact that the membership since then has more than doubled.

The "50,000th member" is William R. Matthews, admitted as a student.

Transport Minister Opens Medway Scheme

THE Right Hon. Ernest Marples, M.P. recently opened a new radar and radio control centre for the Medway Conservancy Board. The ceremony was carried out in the new control room and was seen by visitors in the reception centre on a closed-circuit television chain.

A well planned operation room, built on top of Garrison Point Fort at Sheerness, houses the control consoles for the three viewing units of the Decca Harbour Surveillance Radar and the Pye v.h.f. radiotelephone equipment. The Pye radio transmitters, which are sited on the Southdown Hills two miles from the operations room, give the best possible coverage to shipping in the Medway.

The Medway Port and Information Service has now been extended to include harbour surveillance radar and the radiotelephone system has been improved and enlarged.

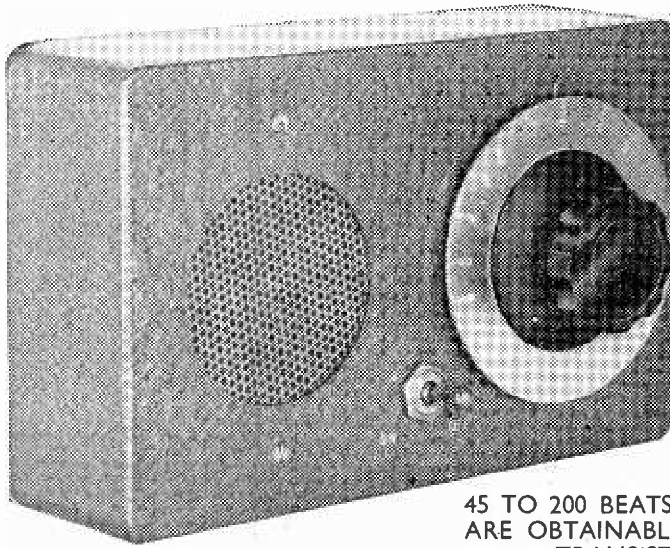
International radiotelephone channels recommended by the Hague Convention are used and two-way v.h.f. radio communication between the Port Authorities and Ships' Masters help in the safe and fast movement of shipping in the Medway.

New British Railways Testing Station

BRITISH Railways Eastern Region has placed a contract with Associated Electrical Industries Ltd. covering electrical loading equipment and a communication system for the new diesel-electric locomotive testing station now being built at Doncaster. When completed this station will be capable of testing a range of twenty-one different locomotives, from small shunters to 3,300 h.p. "Deltics".

Testing will be carried out from two control desks mounted in a control room overlooking the interior of the station. The desks will control the contactors on the fan-cooled loading resistance banks and will also carry test instrumentation.

An AEI type RP loading resistor, in which the resistance strip is edgewise wound and ceramic insulated from the central steel mounting strips, will be mounted on two banks, each with a dissipating capacity of 2,000 h.p. Tappings can be varied on-load by means of contactors mounted on the resistor banks which, in conjunction with the changeover switches and links in the termination cubicles, will enable either one Deltic locomotive to be tested alone, or two locomotives of 2,000 h.p. maximum, by using both resistor banks separately.



45 TO 200 BEATS PER MINUTE ARE OBTAINABLE WITH THIS TRANSISTORISED UNIT

Electronic METRONOME

By K. Berry

ESSENTIAL to someone learning to play the piano and useful to anyone (hi-fi enthusiast or not!) with a keen interest in music is the metronome. This article describes a cheap, easy-to-build electronic metronome. The beat note is continuously variable over the range 45-200 beats per minute. Should this range seem rather large it must be pointed out that this is approximately the range found in a proprietary clockwork metronome.

Circuit

The circuit of the unit is shown in Fig. 1. It will be seen that it is basically a transistor version of the well-known multivibrator circuit.

The rate of operation is altered by varying the time constant C1, VR1, R2. When VR1 is set for zero resistance C1, VR1 is equal to R3 and the circuit operates at its fastest rate with Tr1 and Tr2 "bottomed" for equal periods of time (i.e., with a 1:1 mark-space ratio). When VR1 is set for maximum resistance, C1, VR1, R2 is about eight times as large as C2, R3 and the circuit operates at a lower rate with Tr1 and Tr2 being bottomed for unequal periods of time (the approximate mark-space ratio in this case is 6·5:1).

The audio output is obtained by connecting a loudspeaker from the collector of Tr2 to ground via a capacitor.

Components

The components required for this metronome are given in the component list. The timing capacitors C1 and C2 are ordinary 50μF 12V etched aluminium foil electrolytic capacitors. Now since the capacity marked on these is subject to a tolerance of some +100% or −50% one can obviously get into difficulties here. The capacitors used in the prototype equipment were 47μF and 48·5μF respectively and measurements made of other electrolytic capacitors would suggest that although electrolytics *can* vary by +100% or −50% they do not often do so. The best solution is to check the capacitors on an impedance bridge if one is available. Failing that, go ahead with

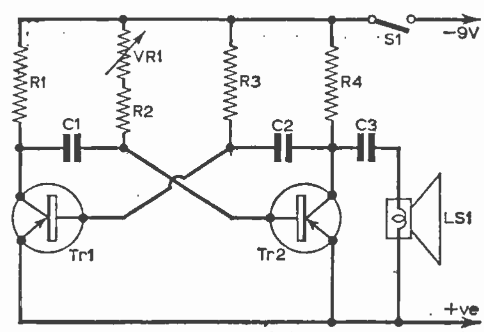


Fig. 1—The circuit of the unit.

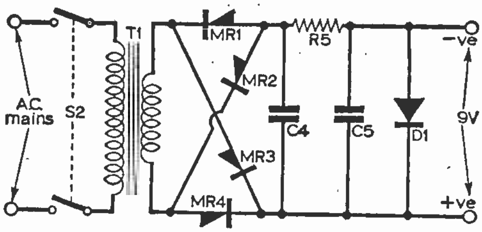


Fig. 2—A suitable power-pack.

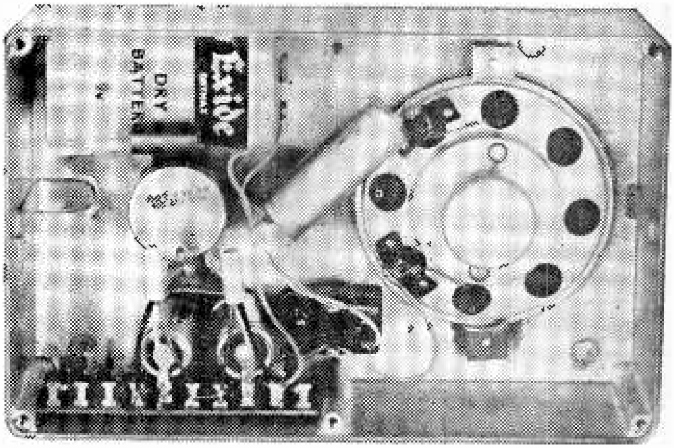
standard electrolytics and, if the correct speed cannot be obtained from the metronome at first, substitute fresh 50μF capacitors first for C1, then for C2. If this dodge fails the "50μF" capacitors can be shunted with some small value electrolytics (if the metronome runs too fast) or replaced with a parallel configuration of small values, say two 20μF capacitors plus a 5μF capacitor. This may sound rather formidable and in fact one probably won't be faced with having to do this but, since the possibility exists, it is best to bring it out rather than conveniently forget about it!

The transistors used in the prototype unit were Mullard, type OC41. This type is a p-n-p germanium junction switching transistor, but most types of audio p-n-p transistors should serve just as well and a list of possible alternatives has been included in the component list.

The loudspeaker which was incorporated in this unit was marked as having an impedance of 10Ω. Also tried was a loudspeaker with a speech coil impedance of 2-3Ω and this was equally satisfactory. In view of this the impedance quoted in the component list for the loudspeaker has been given as 2-15Ω. If a small loudspeaker is not readily available, or if it is required to make the unit as small as possible, then a single earpiece from a pair of low-impedance headphones could be used.

Construction

The photograph shows the interior of the metronome, which is housed in a proprietary die-cast equipment box of size 7¼in. x 4¼in. x 2¼in. The underside of the unit has four small rubber feet attached to it to prevent its scratching polished surfaces. In view of the simplicity of the metronome no further details of construction have been given.



This photograph shows clearly the wiring of the unit.

COMPONENTS LIST

Resistors:

R1	1kΩ	R3	3·3kΩ
R2	3·3kΩ	R4	1kΩ

All ¼W carbon

VR1 25kΩ carbon potentiometer, log

Capacitors:

C1 50μF electrolytic 12V
C2 50μF electrolytic 12V
C3 8μF electrolytic 150V
C4 250μF electrolytic 25V
C5 250μF electrolytic 25V

Semiconductors:

Tr1, Tr2 Transistors Mullard OC41 (alternatively OC71, OC72)
MR1-4 Rectifiers S.T.C. RS20
D1 Zener diode Mullard OAZ207

Miscellaneous:

LS1 Loudspeaker, 2-15Ω impedance
S1 Single-pole switch
S2 Double-pole switch
T1 Mains transformer: input 240V 50 c/s; output 12V 30 mA

Power Supplies

The prototype was self-powered by means of a dry (primary) battery. This was a layer-type battery intended for use with transistorised equipments of size 1¼in. x 1¼in. x 2in., but any type of 9V battery may be used. The normal current consumption of the metronome is 12-15mA at 9V.

There is no reason why the unit should not be run off the d.c. mains supply if portability is not important. A suitable power unit is shown in Fig. 2. The use of a Zener diode to regulate the output voltage is necessary because of the fluctuating nature of the current drawn by the metronome

Calibration and Use

When the unit has been wired all that remains is to calibrate it. This can most easily be accomplished by using an electronic or electro-mechanical counter, but since these are not readily available the practical method is to count the number of beats whilst observing a watch or clock with a sweep second hand. This is quite easy up to about 150 beats per minute and with a little practice one can count up to 240 beats per minute. ■

TEST GEAR techniques

PART 1 - THE BASIC METER

H. W. Hellyer

THE story of the radio enthusiast who progressed from the crystal set to a high-powered transmitter with nothing but a keen, wet finger is probably apocryphal. But during the short and crowded history of radio a surprising amount of good work has been done with the minimum of test equipment.

Partly this may have been due to high capital costs, partly because of a lack of information on the capabilities—and, indeed, the limitations—of individual items of test gear. Today we find a very wide range of equipment at our disposal, both surplus and commercial, in kit form and brand, spanking new. The advertisement columns of PRACTICAL WIRELESS abound in tantalising offers.

The problem is to know what to buy or make.

This series of articles aims to reduce the problem by outlining the scope and purpose of test equipment and presenting some of the applications. It does not set out to be a catalogue and specific items of equipment will not be described except where they illustrate a particular test sequence.

Circuits and methods are the result of practical experience at the bench and in the field. Many articles on the modification and adaptation of test gear have appeared in these pages and it is not intended to tread the same ground: additions to commercial test equipment will be mentioned only where such circuits extend the scope and versatility of the basic instrument.

However, queries are welcomed; novel ideas that readers may suggest will be laboratory tested and passed on. In this way it is hoped that these articles may prove a useful source of reference to those who study the advertisements and wonder whether particular instruments are suitable or will fulfil the desired purpose.

Information on test gear is singularly scarce. Of the few books available on the subject perhaps the best, and certainly the most up to date, is "Radio and Television Test Instruments", by Gordon J. King, published by Odhams Press, 25s. Mr. King is no stranger to readers of PRACTICAL WIRELESS; his help and guidance in the preparation of this series is gratefully acknowledged.

The Basic Meter

The fundamental item of equipment in any workshop, amateur or professional, is the test meter. Without it other, more complicated, instruments are just so much expensive decoration. A good deal of testing can be done with a trustworthy meter and plenty of time and ingenuity.

Unfortunately modern receivers and other electronic circuitry are much more complex than those of previous "wet-finger" days. Closer tolerances demand a higher standard of testing and more precise instruments.

This does not mean that the most expensive meter is necessarily the best for any particular purpose. There are multimeters ambitious enough to knock a hole in any wage packet with many ranges and functions that the owner never uses—even if he has found out how.

But if the only measurements required are voltages and currents met during receiver repair, plus the general purpose resistors of no closer than 5 per cent tolerance, a good "standard" meter should be sufficient. Such factors as robustness, ease of scale reading, foolproof overload and

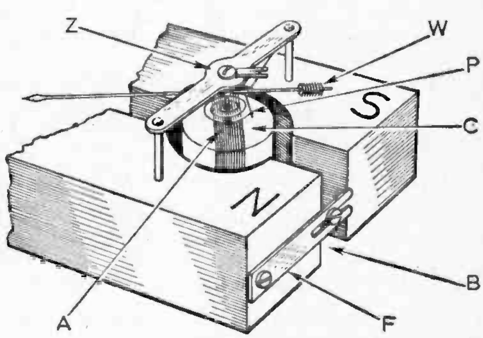


Fig. 1—A typical meter movement.

simple connection may be as important as the movement sensitivity.

Sensitivity

Nevertheless it is the sensitivity of the basic movement that ultimately determines how good or bad a meter can be. Remembering that a meter connected to a circuit for measurement becomes part of the circuit under test, it is obvious that the less effect the meter has upon the circuit the greater the accuracy of readings.

The sensitivity of a meter depends upon the current needed for FULL-SCALE DEFLECTION and the fundamental resistance of the meter. The latter important factor is stated as the OHMS PER VOLT rating. General purpose meters for measuring voltage and current and, by the addition of a voltage source, indicating resistance, are usually MOVING COIL instruments. There are other types, having special purposes, which we shall discuss later.

A typical basic moving coil assembly is illustrated in Fig. 1. In this the coil A is wound on a rectangular former and mounted on jewelled bearings in a magnetic field provided by polepieces N and S. The field is carefully determined and there are wide variations in the polepiece conformation between different manufacturers.

In our example a brass section is seen, B, between the poles with an iron flux adjustor, F, which should not be altered. Indeed when servicing or cleaning meters take care not to disturb the mechanical assembly: clamps and brackets may, in fact, be acting as magnetic shunts.

Note the flux compensator, C, the cylinder on which the coil is mounted. This serves to maintain a radial field and to reduce the reluctance effect between the moving arms of the coil assembly and the inner surface of the polepieces. On some types advantage is taken of this effect for additional damping.

Even Movement

Others have an aluminium plate fixed to the pointer arranged to operate in a magnetic field. The flux opposes the actuating current and, by Faraday's Law, increases with the acceleration of the pointer movement. This tends to produce an even movement of the pointer across the scale.

On the model shown in Fig. 1 additional balance to the movement is afforded by the weights, W, near the lower end of the pointer. These should not be confused with the gravity balance weights fitted on some of the cheaper models.

Current is fed to the coil by a pair of springs, P, wound in opposing spirals, also assisting in movement balance, particularly in return action of the pointer when the actuating current is removed. An important function of these springs, generally made of a non-magnetic material, phosphor bronze, which has the added advantage of a lower coefficient of linear expansion than spring steel, is the temperature compensation they afford.

Refinements

Other refinements may be found: a transverse bar for extra balancing, a light piston or vane in a virtually closed air chamber for braking action, a mirror backing to part of the scale to assist visual alignment—an anti-parallax device. And the zeroing set screw, Z, which adjusts an eccentric thread to move a fine wire in an inverted U-piece at the lower end of the pointer.

From the foregoing it can be seen that the lighter and more perfectly balanced the meter movement is the less current needed to operate the pointer. Other things being equal, the more sensitive the instrument. By winding the coil with a high number of turns of very fine wire a meter can be constructed having a high resistance and needing a very small current for full-scale deflection.

Nowadays meters of 20,000 ohms per volt having an f.s.d. of 50 microamps (0.00005 of an ampere) are quite common and at least one well-known meter available to radio engineers has a sensitivity of 100,000 ohms/volt. This means that on the 100-volt range of such an instrument the load presented to the circuit is in the region of 10 Megohms, comparable with the standards of many an electronic meter, about which more later.

The importance of this factor of high Ω/V can be seen by reference to Fig. 2. Here we have an identical pair of 100,000Ω resistors cannected across a 100-volt d.c. supply. We know by simple

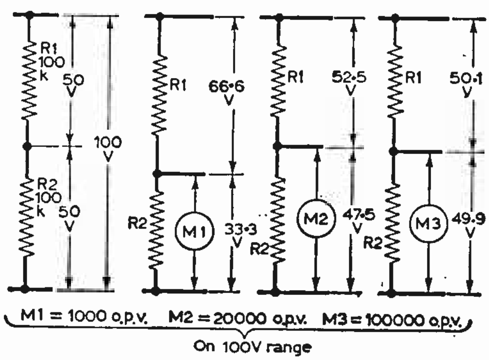


Fig. 2—These diagrams illustrate the importance of high Ω/V factor in meters.

calculation that 50 volts is dropped across each and would be indicated by an ideal voltmeter.

But if we put a meter with a sensitivity of 1,000 ohms/volt across R2 the actual reading is as low as 33·3 volts. This is because a 1,000 ohms/volt meter on its 100-volt range has a resistance of 100,000 ohms. In parallel with the resistance of R2 this reduces the total resistance across the section BC to 50,000 ohms, giving a 2:1 ratio of AB to BC and a voltage drop of 66·6+33·3 instead of the 50+50 in the former instance.

Similarly a 20,000 ohms/volt instrument would read 47·5 volts across R2, which is better, while a 100,000 ohms/volt instrument would indicate the near-accurate voltage of 49·9 across the same point.

This serves to illustrate one practical point. Greater accuracy is obtained by using the voltmeter on its higher ranges. However, from the point of view of mechanical accuracy, anti-parallax reading and an aid to interpolation (the assessment of readings between the divisions of the scale) it is often better to adjust the range so that the pointer lies in the middle third segment of the scale.

A further practical point to note is that most of scale of 110 deg. or more, while there are less useful models with an 80 deg. scale.

Linear Scale

Moving coil meters have the advantage that the torsion, and thus the arc of travel, is proportional to the actuating current so that the scale is linear. They can be made accurate to 1 per cent for

Keep this for reference

FACTS, FIGURES & FORMULAE

During this series, various references will be made to electrical and magnetic properties. Before we can employ test gear efficiently, we must know what the quantities are that we are measuring. The following notes contain definitions that may be familiar to many readers—but their collection and statement at the outset will save time and space in digressing explanations later.

Valve Characteristics

Amplification factor (μ) = Anode impedance (r_a) × Mutual Conductance (g_m)
where r_a is in thousands of ohms and g_m in mA/volt.

$$\text{Stage Gain, } A = \frac{\mu \times R_a}{R_a + r_a}$$

(where R_a is the anode load, in the same unit as r_a).

Equivalences

$$R \text{ (ohms)} = \frac{E \text{ (volts)}}{I \text{ (amps)}}$$

$$W \text{ (watts)} = I^2R = \frac{E^2}{R} = EI$$

$$F \text{ (in Mc/s)} = \frac{3 \times 10^2}{\lambda \text{ in metres}} = \frac{300}{\lambda}$$

(Where λ is wavelength).

$$X_C \text{ (ohms)} = \frac{10^6}{2\pi fC}$$

(Capacitor reactance, where f is frequency in cycles/second and C is capacitance in microfarads).

$$X_L \text{ (ohms)} = 2\pi fL$$

(Inductor reactance, where L is inductance in henries.)

(*N.B.* $2\pi f$ often designated ω (omega).)

$$\text{At resonance, } X_C = X_L \text{ and } f_r = \frac{1}{2\pi\sqrt{LC}}$$

(Where f_r is resonant frequency in kilocycles, L in microhenries, C in microfarads).

$$\text{Magnification factor of tuned circuit: } Q = \frac{2\pi fL}{R}$$

Decibels

The Bel is the common logarithm of the ratio of two powers.

One-tenth of a Bel, the decibel (dB) is used for convenience.

$$\text{Thus dB} = 10 \times \log \frac{W_1}{W_2}$$

(where W_1 and W_2 are the two power levels).

$$\text{and dB} = 20 \times \log \frac{V_1}{V_2}$$

(where V_1 and V_2 are the two voltage levels) (this supposes equal impedances to be employed).

Typical dB ratios are:

Power ratio of 2 = 3dB, *of 10* = 10dB
of 100 = 20dB.
Voltage ratio of 2 = 6dB, *of 10* = 20dB,
of 100 = 40dB, *of 1000* = 60dB.

Meter Calculations

$$\text{Shunt } R_s = \frac{R_m}{n-1}$$

(where R_m is internal resistance of meter, and n is the factor of multiplication)

$$\text{Multiplier } R_v = \frac{(E \times 1{,}000)}{I} - R_m$$

(where E is the required full-scale voltage, R_m the internal resistance of the meter, and I the full-scale current of the meter (mA)).

A unit of reciprocals is given on the following page.

Other factors, figures and formulae will be defined where applicable in the articles.

ABBREVIATIONS AND PREFIXES

Abbr.	*denotes*	*meaning*
M	Mega, or Meg	"millions of", as in Megohm = 10^6 ohms.
k	Kilo	"thousands of", as in kilohm or kilocycles, = 10^3 ohms or cycles per second.
d	Deci	"tenths of", as in decibel (dB) = 10^{-1} Bel.
m	Milli	"thousands of", as in milliampere (mA) = 10^{-3} amperes.
μ	Micro	"millionths of" as in microfarad = 10^{-6} Farad.
$\mu\mu$ or p	Pico	"million-millionths of", as in picofarad (pF) = 10^{-12} Farad.
v.l.f.	Very low frequency	0-30 kilocycles per second (kc/s), or above 10,000 metres wavelength.
l.f.	Low frequency	30-300 kc/s, or 10,000-1,000 metres.
m.f.	Medium frequency	300-3,000 kc/s, or 1,000-100 metres.
h.f.	High frequency	3,000-30,000 kc/s (3-30 Mc/s), or 100-10 metres.
v.h.f.	Very high frequency	30-300 Mc/s, or 10-1 metre.
u.h.f.	Ultra high frequency	300-3,000 Mc/s, or 100-10 cm.
s.h.f.	Super high frequency	3,000-30,000 Mc/s, or 10-1 cm.

Reciprocals

Conductance (G) is the reciprocal of resistance, $=\frac{1}{R}$

Susceptance (B) is the reciprocal of reactance, $=\frac{1}{X}$

Admittance is the reciprocal of impedance, $=\frac{1}{Z}$

general work (sub-standard models are accurate to 0·2 per cent) and are not liable to interference from external fields.

Their principal disadvantage is that a reversal of energising current results in a reversal of torque and thus they are basically suitable for d.c. only and polarity must be observed. A.C. ranges are obtained by rectification of the applied current, usually by small metal rectifiers.

These have a non-linear characteristic in the conductive direction and therefore the sensitivity and accuracy of a.c. ranges is less than of d.c. ranges. Calibration is in r.m.s. values and the readings should be multiplied by 1·414 to obtain peak values, but this applies only when a sinusoidal waveform is applied. Other waveforms will give misleading indications.

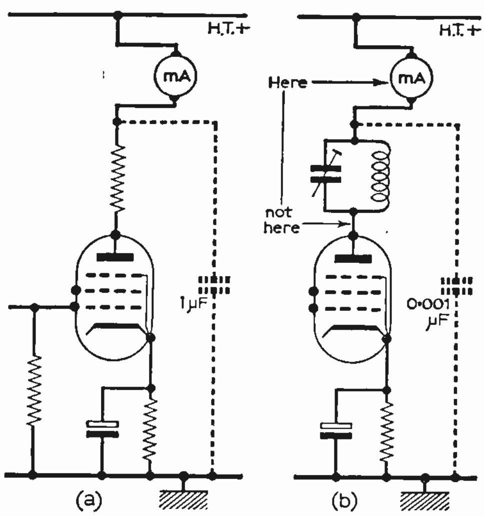


Fig. 3—Methods of decoupling moving coil instruments

This makes it necessary to provide decoupling for a standard moving coil instrument when it is used to take readings where, for example, signal voltages may be present. Fig. 3 indicates such a method and also shows that the correct place at which a meter should be applied is where the signal voltages have the least effect or, alternatively, are least affected by the presence of the meter.

Thus in Fig. 3a a reading of anode current of an audio amplifier stage is made by inserting the meter on the h.t. side of the load resistor and decoupling the meter for signal voltage by a suitable capacitor. And in Fig. 3b the meter is inserted in the anode lead of an i.f. amplifier at a point of low signal potential and similarly decoupled. Do not insert the meter between the anode of the valve and the load.

Current Testing

Current testing is done by the insertion of the meter in series with the circuit. From our former statement we can see that a meter with a small f.s.d. current needs a smaller value of shunt resistance for a greater total measured current. Thus the meter plus shunt presents less disturbance to the circuit.

It is not intended to give details of shunt calculation and construction at this point, nor the details of multipliers for extending voltage ranges—this has been done many times before in these pages. We shall assume that we are using the meter within its designed limits.

Practically, however, there are several points to note. Before inserting a meter for current testing switch off the apparatus. In addition to safeguarding the circuit under test this also protects the meter from unnecessary transients which can upset a delicate movement.

Polarity

Observe polarity—a meter which has the reverse connection at high loading can suffer mechanical damage because of the attempt of the pointer to force against the lower stop.

If the current to be tested is not known, always try first on the highest range. Actually it may be better to make some alternative test first to ensure that the current does not exceed the range of the meter. This can sometimes be done by making a voltage reading across part of the circuit and doing a quick calculation.

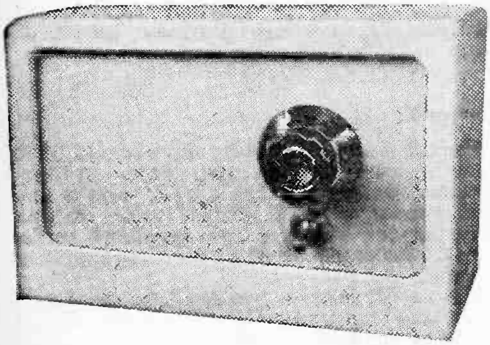
In a similar way always test at the highest voltage range first and do not switch ranges with the meter in circuit. Overload protection is generally provided; some instruments have a mechanical trip that is operated by the pointer over-riding the upper stop, some use a shunting rectifier which bypasses harmful currents from the moving coil. But there are limits and meters are expensive items to repair or replace.

Maintenance

When attempting meter maintenance, care must be taken not to employ magnetic tools or, indeed, ferrous tools of any kind. Metallic particles can be transmitted to the polepieces and movement very easily and are extremely difficult to eradicate. Getting magnetic particles from the gap in a movement is best done by removing the coil assembly altogether and cleaning the pole faces with a soft cloth. Take great care not to damage the flat spiral springs or pointer. Pivots can be cleaned with jeweller's rouge applied with a sharpened matchstick.

A good deal of space has been used in this introductory article for the purpose of laying the ground. In the next part we shall take a look at other kinds of meter and capacitance resistance testing.

(To be continued)



SIMPLE TRANSISTOR TWO

By F. G. Rayer

THIS receiver is of extremely simple construction, and is thus particularly suitable for beginners who may be looking for an easy, straightforward circuit. There are three stages—a crystal diode detector, followed by an audio amplifier, and a Class A output stage. The set is intended to run from a L5048 or similar $7\frac{1}{2}$V battery, though a 9V battery may be used.

The circuit is shown in Fig. 1. A receiver of this kind is not intended for reception of distant or overseas stations, and it requires some kind of aerial and earth. For local station reception, for which it is intended, an indoor aerial should usually be sufficient. The aerial may be taken to tappings B and D, or to the beginning of the coil (A) according to conditions.

Holders are used for the transistors. This avoids possible damage due to overheating, and allows any audio frequency transistors which are to hand to be tried. The transistor in the Tr1 position can best be an OC71 or similar type, while the Tr2 transistor is an OC72 or similar output type. Results obtained with spare transistors can easily be compared by inserting them in the holders.

For optimum amplification, resistor values are quite important. It is easy to check the working of each stage, with phones and a meter, as described later.

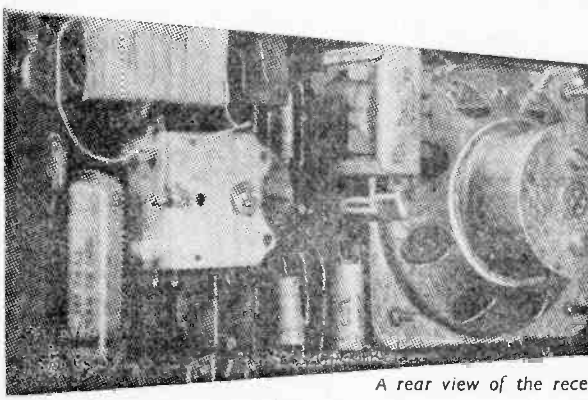
Capacitor values are not particularly critical. VC1 is a midget air-spaced capacitor of about 380pF, but the value is not important, and a 500pF solid-dielectric tuning capacitor could be used instead. Alternatively, a 500pF air-spaced capacitor, or similar component. C1 may be 0·1μF to 0·5μF. C2 may be 32-100μF, while C3 may be 4-8μF.

The output transformer T1 is a non-miniature transistor type component, such as would be used with a pair of transistors in push-pull. The speaker unit shown is a highly sensitive one, but there is no actual need to use this particular size. Many speakers have a 2 to 3Ω speech coil, and these require a 2 to 3Ω secondary on the transformer T1. Speakers of other impedance may be used, with their particular matching transformers. A 75Ω loudspeaker may be connected directly, with no transformer.

Paxolin Panel

The receiver is built and wired on a paxolin panel 4in. x 8in. Material $\frac{1}{16}$in. thick is sufficiently strong, though $\frac{3}{32}$or $\frac{1}{8}$in. paxolin could be used. All the holes are drilled as indicated in Fig. 2. Holes for leads can be made with a $\frac{1}{16}$in. or similar small drill. Holes for the speaker bolts, and L1 mounting, should be about $\frac{1}{8}$in. diameter, while VC1 is secured with three short 4B.A. bolts.

If any changes are made, such as to the speaker or VC1, these holes should be modified to suit. T1 had lugs, which are passed through slots, then twisted. These slots can be made by drilling two or three small holes close together.



A rear view of the receiver.

There is no reason why a ready-made coil should not be used. If so, the ferrite slab, with winding, is not required. The coil should be wired to agree with its maker's data. The receiver will also be found to work well on long waves, in those areas where the Light Programme on 1500m is available, so a small rotary switch can replace the on/off switch, for dual-wave tuning. In this case coil wiring should be taken from the coil maker's instructions leaflet.

All holes are drilled before mounting any parts. The transistor holders are a tight push fit in their holes, and are held with a touch of cement. The speaker can be left off until wiring is otherwise finished.

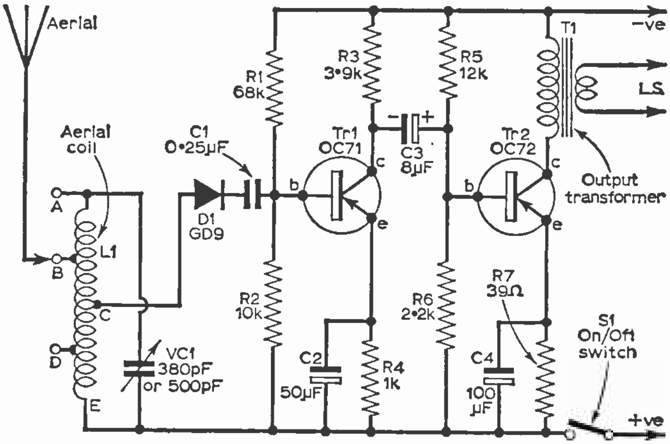


Fig. 1—The circuit.

Rear of Panel

All the components are fitted to the panel, at the back, as in Fig. 3. C2, C3 and C4 have positive and negative ends, so their leads are inserted through the holes as indicated. There should be no possibility of wiring or component value errors, if care is taken to insert the resistors and capacitors as shown.

The tuning coil is wound with 28s.w.g. d.c.c. wire, on a ferrite slab about ⅛in. x ⅝in. x 3in. Referring to Figs. 1 and 3, there are 20 turns from A to B, six turns from B to C, six turns from C to D, and 20 turns from D to E, making a total of 52 turns. All turns are wound in the same direction, closely side by side, and some modification to the number of turns, or gauge of wire, or the size of the slab or ferrite rod, will not be very important.

The tapping points B, C and D can be made by twisting small loops, during winding, and a dab of cement will hold the ends A and E, which are long enough to reach VC1. A is taken to the fixed plates tag, and E goes to the frame, which is also connected to the battery positive line, on the other side of the panel.

Two small blocks of hardwood or other insulating material are secured to the paxolin by means of small screws. The ferrite slab rests on top of these blocks, and is held with elastic bands passed through holes, and tied.

All wiring is on the front of the panel, and is very simple. Leads can be of any thin, insulated wire, and all connections are kept flat against the paxolin. Wiring is shown in Fig. 4. Point +ve joins a tag held by one of the bolts securing the variable capacitor. These bolts must be short, or have washers, so that they do not touch the fixed plates of the capacitor. With the solid dielectric type of capacitor, take the lead through to the moving plates tag.

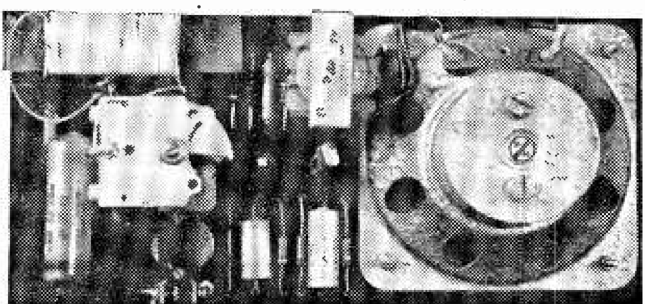
Clips, or a non-reversible 2-pin plug, may be obtained for the battery, and are convenient, while assuring the battery is not wrongly connected. If a meter is to hand, this may be connected in series with one battery lead, when first testing the receiver. More than 9V should not be used, and the battery must never be connected in the wrong polarity.

Testing

An earth was not found to be essential in some cases, but is preferable, as much better volume is then obtained. A simple indoor aerial can be arranged by having a few yards of thin, insulated wire round the room, near the ceiling. An outdoor aerial will usually give better volume, but is not essential.

The aerial lead is taken to the tapping which gives best results. Point A gives best volume, especially with a poor aerial. Points B and D allow rather more selective tuning, especially with a fairly long aerial. Tuning with this kind of circuit is quite flat.

With no transistors or battery, headphones may be wired across R2. Reasonable headphone volume should be obtained. If not, the diode may be suspected, or wiring, etc., in this stage, or the aerial and earth system may be too inefficient.



The receiver complete except for its cabinet.

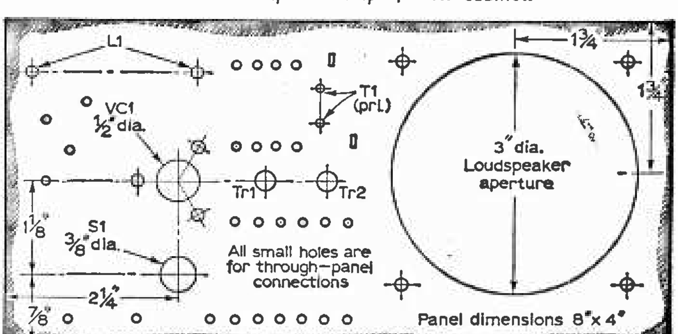


Fig. 2—Drilling details of the panel.

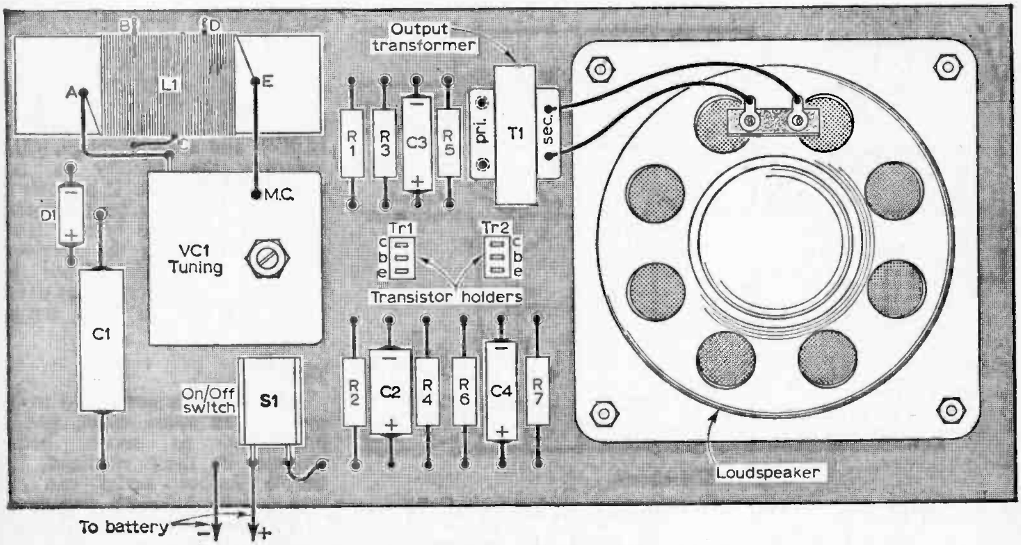


Fig. 3—Component layout on the rear of the panel.

With any reasonably effective aerial, and an average earth, quite good, phone volume should be obtained, from local stations.

The 'phones may then be wired in parallel with R6, and Tr1 may be inserted. There is no need to cut the transistor leads, but thin sleeving should be placed over them, to avoid shorts. It is essential that the collector, base and emitter leads are inserted in the correct sockets, as in Figs. 3 and 4.

Volume should be very much increased. Current consumption of Tr1 will depend on the transistor, but can be expected to be around 1mA. If the stage does not amplify, or if results are distorted, suspect the transistor, or wiring, etc. If Tr1 is of a type much different from that mentioned, the values of R1 and R4 may need changing.

The 'phones can then be removed, and Tr2 inserted. Consumption should be around 18mA to 25mA, with average loudspeaker volume. If current is over about 25mA, with the values shown and a particular transistor of different type, R5 may be increased in value, until the set draws about 20mA or so. If current is low, with lack of volume, R5 may be reduced in value, until the set draws about 20mA. An L5048 or similar battery will have a long life, with this current drain.

COMPONENT LIST

Resistors:

R1 65kΩ	R4 1kΩ	R7 39Ω
R2 10kΩ	R5 12kΩ	
R3 3·9kΩ	R6 2·2kΩ	

Capacitors:
- VC1 Approx. 380 or 500pF variable capacitor
- C1 0·25μF paper
- C2 50μF 3-6V or similar
- C3 8μF 6-9V or similar
- C4 100μF 3-6V or similar

Semiconductors:
- Two transistor holders
- TR1 OC71 or similar
- TR2 OC72 or similar
- GD9 Crystal diode

Miscellaneous:
On/off switch. Control knob. Ferrite slab and wire as described, or transistor set coil. W/B HF.3.57 3½in. 3 ohm speaker, or similar unit. Non-midget type transistor output transformer, ratio about 8 : 1. Paxolin panel approx. 8 x 4in., etc.

Cabinet

The receiver is not intended for portable use, so the smallest possible cabinet is not required.

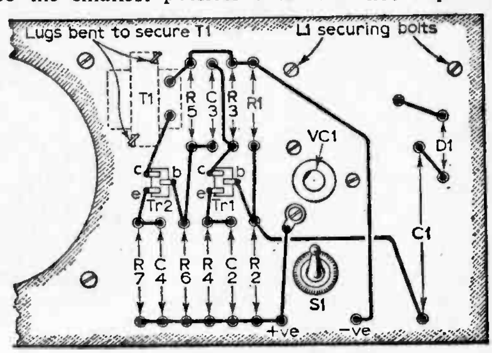


Fig. 4—The wiring diagram.

If no cabinet is to hand, one can be constructed from thin wood.

The receiver front consists of a piece of paxolin or any other thin material, with holes to agree with VC1, switch, and the speaker aperture. Silk or other fabric is stretched over the front, and cemented round the edges. Holes are cut in the fabric to clear the switch, and the spindle of VC1.

The securing nut of the switch is removed, and washers are placed on the switch, so that the front panel will just clear the receiver wiring. The two panels are then locked together with the switch nut, and a control knob is placed on the tuning capacitor spindle. ■

EXPLORE the WORLD!! on SHORT WAVE

with our exciting new
"VENTURE-I" KIT

Covers both 20M and 40M bands (switched). Band spread tuning. Aluminium chassis. Three ceramic air spaced tuning condensers, valve, plugs and sockets, hardware, etc. Full building plans provided.

COMPLETE FOR ONLY **47/6** P.P. 2/6

High Imp. Phones 14/6 extra.

The 'NORPAK' MAINS POWER PACK KIT FOR TRANSISTOR RADIOS

Operates your radio direct from mains. Miniature Size—4 x 2 x 1¾in. In attractive two-tone plastic case. Assembled in an hour. Normal output 9 v. 100 mA. (Adjustable) Full Mains Transformer. Full wave germanium diodes. Cartridge fuse.

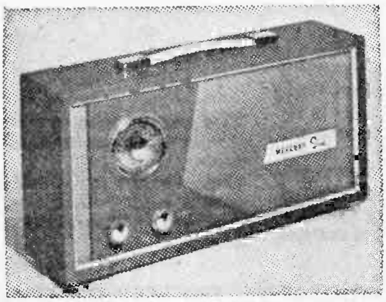
Complete Kit with Plans
35/- Plus 1/6 P.P.
(Ready assembled 45/-).

WE PROUDLY ANNOUNCE

★ THE NEW

P.W. MERCURY - 6 MK. II !!!

6 TRANSISTOR LONG AND MEDIUM WAVE SUPERHET



£10.7.6. plus 3/6 P. & P. All parts required

This exciting new cabinet has been acclaimed by everyone who has seen it. Existing Mercury owners may purchase it for 48/-. All components supplied to the last washer, together with full building plans (2/6) Free with parts.

- ★ New, brilliantly styled, timber cabinet giving elegant appearance.
- ★ New 8in. ferrite rod.
- ★ Printed circuit.
- ★ 500 mW into 7 x 4in. speaker.
- ★ Fine performance on both L.W. and M.W. bands including Luxembourg.
- ★ All parts available separately.

MAINS OPERATION BUILT IN!!

30/- EXTRA. Also

CHARGEABLE BATTERY

Write for details S.A.E.

ALIGNMENT SERVICE available for both the MERCURY and P.W.6 POCKET SUPERHET at reasonable charges. (Write for details).

NORCOL LTD 147 LONDON RD., YORKTOWN, CAMBERLEY, SURREY Phone: CAMBERLEY 3743

ACKNOWLEDGED TO BE THE BEST COMPONENT CATALOGUE

A
MUST
for every radio enthusiast

NOW
172 pages
Over **600** illustrations
Over **5,000** components listed

This is to-day's most up-to-date, most comprehensive component catalogue for the radio constructor, experimenter, engineer and Hi-Fi enthusiast.

2/6
PLUS 9d POST

POST COUPON TODAY
Write CATALOGUE on top left of envelope
Enclose P.O. 3/3

Name ....
Address ....
....

Home Radio Ltd. (PW) 187 London Rd, Mitcham, Surrey

Quality Amplifier and pre-amp

(Continued from page 823 of the January issue)

THIS MONTH THE DESCRIPTION OF THE MAIN AMPLIFIER IS CONCLUDED

By A. Cole

THE author ended last month by mentioning a method of tone control by connecting a 10-50kΩ potentiometer and 0·1μF capacitor in series from the anode of the output valve to chassis. This cuts treble by shunting actually produced power to earth instead of through the loudspeaker, and introduces effectively lower impedance at high frequencies to mismatch the output valve, leading to distortion and cross modulation. The "bass" in the "top-cut" setting of such a tone control is muffled and woolly, and the application of a shrill-toned signal can lead to severe overloading even though the actual volume finally present in the loudspeaker may be quite small.

The ideal position for a "top cut" control is right at the grid of the input stage; since then the above named disadvantages do not apply. Accordingly, VR2 and C6 constitute a treble-cut tone control of this kind, at the input grid of V1. This is ahead of the negative-feedback loop, and does not in any way limit the available output power, as there is linear treble response within the amplifier proper.

A treble cut control is more useful than a balanced treble lift/cut. In the same way, a bass-boost is more useful than a balanced bass boost/cut. VR3 and C9 vary the amount of bass negative feedback, so that the gain at bass frequencies may be raised above that at other frequencies, when VR3 is at high resistance setting.

Naturally, the degree of bass-boost available cannot exceed the degree of negative feedback employed, and is thus adjustable by means of VR4. If the completed amplifier howls or squeaks, reverse connections to the secondary of the output transformer.

Amplifiers overload much more easily on bass than on treble, because the human ear is less sensitive to bass sounds and considerably more power is required. Thus many arrangements which simply pump the necessary bass voltage into an amplifier, without further considerations, give a very rough bass response. because of overloading before the necessary sound-intensity is reached.

The arrangement here adopted is much purer, because any would-be distortion consists of higher harmonics for which the negative feedback reduction is much less, so they are still strongly cancelled by the negative feedback, in spite of its bass reduction for bass-boost tone control.

This form of tone control is an interesting exception to the otherwise normal rule saying "tone and volume controls should not be placed within a negative feedback loop".

Finally, as far as tone is concerned, one of the most effective methods of getting very clean distortion-free reproduction is to use an output stage with a generous power reserve, so that one does not need to drive it to the end if its tether for normal usage.

Checking for Balance

On completion, an oscilloscope check can be made. First of all, after checking the wiring, ensure that in the absence of a signal there is 10V drop across R25 and equal voltages at V2 and V3 anodes.

Connect the oscilloscope Y-amplifier to the loudspeaker terminals (with a resistor of correct value and power rating as load). There should be no extraneous audio or supersonic signals present at any combination of settings of the controls, apart from slight residual hum.

Feed in a sine wave signal from an oscillator to the input and turn up the volume gradually. If the Y-amplifier is voltage calibrated, the r.m.s. voltage across the load resistor when visible distortion just starts can be read off and by dividing its square by the load resistance in ohms, the maximum power output under prevailing conditions obtained.

Turning the volume up still more, distortion should commence symmetrically on both half cycles. This is a sensitive criterion for balance throughout the amplifier and if serious asymmetry on onset of distortion is experienced this must be cured. Possible reasons could be wrong value of R8, R16/R18 unmatched, wrong value of R17, V2/V3 emission grossly different, and parasitic oscillation.

The oscilloscope method of testing can be used to determine the power output at various frequencies throughout the entire audio range, and to determine the necessary input voltage for full output by transferring the oscilloscope probe to the input, after adjusting the input signal for full output as observed when the probe is connected to the output load. The effect of the tone controls can also be studied this way (Table 2).

Power Supply

Separate rectifier bridges are used for the amplifier and the tuner supply. There is no great objection to using a single bridge (300V a.c., 200mA rating) if available. C2 will then appear in parallel with the first section of C1, which should then be about 64-100μF. However, the design of Fig. 1 gives good decoupling and better smoothing.

The arrangement of R3, R4, R5, C3, C4, C5, gives three well decoupled separate supplies for the different sections of the tuner.

R3, R4, R5, C3, C4, C5 are located on the power-pack chassis instead of the tuner chassis, otherwise the return paths for a.c. through C3, C4, C5 would run between the two chassis and the interconnecting cables would carry a.c. components at high mains harmonics, resulting in increased stray hum injection into the circuits.

direct galvanic injection through stray "earth-loops". If one makes haphazard earth-connections between the various items and the screenings of signal cables, a chassis inter-connection lead or a signal-cable screening may share some of the a.c. components of power flowing between the two units.

By virtue of the always-present pure resistance of the cable or screening concerned, there will be a resulting a.c. voltage drop along the connection concerned, so that all parts of it are no longer at the same a.c. potential. The result is that proper earthing or screening cannot then be present, because the a.c. voltage drops along the supposed earthing or screening are injected directly in series with the signal proper, such effects being called

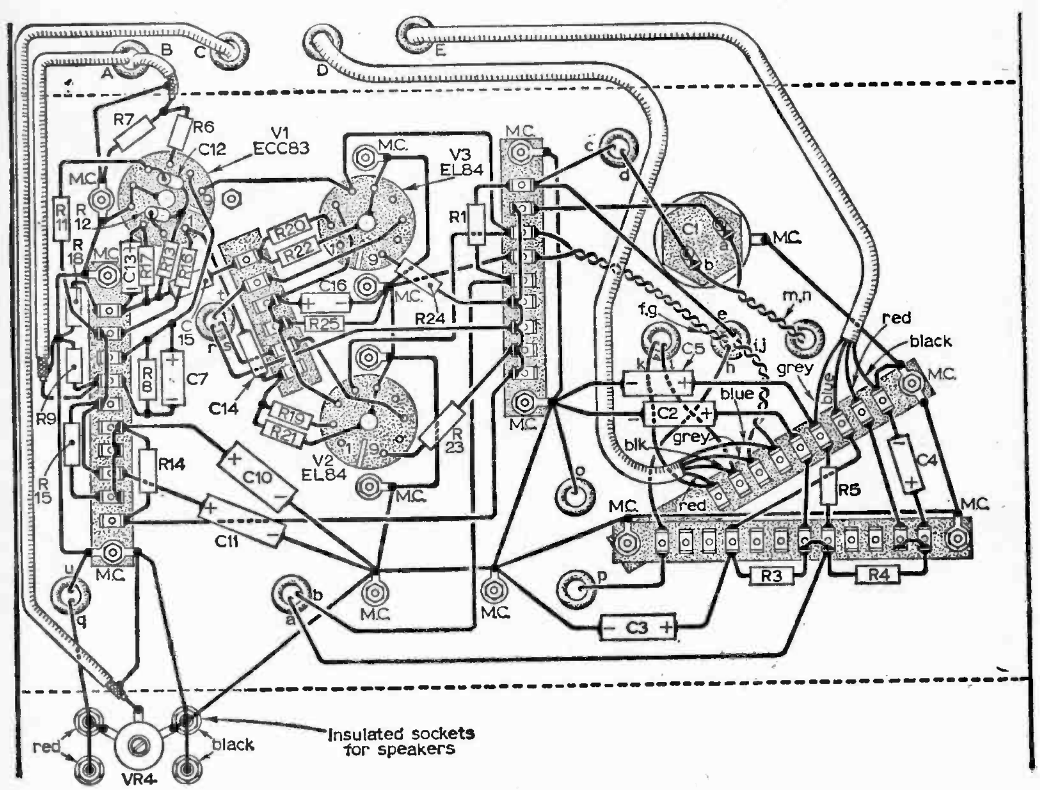


Fig. 2: The under-chassis wiring diagram.

Double Smoothing

Note the arrangement of R14, R15, C10, C11. The ripple from a fullwave bridge rectifier from the 50c/s mains is at 100c/s. A capacitor of 32μF has an impedance of roughly 50Ω at 100c/s; 8μF roughly 200Ω. R14 and C10 thus reduce ripple in the ratio 300:1 and R15, C11 reduce the remainder in the ratio 75:1. The total reduction is thus in the ratio 22·5 thousand to one.

Earth Connections

Hum induced by capacitive coupling of grid circuits to a.c. potentials is less of a danger than "hum-injection on earth-loops".

Such effects also take place to a slight exten over stray capacities, which also present a finit impedance to a.c., and thus can never be avoide absolutely, yet one can do a great deal to reduc stray hum by a properly-conceived arrangement o earthing connections.

Earthing of Signal-cable Screens

The purpose of a signal cable screen is t prevent the amplifier at the output end of th cable seeing anything else but what is fed in a the input end of the cable. Therefore the cabl

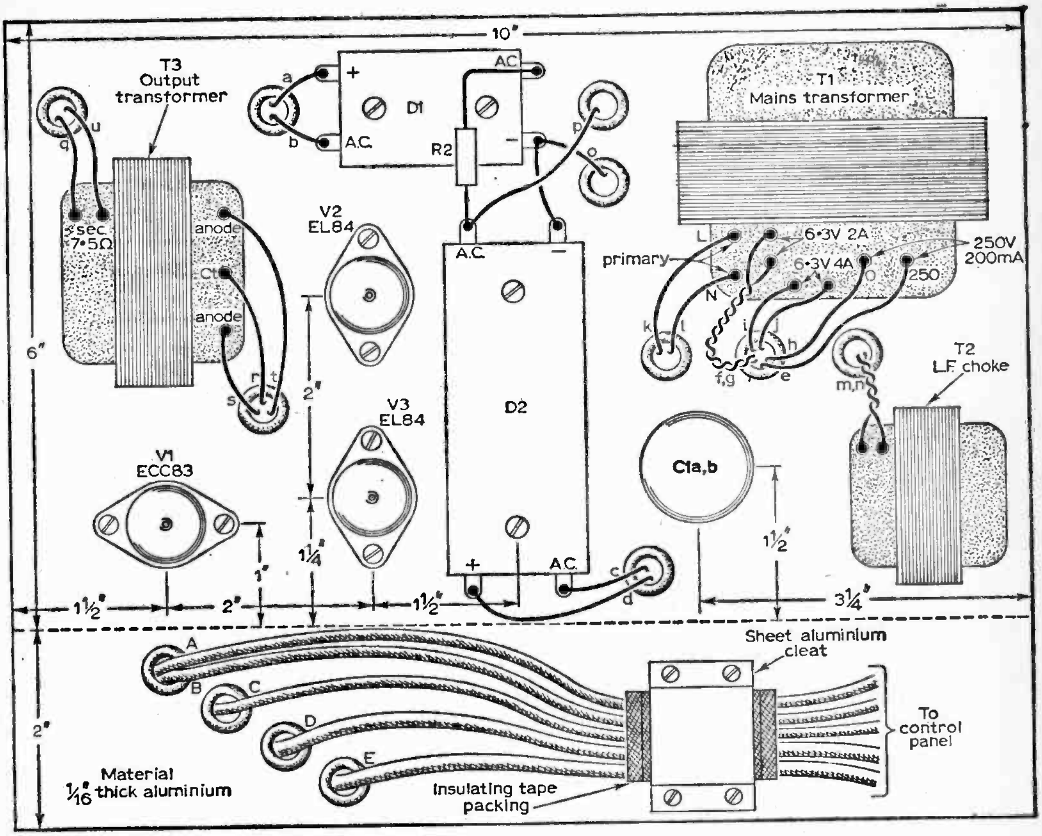


Fig. 3: The above-chassis layout of components.

screening must be at the potential of the "prevailing earth" for the following amplifier stage.

The proper place for earthing the screen of the signal cable is thus at the following amplifier which it feeds, and nowhere else. If the signal input to the cable is from another chassis, it is better to use a separate earth-wire connecting the two chassis, and earth the cable screen only at the following amplifier end, rather than use the screen itself as only, or additional, earth connection between the two chassis.

Furthermore the separate earth connection between the two chassis concerned must be such that no a.c. power components flow along it.

Avoiding A.C. Power Currents

There is only one solution to this problem. If one has to send a.c. power between two chassis of equipment (heater supplies, mains), then one should provide separate outward *and return* wires for the a.c. from the chassis supplying this power. In other words, earth connections for the a.c. supply concerned must be made on the *consumer* chassis ONLY. (See Fig. 5.)

The Present Amplifier

In Figs. 2 and 4 cables A, B, C are screened signal cables. Cables A and B may be combined as a single screened cable with two insulated "inners" not individually screened from each other, but it is essential that C remains separate—otherwise serious interference with the negative-feedback characteristics can result.

Cable E is a substantial four-core 15A mains power type cable, carrying the three h.t. supplies for the tuner and the negative/inter-chassis connection. This cable is entirely for d.c., and the "d.c. loops" thereby resulting, giving slight d.c. differences of potential between the two chassis, are unimportant. They certainly cannot introduce hum! Cable D is another four-core power cable, for all a.c. connections. Note that none of its wires have any direct earth connection to the amplifier chassis nor to the control-panel chassis.

The grey wire, which will be the subsequent earth side of the tuner heaters, will receive an earth (chassis) connection *only on the tuner-chassis*, where the heater power is consumed.

Note that the black lead of the d.c. cable E, used as a.c.-free inter-chassis earth connection, also picks up mains earth on the control panel, yet is not connected to the chassis plate of the control panel. The control panel is earthed via the signal cable screenings, and is thus merely a part of the main amplifier/power-pack chassis.

Hum Injection via Valve-heaters

With modern valves there is only a very small hum-contribution from this source, which can be compensated by connecting a centre-tapped potentiometer across the heater supply.

Such measures were not found necessary in the prototype, the residual hum at zero-setting of VR1 being such that one can just hear that the amplifier is operating in a quiet room. Also as far as r.f. and i.f. stages are concerned—particularly at v.h.f.—it is definitely of advantage, for stability, if one side of the heater supply can be earthed directly.

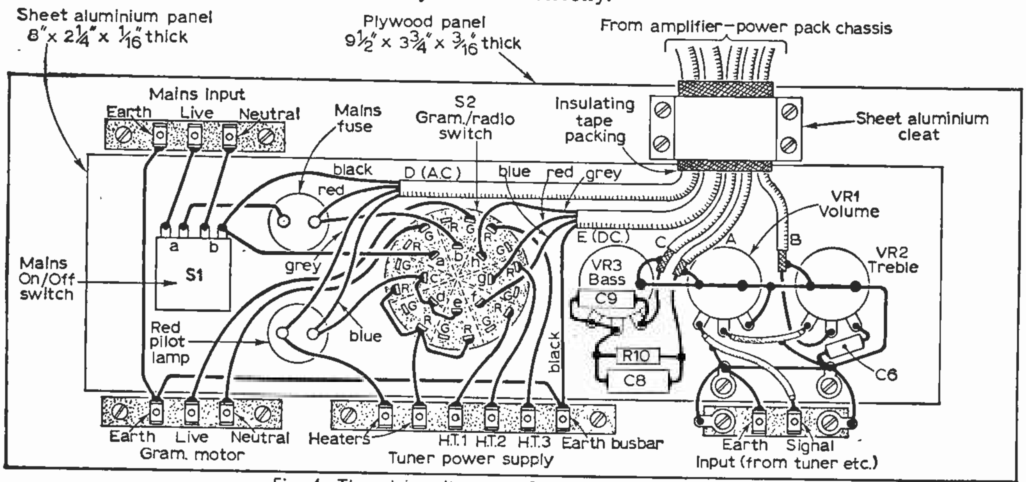


Fig. 4: The wiring diagram of the flying control panel.

COMPONENTS LIST

Resistors:

R1 100Ω R2 100Ω
R3, R4, R5 5kΩ 10W w.w.
R6 22kΩ R10 5·6kΩ
R7 4·7MΩ R11 68kΩ
R8 1·8kΩ ± 5% R12 22kΩ
R9 100Ω R13 1MΩ
R14, R15 15kΩ
R16 47kΩ matched with R18
R17 1·5kΩ ± 5% matched pair
R18 47kΩ
R19 10kΩ R20 10kΩ
R21 560kΩ, R22 560kΩ matched pair
R23 100Ω R24 100Ω
R25 90Ω 2W w.w. ± 2%
All resistors ± 20% 1W carbon, unless otherwise stated.

Variable Resistors:

VR1 500kΩ log
VR2 500kΩ lin.
VR3 50k log.
VR4 500Ω l.n. w.w. preset

Capacitors:

C1 Electrolytic Can, 50 + 50μF 450V, high ripple rating
C2 32μF, C3 16μF, C4 16μF, C5 16μF Tubular Electrolytics 350/385V
C6 200pF Paper, 500V
C7 50μF 15V electrolytic
C8 1000pF Paper, 500V
C9 0·1μF Paper, 500V
C10 32μF Tubular Electrolytics 350/385V
C11 8μF Tubular Electrolytics 350/385V
C12 0·056μF Paper, 500V
C13 50μF 15V electrolytic
C14 0·056μF, C15 0·056μF Paper, 500V, matched pair
C16 50μF 25V electrolytic

Valves, Transformers, etc.:

V1 ECC83
V2 EL84, V3 EL84 matched pair
D1 Selenium Bridge Rectifier B250C80
D2 Selenium Bridge Rectifier B300C150
T1 Mains Transformer, 250V 200mA, 6·3V 2A, 6·3V 4A
T2 Smoothing Choke 10H/125mA
T3 Hi-Fi Output Transformers for 2 x EL84 in Class A Secondary for 7½ ohms, push-pull

Switches:

S1 2 pole On/Off Toggle Switch, Mains 2A rating
S2 Ceramic 2-way rotary switch, 8 pole 2A, 500V

Loudspeakers:

WB "Stentorian" HF1016

Miscellaneous:

Panel Pilot Lamp, Red. Insulated Panel Fuse (Mains). Four knobs. Three Noval Valveholders, Ceramic, 1 with screening-hood (steel). Thirteen Rubber Grommets, ⅓ to ½in. diameter. Two pairs insulated Wanderplug Sockets (Red/Black). Approx. 3 yards 4-core Power Cable, 15A. Approx. 4½ yards flexible thin coaxial screened cable, PVC outer coating (quality microphone cable). Tagstrip, bolts, connecting wire, solder, etc. Aluminium sheet, 1/16in., for Chassis, Panel Plate and Cleats. (Approx. 16 x 10in. piece, total needed.) 3/16in. plywood, approx. 4 x 10in. raw, for Control Panel. Insulating tape.

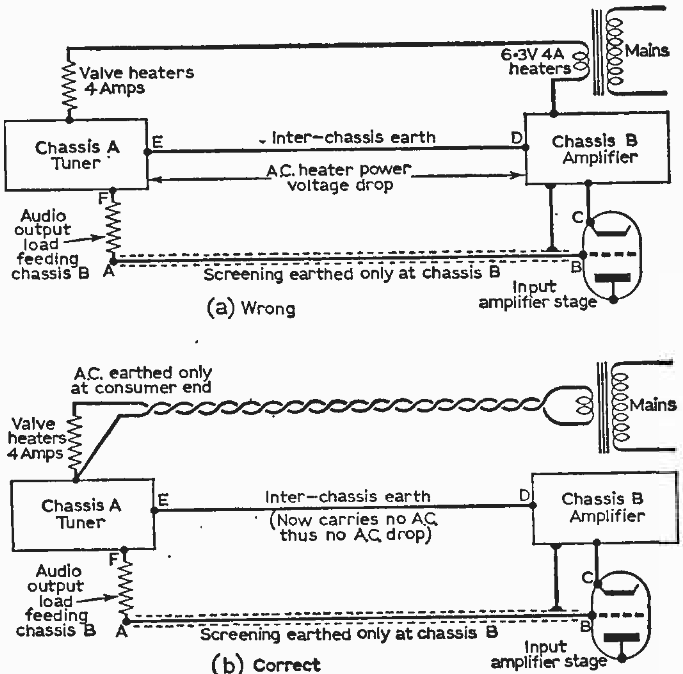


Fig. 5: The correct and incorrect methods of connecting chassis earths.

In general, the author is of the opinion that one need not be hypercritical in striving to get the hum-level in an amplifier so low that it is inaudible even under the most exacting circumstances, for as soon as any ordinary programme is playing at normal volume, slight residual hum is normally quite unnoticeable.

Final Remarks on Wiring

Note the spaced arrangement of R3, R4 and R5 in Fig. 2. This is important, as these resistors will generate considerable heat. Note also the "grid" of bare earth wires strung between chassis-connecting tags (marked MC) under component fixing bolts. This is a very effective and convenient component earthing system, giving very high contact reliability.

In Fig. 3 and Fig. 4 can be seen the method of anchoring the cables, to prevent destruction of connections by pulling.

Note carefully the layout of components on the chassis, as shown in Figs. 2 and 3.

The mains transformer and the output transformer are mounted as far apart as possible, and with the cores at right angles to each other. The amplifier components are mounted huddled-up in the opposite corner of the chassis to the mains transformer. The major heat-producers, V2, V3 and the mains transformer, are not placed in the immediate vicinity of each other. The input valve V1 is situated furthest of all from the power supply components.

It is advisable to operate the input valve V1 in a screening can, but this is very inadvisable for V2 and V3, as ventilation of these valves is thereby impaired, leading to overheating of the electrodes and early failure.

The radio/gram switch, S2, should preferably be a ceramic type with good contacts rated at 2A each. It is 8-pole, 2-way, normally on two wafers; the depiction in Fig. 4 is as one wafer only for clarity. Those sections *remote* from VR3 should be used for the five a.c. switching functions. Three sections are wired in parallel for switching the heaters, to give ample surge rating when switching on the cold heaters of the tuner.

The four tagstrips on the panel are mounted on brass stand-off bolts on the plywood overlap, countersunk from the front. Those of the signal input tagstrip are earthed to the chassis plate, to prevent hand-capacity hum effects from the front. Others may be treated the same way, but this is an unnecessary complication. Note the positioning of tags for higher voltages towards the centre of the strips, for safety.

The amplifier/power-pack chassis and flying panel form an inseparable unit. The panel is intended for mounting with four bolts through the corners to the back of the cabinet top-panel, so that the controls appear through a suitable (smaller) cut-out in the latter.

The gram motor, tuner power supplies and signal from the tuner are connected with soldered joints on the flying panel tagstrips, removable for servicing. Mains input is also wired to the appropriate tagstrip on the flying panel. The pick-up output goes to a socket on the tuner chassis. If the final stage of the tuner requires to be used as audio pre-amplifier, this valve must take h.t. and heaters ahead of S2.

TABLE 2

r.m.s.—DRIVE AT INPUT for *full power* output as in Table 1.
(oscilloscopically measured on prototype)
LEVEL SETTING: approx. 200mV.
VR2: Treble-Cut (level when full up)
VR3: Bass-Boost (level when full down)

VR2	2kc/s	5kc/s	10kc/s	15kc/s
Max. Treble	200mV	200mV	200mV	200mV
Min. Treble	600mV	1¼V	2½V	2V

VR3	50c/s	100c/s	
Min. Bass	200mV	200mV	for VR4 in setting with negative-feed-back over ⅗ of output transformer secondary voltage (approx. optimum setting)
Max. Bass	50mV	100mV	

NEXT MONTH THE PRE-AMP WILL BE DESCRIBED

ECHO CHAMBER

FOR MICROPHONE OR ELECTRIC GUITAR

By B. M. Jeffery

In this instrument, reverberation is achieved by delayed playback from a continuous loop of magnetic tape. Details are given for constructing a special tape deck, together with details of a suitable amplifier and mixing circuit.

THE amplifier used in this echo chamber is a modified Mullard type amplifier, but there is no reason why any other tape amplifier and record oscillator should not be employed if preferred. It should be noted that the amplifier and oscillator is used only for amplifying the input signal and for recording on to the tape; no playback switching or erase switching is needed. To obtain the correct echo an attenuator circuit is needed and is described later. A switch for selecting the playback heads is required. Output from the selected playback head is fed to a separate power amplifier, together with the original signal.

The Tape Deck Details

All the materials used are easily obtainable. The record/playback heads can be of any make or type. Those used in the prototype were made by Telefunken and if other types are used the head mounting plate and the head covers will differ from the measurements given.

A small magnet is used for erasing purposes. This type of erasing saves extra cost and is quite adequate. One edge of the magnet must have a smooth surface to prevent scratching the tape. All metal used is of a certain thickness to obtain a rigid construction. The small springs, felt pads, metal etc., can be obtained from any hardware store.

The motor used is an ordinary autochange type, B.S.R. U8. The flywheel, brass pulley wheels, brass drive wheel and brass mounting bush were all made by a light engineering firm for a small cost. The two rubber wheels used are standard tape deck parts obtainable from B.S.R.

In the constructional diagrams all holes have to be drilled to take 4B.A. bolts, unless otherwise stated.

Main Deck Plate

The main deck plate is made from a piece of ⅛in. thick steel plate or a similar metal, size 10in. x 8in. The plate is drilled as Fig. 1. All holes marked "A" are drilled to take 2B.A. bolts, holes marked "B" are drilled to take ¼in. rubber grommets. The hole marked "C" is drilled to take the ½in. brass bush. The corners of the deck plate can be rounded slightly as shown in Fig. 1. The holes marked "A" on each corner are used for fixing the plate to the cabinet.

Head Mounting Plate

This plate is made from ⅛in. thick brass size

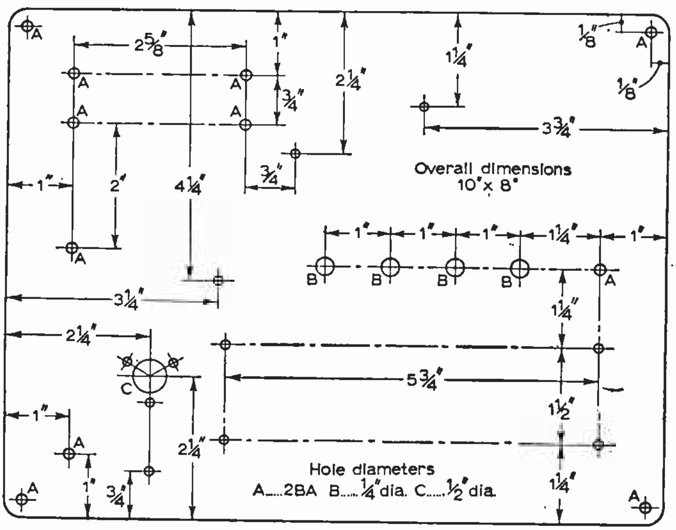


Fig. 1: Dimensions of the main deck plate.

LASKY'S RADIO

"BUILD-YOURSELF" TRANSISTOR RADIOS

The finest receiver at present available for home construction. Fully tunable long and medium wavebands. Uses 7 Mullard Transistors: OC44, 2 OC45's, OC71, OC81D and 2 OC81's, plus Crystal Diode OA70.

The "REALISTIC" Seven

STAR FEATURES ★★★★

★ 7 Transistor Superhet. 350 Milliwatt output into 4-inch high flux speaker.

★ All components mounted on a single printed circuit board, size 5¼ x 5½in. in one complete assembly.

★ Plastic cabinet, with carrying handle size 7 x 10 x 3½in. in choice of colours:

★ Red/Grey, Blue/Grey, all Grey.

★ Easy to read Dial.

★ External Socket for car aerial.

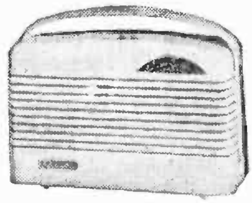
★ I.F. frequency 470 Kc/s.

★ Ferrite Rod internal aerial.

★ Operates from PP9 or similar battery.

★ Full comprehensive data supplied with each Receiver.

★ All coils and I.F.'s, etc., fully wound ready for immediate assembly.



An Outstanding Receiver. Lasky's Price for the complete parcel including Transistors, Cabinet, Speaker, etc., and Full Construction Data: **£6.19.6** Postage and Packing 4/6

Battery 3/9 (included **free with complete parcel**). Data and instructions separately **2/6**, refunded if you purchase the parcel.

THE BETA TWO

A 2-transistor plus 2-diode personal receiver for home construction. Uses printed circuit and ferrite rod aerial. Personal earphone gives clear reception for private listening. Tunes over full medium waveband. Size 5¼ x 3¼ x 1½in. overall. All components available separately. CAN BE BUILT FOR **21/-**

Postage. 2/6 ex.
Including personal earphone, cabinet, etc. Circuit diagram and step by step instructions 1/6. (Free with parcel).

KAPURA Model U1 Multi-Test Meters

★ Complete with test leads.

★ Brand new, fully guaranteed.

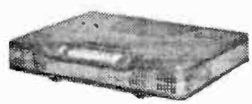
Sensitivity: 1,000 ohms per volt A.C. and D.C.
Ranges: (A.C. and D.C.) 0-15-50-250-500-1,000 v. D.C. current 0-100-500 mA. 0-1 mA (used at 0-10 v. range).
Resistance: 1-2,000 ohms (centre 24 ohms), 100-200,000 ohms (centre 2.4k.)
Size: 5in. x 3in. x 2¼in.

LASKY'S PRICE **39/6**
Carriage and Packing 5/-

TELEFUNKEN STEREO HI-FI AMPLIFIERS

Further Great Purchase Enables us to Offer this Excellent Unit at £5.19.6. Post 7/6.

A complete stereo amplifier of unsurpassed quality, with inputs for radio, tape recorder, F.M. tuner or any other hi-fi source, either monaural or stereo. Output power 5 watts total (2½ watts each channel). New and unused, listed at 16 gns.



LASKY'S PRICE £5.19.6

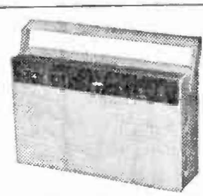
THE SPRITE

★ Six-Transistor Superhet Miniature Personal Pocket Radio. ★ Tuneable over Long and Medium wavebands. ★ Used PP3 battery. ★ Ferrite Rod aerial. ★ I.F. Frequency 470 K/cs. Transistors: 3 x Philco 2067's 2 x Mullard OC81 M, OC81 DM and OA90 diode. ★ 3 inch speaker. ★ Printed circuit 2¼ x 2in. ★ Slow Motion Drive. ★ In plastic case, size 4 x 2½ x ⅞in.

Inclusive price of **89/6** P.P. 3/6 extra.

In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver and Output stages, ready built with all components ready mounted on the printed circuit. To complete assembly you only have to fit the wavechange switch, tuning condenser and drive, volume control, earphone socket and aerial rod, the remaining components all having been prefitted at the factory for you. The SPRITE is offered as above, pre-assembled, plus cabinet, speaker and all components for final construction, at the inclusive price of 89/6. Postage and packing 3/6 extra. Data and Instructions separately, 2/6. Refunded if parcel is purchased. Real calf leather case, wriststrap, personal earphone and case for earphone 10/- the lot extra. Make no mistake this is SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit.

THE COROVER '6'



★ A 6-transistor plus 2-diode superhet receiver using the latest circuitry. ★ Three Mullard AF117 alloy diffused transistors are used with OA79 and OA91 diodes, followed by OC81D and two OC81's in push-pull. ★ I.F. frequency 470 Kc/s. ★ Covers the full medium and long wavebands. ★ Sockets provided for personal earpiece or tape recorder, and car radio aerial. ★ Large internal ferrite rod aerial gives high sensitivity. ★ Uses four 1.5 v. pen torch batteries. ★ All components mounted on a single printed circuit. Simple stage by stage instructions. ★ Cabinet size 6¾ x 4 x 1½in. With carrying handle. ★ All coils add I.F.'s ready wound.

ALL COMPONENTS AVAILABLE SEPARATELY. *Data and instructions separately 2/6. Refunded if you purchase the parcel.*

CAN BE BUILT FOR **£5.19.6**
Post and packing 4/- extra.

CRYSTAL PICK UP CARTRIDGES

Lowest Prices Ever!
All complete with Styli, L.P. and Standard (and Stereo where shown). Fully guaranteed, standard fitting, will fit most P.U. arms and heads.
Postage 1/- each extra.

MONO

TYPE C.T.1. By well known manufacturer. With two sapphire styli 12/6
Garrard GCE.4 .... 15/-
Ronette Studio O 15/-
Acos GP.65/3 .... 15/-
Acos GP.65/1 .... 17/-
Acos GP.67/1 .... 17/-
Acos GP.61/1 .... 18/-

STEREO

Acostereo 73/1 with two sapphires.................. 25/-
Acostereo 73/2 with Diamond L.P./Stereo and sapphire Std.............. 28/6
Collaro type C. Turnover, with 2 sapphires 25/6
Collel S.C.1. Turnover with 2 sapphires 24/6
Collel S.C.1. Turnover, with Diamond L.P./Stereo and sapphire Std.............. 29/6
Ronette Stereo O.V. Turnover, with 2 sapphires .. 29/6
Ronette Stereo type 105, with 2 sapphires 35/6
Ronette Stereo type 105, with Diamond L.P./Stereo and sapphire Std. 39/6

TV TURRET TUNERS

By famous manufacturer, I.F. 33-38 Mc/s., PCC84 and PFC80 valves fitted, also 12 sets of coils.
Lasky's Price Complete with Valves and Coils 29/6. Postage 2/6.

Distler Miniature Motors

6 volt battery operated 7/11. P. & P. 2/6.

207 EDGWARE ROAD, LONDON, W.2. Near Praed St. PADDINGTON 3271/2 | **33 TOTTENHAM COURT ROAD, W.1.** Nearest Stn, Goodge St. MUSEUM 2605

BOTH OPEN ALL DAY SAT: Early Closing Thurs. Mail Orders to Dept. P.W., Edgware Rd.

152/3 FLEET STREET, LONDON E.C.4
Telephone: Fleet Street 2833.
Open all day Thursday. Early closing Sat.

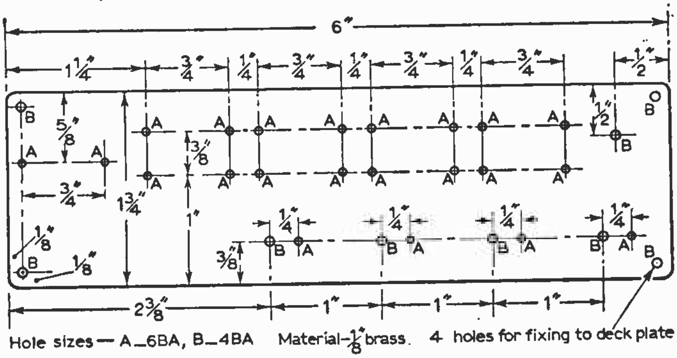


Fig. 2: The head mounting plate.

6in. x 1¾in. Brass was chosen because it is non-magnetic and easy to drill. The plate is drilled as shown in Fig. 2. All holes marked "A" are drilled to take 6B.A. bolts. The corners on this plate should preferably be rounded.

Head Covers

These head covers are made from $\frac{1}{16}$in. thick brass size 2in. x ⅝in. (four required). The covers are drilled and then bent as in Fig. 3. It may be noted that if heads other than the ones stated are used the measurements of the covers will differ slightly. The heads are placed approximately 1in. apart.

The Erase Magnet

The mounting for the erase magnet is made from two pieces of ⅛in. thick brass 1in. x ½in. These are drilled and assembled as in Fig. 4.

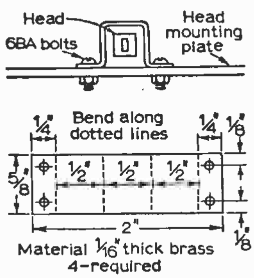


Fig. 3 (above): The head covers.

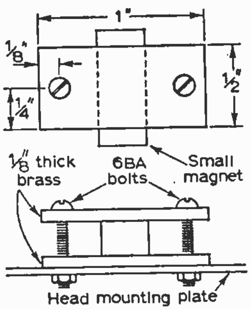
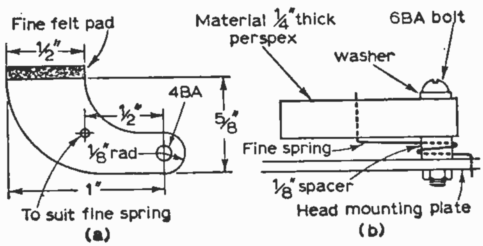


Fig. 4 (right): The method of mounting the erase magnet.

Fig. 5 (below): The pressure pad arms.



Head Pressure Pads

The measurements and mounting details of the pressure pad arms are given in Fig. 5. These arms are cut from ¼in. thick Perspex. Two holes are drilled, the one marked "A" to take a 4B.A. bolt, and the other marked "B" to take a fine spring. This fine spring provides the necessary pressure against the head. A piece of fine felt is glued to the end of the pressure pad, this prevents the tape from being scratched and allows it to be pulled through the heads easily.

At this stage one small brass pulley wheel is required, and this acts as a tape guide. Fig. 6(a) shows the size of the pulley wheel and how it is mounted. Fig. 6(b) shows an alternative type of tape guide which can be used in place of the pulley wheel. This is a fixed mounting, but it will be found that the pulley type is better as it allows the tape to be pulled through the heads more smoothly than this fixed type guide. At this stage the heads, erase magnet, tape guide and pressure pads are assembled on the head mounting plate as in Fig. 11.

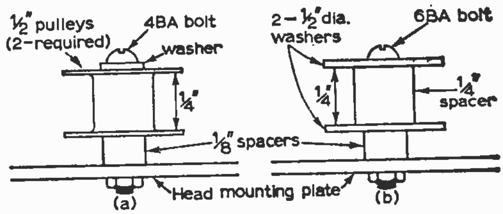
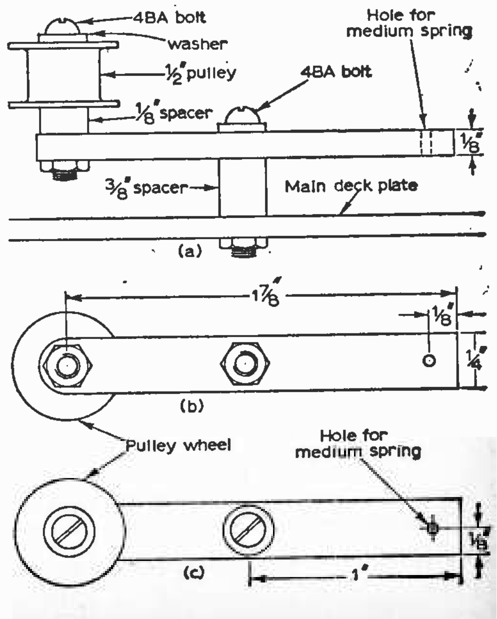


Fig. 6 (above): a: Tape guide pulley assembly; b: alternative fixed-type guide.

Fig. 7 (below): Tension pulley assembly.



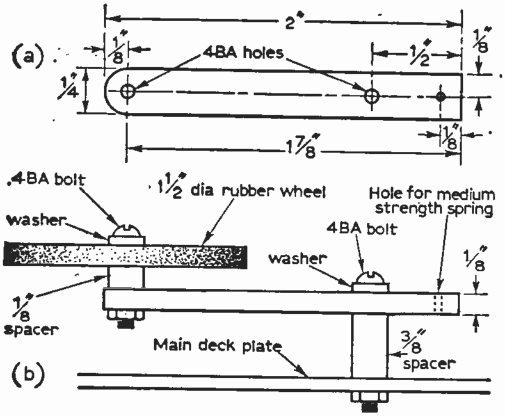
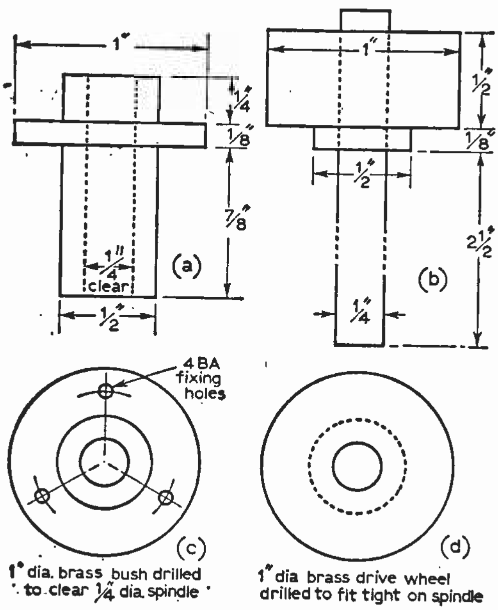


Fig. 8 (above): Motor drive wheel assembly.

Fig. 9 (below): Drive wheel and bush assemblies.



Tension Pulley Assembly

This is made from ⅛in. thick steel, drilled and assembled according to details given in Fig. 7. A second pulley wheel is used here, the size being the same as the tape guide pulley. A medium strength string is attached to one end and provides the tension necessary to keep the tape tight. All holes are drilled to take 4B.A. bolts.

Motor Drive Wheel Assembly

This piece is made from ⅛in. thick steel cut and drilled as shown in Fig. 8(a). The rubber used is 1½in. diameter. Another medium spring is used to keep the rubber drive wheel in contact with the motor and flywheel. Fig. 8(b) shows the completed assembly.

Drive Wheel and Bush Assembly

This bush is made from a piece of brass rod cut and drilled as in Fig. 9(a). The bush used in the prototype was obtained ready made from a light engineering firm. Fig. 9(b) and Fig. 9(d) show the construction of the drive wheel with the main spindle fitted. The drive wheel is made from a piece of 1in. diameter rod. The wheel is made to fit tight on to the main spindle. A small screw can be fitted through the wheel to keep it tight, but this screw must be set well into the brass wheel to avoid scratching the tape. Fig. 9(c) shows the plane view of the brass bush. The holes marked "A" are drilled to take 4B.A. bolts which secure the bush to the main deck plate. The main spindle is cut from ¼in. steel rod as in Fig. 11(a).

The Pressure Wheel Assembly

This is made from ⅛in. thick steel, cut and drilled as Fig. 10(b). All holes are drilled to take

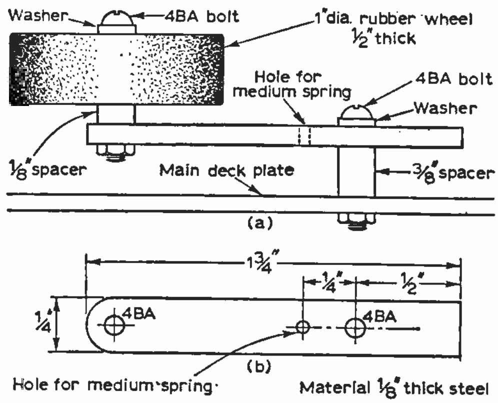
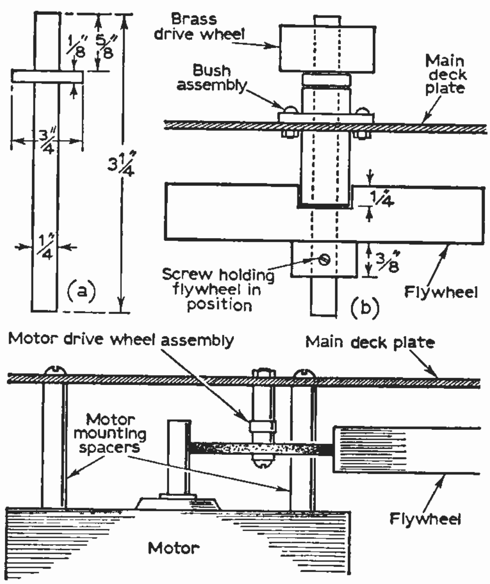


Fig. 10 (above): Pressure wheel assembly.

Fig. 11 (below): Drive wheel and flywheel assemblies.



4B.A. bolts. A standard rubber pressure wheel size 1in. diameter by ½in. thick is used. This is mounted as in Fig. 10(a). A medium spring at one end of the metal provides the tension against the drive wheel for the tape motion through the heads. At this stage the whole drive assembly and motor are mounted to the main deck plate. The completed assembly is shown in Fig. 11(b). Next the pressure wheel is mounted. Fig. 11(c) shows the flywheel, motor and drive pulley in position.

Completing the Deck

The tension pulley wheel is now added to the deck together with the spring. Then the leads from the heads are connected to a small piece of tag panel mounted on the underside of the deck. The holes marked "D" in Fig. 12 are for the mounting feet which support the deck when it is in the cabinet. Three supporting feet are required and are made from ¼in. steel rod, 4in. long. The hole marked "E" is used for mounting a twin connector or a piece of tag panel for the mains supply to the motor. Fig. 12 shows the completed deck with the tape in position. The tape used is the standard ¼in. type, and is joined by a piece of splicing tape to make a continuous loop.

Adjustments

The adjustments for the bias level are carried out in the normal way. Other adjustments to the completed echo chamber can be made as required. The bias current through the record head should be 1mA constant.

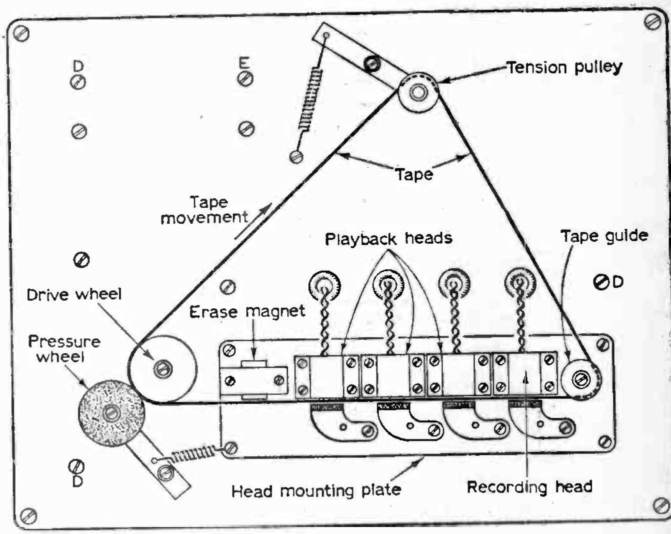


Fig. 12: The completed deck.

The Amplifier

This amplifier is built in the normal way. Care should be taken when wiring the valve grids and heater chain, and these should be kept well away from each other to prevent hum pick-up. Three valves are used: EF86, ECC83 and EL84 (see Fig. 13). The EF86 low noise pentode is used for amplifying the input signals. The first section of the ECC83 double triode valve is used in the equalising stage, and the second section is used as the output stage when recording. The EL84 output pentode is used as the oscillator. An EZ80 full wave rectifier is employed in the power pack.

Input Stage

The EF86 acts as a voltage amplifier. It is possible to record from either microphone or

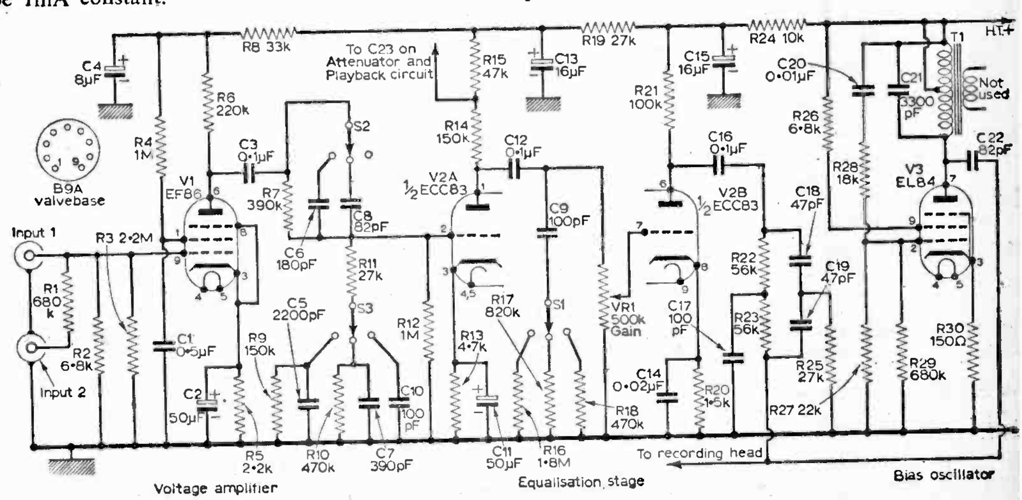


Fig. 13: The main amplifier circuit.

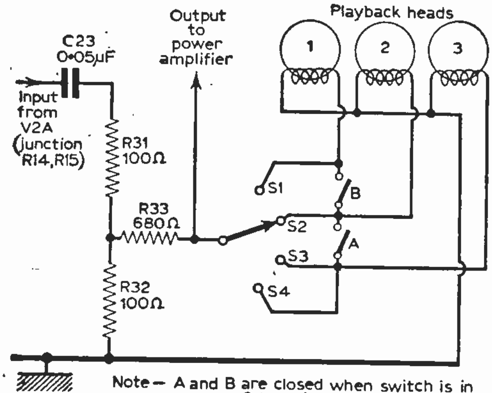


Fig. 14 (above): Attenuator and playback circuits.

guitar input sources. Both input are fed to the grid of the valve. Input two being attenuated by R1. The two inputs can be used at the same time if required.

Equalising Stage

The first section of the ECC83 (V2A) is used only for equalisation purposes. The component values used in this part of the circuit may need to be varied to give the correct bass and treble response, according to the type of head used. Switches S1, S2 and S3 select the desired equalisation circuit. A low level output is taken from the anode load of this stage and is taken to the attenuator circuit (Fig. 14).

Recording Stage

The output from the anode of the equaliser stage is taken to the grid of the section of the ECC83 via the gain control VR1. Further high frequency boost is added to the recording signal by C14 and R20, in the cathode circuit of V2B. The recording signals are taken from the anode of this stage via a parallel-T network to the recording head. Bias is fed to the recording head immediately after the T network.

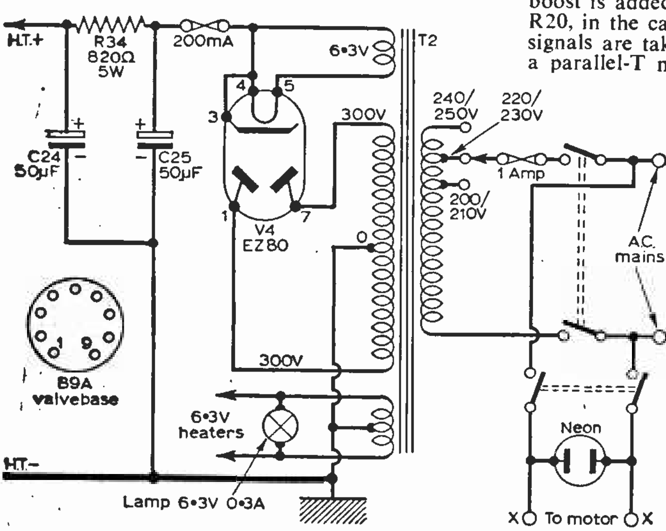
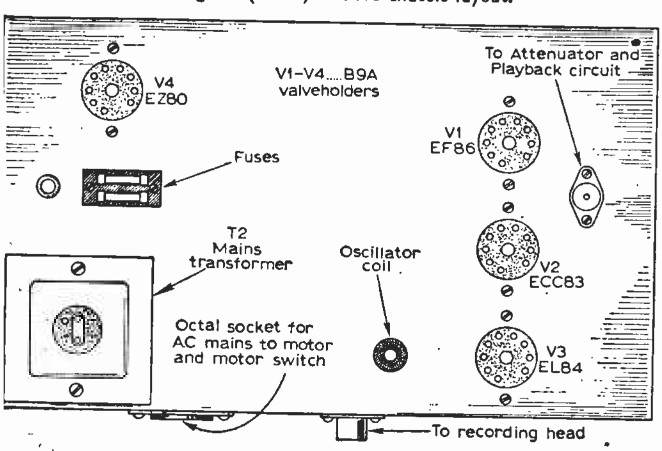


Fig. 15 (above): Power pack circuit.

Fig. 16 (below): Above-chassis layout.



H.F. Oscillator

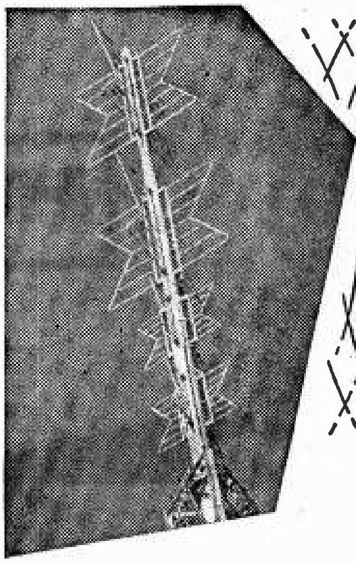
The bias signal is fed to the recording head via the 82pF capacitor C22. The valve of this capacitor determines the bias current flowing in the head. The bias voltage is obtained from the anode of the EL84. The oscillator coil and oscillator component values will depend on the type of recording head used. The record head used in the author's model had an impedance of 300Ω.

Attenuator and Playback Circuit

The attenuator is a straightforward circuit using three resistors and a capacitor (Fig. 14). The input to this circuit is taken from the anode of V2A (junction of R16, R17). The original signal is thus attenuated and then combined with the output from the playback heads to form the echo required. Switches S1-S4 allow the playback heads to be switched simultaneously as required. Switches A and B are closed with the switch in S4 position. The playback signals and the orginal signals are fed to the main power amplifier.

Power Pack

This is an ordinary power-pack and is wired as shown in Fig. 15. The transformer used is a standard type with a 300-0-300V 250mA h.t. winding and two 6·3V heater windings. ■



On Your Wavelength

By THERMION

WE have had considerable correspondence in the past regarding the "wonderful tone" of many old sets, and although we are sure many of these claims are due to prejudice, we agree that there is a subtle something about some of them which cannot be denied.

An acquaintance of mine recently asked if I thought that it would be worth while fitting a tweeter and crossover to his vintage set—one which I knew was a really beautifully made early 20's model, with a single-ended output stage. The cabinet was a classy piece of work in mahogany with the lower section housing a 9in. or 10in. loudspeaker behind a mass of fretwork and silk.

I told him not to worry about tweeters etc., and told him that I did not think there was any "top" in his set which was suitable for tweeting anyway, and that what was there would be adequately covered, in my opinion, by the 10in. loudspeaker. He seemed rather disheartened, and although I twitted him on wanting to improve such a remarkable set (I had constantly heard about its wonderful tone), I could see that he had rather set his mind on trying out this improvement.

So after a little thought I made a suggestion which has turned out wonderfully well, and may, therefore, interest others with similar types of apparatus. I said that instead of spending money on the tweeter and crossover he should buy four 8in. loudspeakers of modern design. Then I said he should remove the existing loudspeaker and its baffle, and obtain a new piece of wood for a baffle. He should cut four holes equally disposed in the new baffle to house the four speakers—centre top and bottom, and one on each side.

Next I suggested he cut four small squares to take these speakers and from them make mounts so that when the speakers were screwed to the main baffle they would be tilted slightly, the upper one towards the ceiling, the lower one slightly downwards, and the other two towards right and left. The original loudspeaker and output was 3Ω, so I suggested four 15Ω new models, and suggested that the slight mismatch would not be noticeable, and I pointed out that I thought that the removal of a single point source of sound, and the new distribution of sound might give him an improved performance.

I have not yet ceased to hear what a miracle this has performed in the set. It certainly has improved reproduction, giving a much rounder tone without the "hole in the wall" effect, and the top definitely sounds much brighter. Probably ideas on this line might be tried in other vintage models with advantage, but I certainly did not expect it to have worked such an improvement in reproduction on an old set.

A Future Trend

I recently read a news item (from America!) that a new infra-red camera had been developed which could photograph the immediate past—during a test some cars were driven from a car park, the camera was set up, and took pictures of the cars which had vacated the site!

Some years ago a technician, also from America, decided (and I believe proved—or was it in a radio play?) that when a transmission is sent out it goes round and round the earth gradually attenuating, but never completely dying out. Will we next hear that a radio or circuit has been demonstrated which can pick up yesterday's signals from the jumble which must be whirling round our earth?

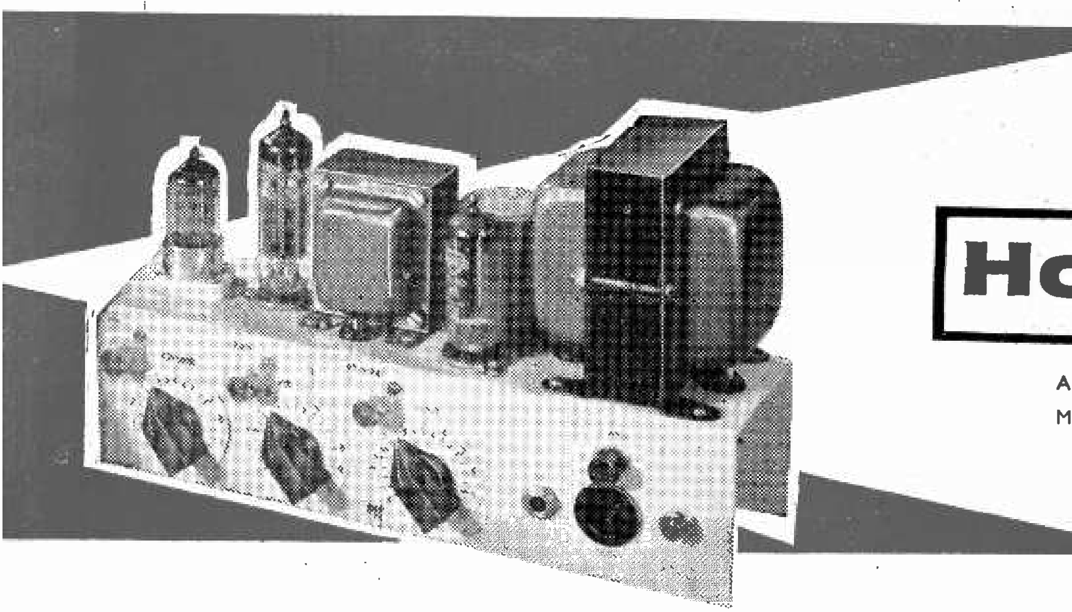
Probably if the transmitter closed down immediately the signal had ceased, a very sensitive set could pick up a weak signal, say after two or three circuits of the earth, but surely next time round it would mix with the outgoing signal on the wavelength.

Come to think of it, perhaps this is the cause of some of our distortion—some of yesterday's signals modulating those of today. Who would like to bet how long it will be before a set is announced which receives old signals?

Modern Music

It is a long time since I mentioned anything about modern music, as I fully realise that the modern generation have much different ideas on this subject than us "old 'uns", but I have become increasingly appalled at the incessant repetitiousness of modern music—not only the melody (if you can call it that), but the words.

In addition to constant repetition of notes or short themes, the words, too, seem to go on and on line after line. Have the writers taken an easy way out, or is this some modern trend? I will not deal with the splitting-up of a single-syllable word into many syllables ("You-who-who-who" etc.)



Ho

A

MI

HAVING become interested in 8mm cine photography last summer I found that there was no commercial amplifier available on the market which provided the facilities that were needed for adding sound commentaries at a reasonable cost.

The amplifier to be described was therefore designed and built primarily for this purpose, but it has many other uses as a compact, good quality audio amplifier and mixer. The main requirements that were needed are as follows:

1. *Good quality output of 3 to 4W suitable for use at home or occasionally in a small hall.*
2. *Microphone input with its own independent volume control.*
3. *Music input (from gram or tape-recorder) with its own independent volume control.*
4. *Ability to "mix" these two inputs as required. This enables a background of music to be fed into the amplifier while at the same time a spoken commentary can be super-imposed.*
5. *A simple but effective tone control to cater for different room conditions.*
6. *The final design had to be sturdy and compact for transporting, have a smart appearance, and be readily accessible for any maintenance that might be required.*

One additional feature was added during the actual building and this provides a bonus item. A tape outlet socket was fitted so that music from records or other source, together with a super-imposed spoken commentary, could be recorded.

Considerable care has been taken in designing the layout of the amplifier and the wiring to give the best results together with a clean, neat, work-

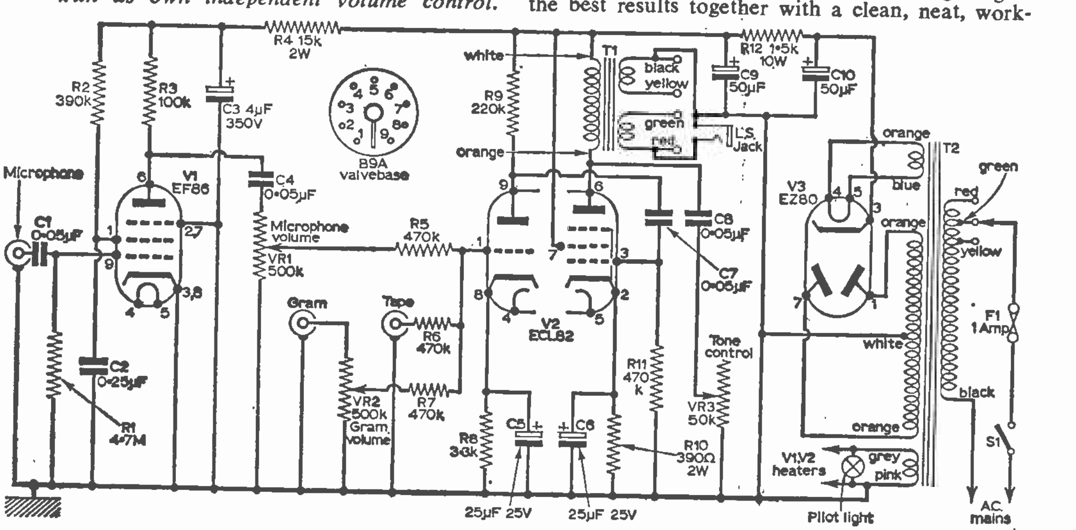


Fig. 1: The circuit.

ne-movie *amplifier*

By S. COLLINS

ιAL PURPOSE 4W AMPLIFIER WITH
AND OTHER SPECIAL FACILITIES

manlike appearance. This has also made for an easy straightforward sequence of assembly and wiring up.

The chassis is constructed from 18s.w.g. aluminium, which was found to be quite rigid enough when formed into the two-sided channel section as shown. The dimensions and drilling details are given in Fig. 6 and these should be closely adhered to.

The next step is to mount the main components on to the chassis, starting with the three valveholders, noting that the special anti-microphonic holder is fitted in position V1 and a solder tag is fitted under the fixing nut nearest to the edge of the chassis. These holders are mounted from above the chassis and careful reference should be made to the wiring diagram to ensure that the gap between pins 1 and 9 on each one corresponds exactly with the drawing.

Next fit the mains transformer, making sure by the coloured wires that it is the correct way round, and at the same time secure a seven-way tag strip under the two inner nuts. Before these fixing nuts and bolts are fully tightened it may be advisable to fit the clip for the 50+50μF electrolytic as the fixing screw for this comes quite close to the lower edge of the transformer. The flying leads from the transformer should be passed through their respective holes in the chassis and, to protect them, a rubber grommet should be slipped over them and fitted into the chassis.

Place the 50+50μF electrolytic capacitor into

COMPONENTS LIST

Resistors:
R1 4·7MΩ ½W 5% high stability
R2 390kΩ ½W 5% high stability
R3 100kΩ ½W 5% high stability
R4 15kΩ 2W 10%
R5 470kΩ ½W 10%
R6 470kΩ ½W 10%
R7 470kΩ ½W 10%
R8 3·3kΩ ½W 10%
R9 220kΩ 1W 10%
R10 390Ω 2W 10%
R11 470kΩ ½W 10%
R12 1.5kΩ 10W 5% wire wound

Capacitors:
C1 0·05μF 500V
C2 0·25μF 500V
C3 4μF 350V electrolytic
C4 0·05μF 500V
C5 25μF 25V electrolytic
C6 25μF 25V electrolytic
C7 0·05μF 500V
C8 0·05μF 350V
C9, C10 } 50μF x 50μF 350V electrolytic

Controls:
VR1 500kΩ log. (microphone volume)
VR2 500kΩ log. (gramophone volume)
VR3 50 kΩ lin. with D.P. switch (tone control)

Miscellaneous:
Three coaxial sockets. One Bulgin D180 signal lampholder. One Bulgin J2 open jack socket. One Belling Lee L575 miniature fuse-holder. One Belling Lee L562 1A mini-fuse. One Bulgin P360 mains plug and socket. Three Eddystone 841 knobs and dials. One 12-way Radiospares group board (std.). One backing plate for above. Two ½in. grommets. Two ⅜in. grommets. One 1⅜in. condenser clip (vertical mtg). One tag strip, 2 insulated, earth, 2 insulated. One tag strip, earth, 3 insulated, earth, 1 insulated. One tag strip, earth, 5 insulated, earth. Twelve 6BA nuts, 10 6BA ¼in. screws, 2 6BA ½in. screws. Twelve 4BA nuts, 11 4BA ¼in. screws, 1 4BA ½in. screw. Two 6BA solder tags. One 6·3V 0·3A mes pilot lamp.

Valves:
V1 EF86 V2 ECL82 V3 EZ80

Chassis:
18 swg aluminium, size 10 x 3 x 2½in.

Valve-holders:
One B9A anti-microphonic
Two B9A plain moulded

Mains Transformer:
Electro Voice No. 104F
H.T. 250-0-250 volts at 65mA
L.T.1 6·3V 1A
L.T.2 6·3V 1A

Output Transformer:
Electro Voice No. 117E
Primary 5000Ω
Secondary 3 and 15Ω

Additional items:
Solder, wire, sleeving, 3-core mains leads, etc.

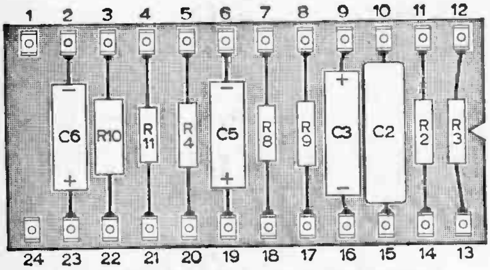


Fig. 2: The front of the group board wiring.

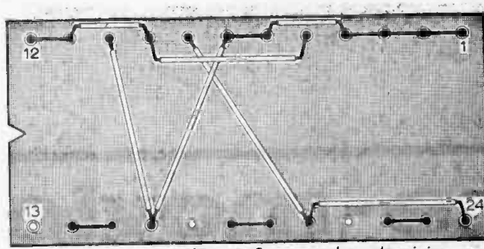
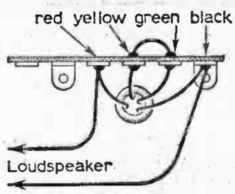


Fig. 3 (above): Rear of group board wiring.



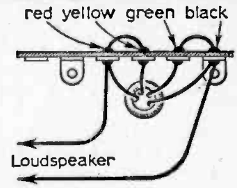


Fig. 4 (left): Loudspeaker/output transformer connections for 15Ω speaker.

Fig. 5 (right): Loudspeaker/output transformer connections for a 3Ω speaker.

the clip and press well down on to the chassis. Before tightening check that the position of the tags corresponds with the diagram and if necessary slightly bend them to give good clearance from the edge of the hole.

The output transformer can now be mounted by means of four 4B.A. nuts and bolts, and here also care should be taken to see that this is the correct way round according to the coloured leads. A six-way tag strip is secured under two of the fixing nuts as shown in the wiring diagram and this will accommodate the transformer secondary connections, allowing an easy adjustment from 3 to 15Ω output impedance.

Turning now to the front panel of the chassis, these components can be fitted. First the three coaxial sockets (not forgetting the 6B.A. solder tag under one nut of the first one which is for the microphone). Next fit the pilot light, fuseholder, output jack socket and the mains input connector as shown in the diagram.

(To be continued)

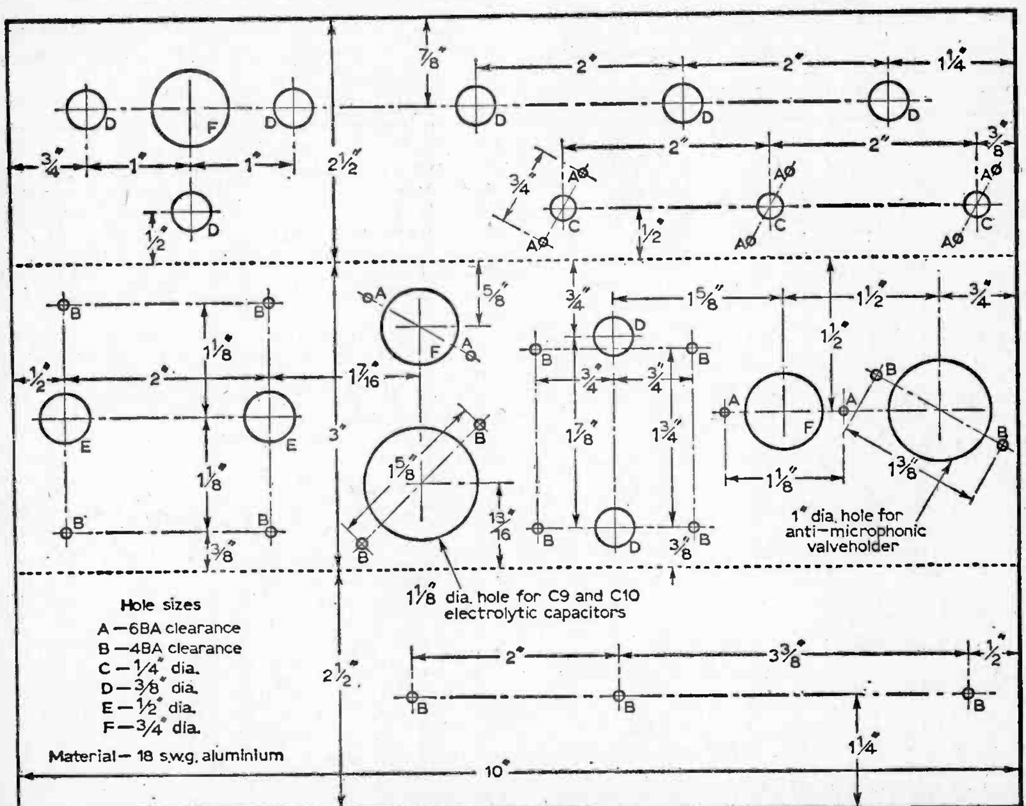
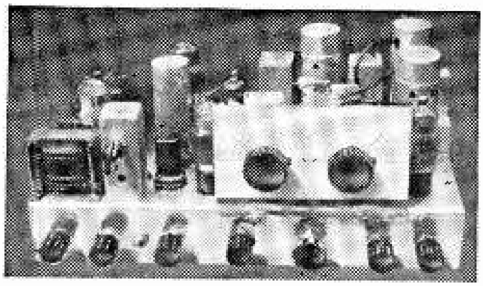


Fig. 6: Chassis drilling details.



(Continued from page 800 of the January issue)

General Purpose COMMUNICATIONS RECEIVER

by R. F. GRAHAM

THE m.w. coil for the r.f. stage is L4, and the aerial trimmer is mounted directly on the front runner. Other components are located as in Fig. 3. The anode lead of V1, from tag 3, passes directly through the screen, to wafer 4.

C1 is connected to a tag near the screen and L4, and a tag is fitted to this bolt above the chassis, and is wired to the rotor contacts adjoining VC1A. C1 is positioned as in Fig. 3, to give a short lead to the smallest coil, L1.

The aerial lead from the coaxial socket SK1 on the chassis is screened, and brought to wafer 1.

Other Wavebands

The other coils may now be added. Four bands are provided:

Band 1, 19-8·5Mc/s, or approx. 16-35m.
Band 2, 9-3·5Mc/s, or approx. 33-85m.
Band 3, 4-1·4Mc/s, or approx. 75-210m.
Band 4, 1·55Mc/s-550kc/s, or approx. 200-550m.

The coils are so positioned as to obtain short wiring for the smaller coils, and particularly for Band I coils. Referring to Fig. 3, the coils are:

	Aerial	Frequency changer	Oscillator
Band 1	L1	L5	L9
Band 2	L2	L6	L10
Band 3	L3	L7	L11
Band 4	L4	L8	L12

If the coils are positioned with their flat sides as in Fig. 3, much of the wiring to one coil will be a duplicate of that to the others. Leads to L1, L5 and L9 must be short and direct. C5 is wired directly to L5, L6 and L7, and is taken to a tag bolted to the chassis. A lead passes from this point to the rotor contact adjoining VC2A.

Short leads pass from the coils, to chassis. If preferred, coils for one band may be inserted at a time, and the receiver may be tested. This will avoid any possible confusion in wiring.

Second I.F. Amplifier

This is V4, and can be wired up complete. A tuning meter can be used with the receiver, or the two sockets provided for this item can be shorted with a length of wire.

The automatic volume control circuit leads are run close to the chassis. The h.t. positive line wires are also kept near the chassis. It is helpful to use sleeving of suitable colours, such as red for the h.t. positive line, and brown or some other colour for the a.v.c. line. Circuits can then be identified more easily.

The IFT's are appropriately wired. Those used had coloured leads, but some have tags or pins. The maker's data will show anode, h.t. a.v.c. and grid connections, which should be followed.

I.F. Filter

This is formed by IFT1 and IFT2, these two transformers being mounted on a small chassis made from aluminium, as in Fig. 1. C11 is of very low capacity, and can be made by twisting together insulated wires, if preferred.

The primary of ITF1 is taken to V2 anode and h.t. line (R7) as shown for an ordinary circuit. The secondary of IFT2 goes to a.v.c. line and V3 between the "grid" tag of IFT1 and the "anode" tag of IFT2. The a.v.c. tag of IFT1 and h.t. tag of IFT2 are joined, and taken to chassis.

C16 is wired from IFT2 to chassis, and R10 is also included in the i.f. filter. A lead from R10 passes through the receiver chassis to the a.v.c. line.

The filter assembly is bolted to the chassis, and holes are required so that the lower cores of the IFT's may be reached by means of a long insulated blade. A plastic knitting needle, suitably shaped, will do for this purpose.

Screening

Adequate screening is required, or the receiver will oscillate when VR1 is adjusted to maximum sensitivity. All valve cap leads are screened, as in Fig. 1. The braiding is taken to the chassis, or other direct earthing point.

When clear glass valves are used, it will be found necessary to fit valve cans round V2, V3 and V4. Valves of many types can be used in the receiver, and they may be of dissimilar size, shape, or may differ in the screening arrangements. The suffix "G" and "GT" indicates glass, and glass-tubular valves, while the omission of this indicates a metal valve. For example, 6K7G valves are of the usual glass shape, while 6K7GT valves are the shorter tubular type. These valves, and a metal type 6K7, are otherwise the same.

Underneath the chassis, anode and grid leads

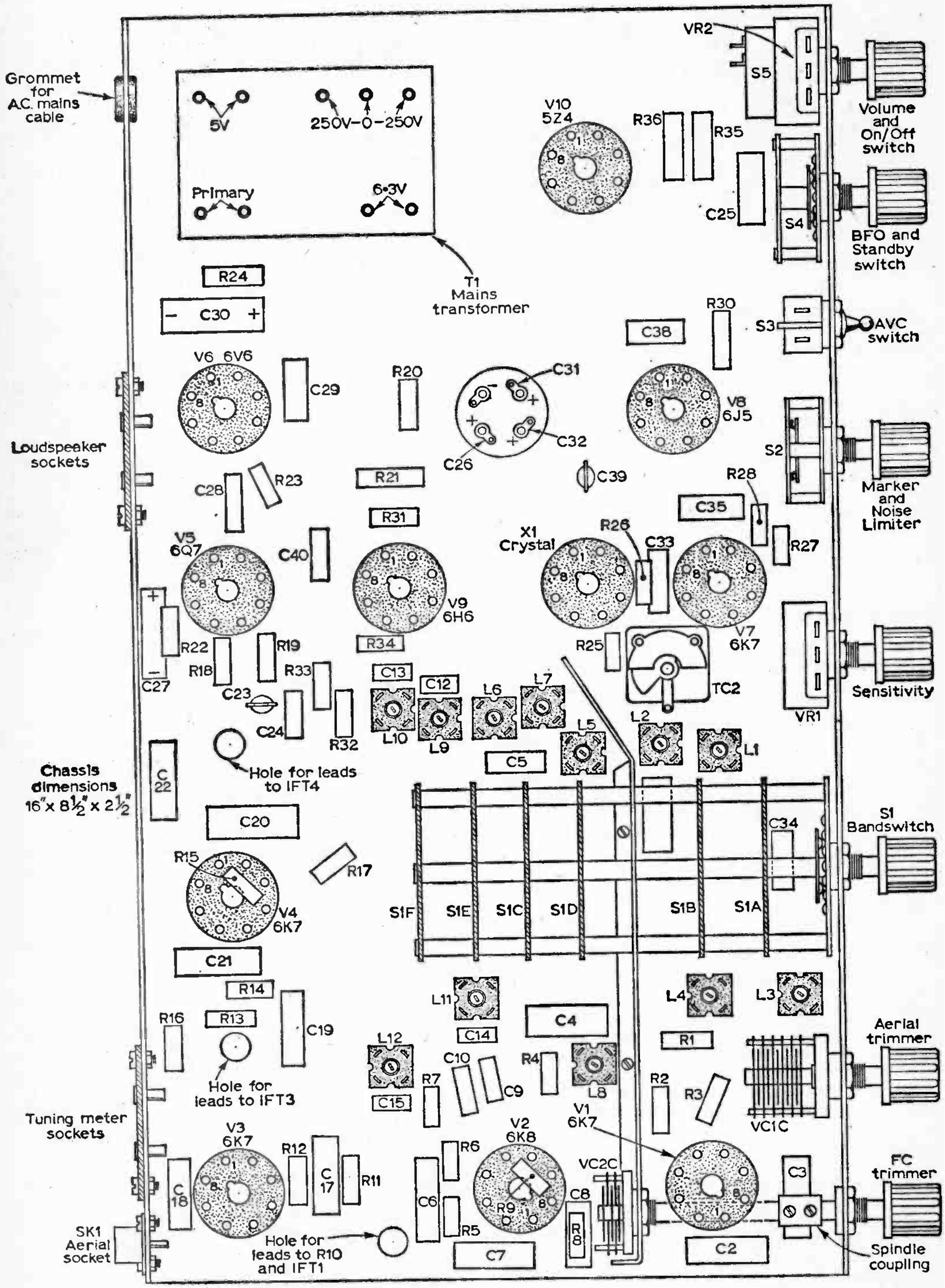
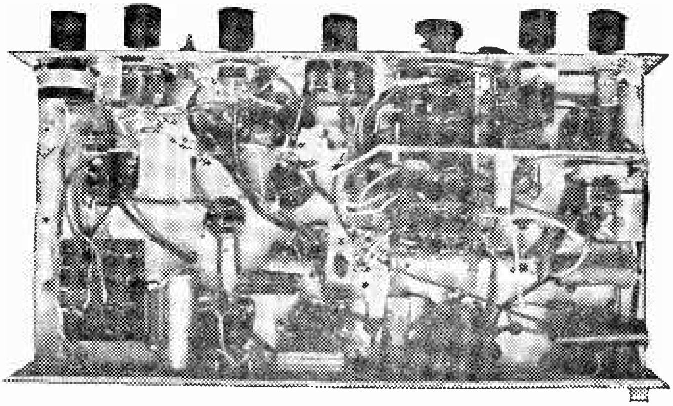


Fig. 3.—The layout of components on the underside of the chassis



An underchassis view of the receiver

should be short and direct, and clear of each other, to avoid back coupling. If oscillation tends to begin when the IFT's are aligned, this shows that screening in these stages is inadequate, or that wiring is too long.

In the audio circuits, the grid lead (cap) of V5 must be screened and also the leads from V9 to the noise limiter switch, and C25. If this screening is omitted, some hum may be heard on signals.

B.F.O.

The beat frequency oscillation is required only for the reception of c.w. morse, and it is built in a screening can, as in Fig. 5. An unused can, as obtained from a fairly large surplus i.f. transformer, is satisfactory. A piece of aluminium forms a bracket, to hold the coil to the variable capacitor VC4, as in Fig. 5. The unit should be tested before fitting it in the screening can, as it is secured by the nut holding the variable capacitor. Leads pass down through the chassis, to V8.

As the IFT's are aligned to 470kc/s, the b.f.o. can best tune from about 467kc/s to 473kc/s, to give an audio beat note of up to 3kc/s (3,000 cycles) with the b.f.o. placed either side of the intermediate frequency.

The b.f.o. coil can be a surplus 470ks/c IFT winding, in which case C36 will generally be present, and a suitable range should be achieved by adjusting the coil core. The variable capacitor VC4 only needs to be of small value, and 15pF should suffice. Exact results depend on the value of C36. Provided the b.f.o can be tuned to produce a good audio note, the exact value of the variable capacitor is not important.

To obtain oscillation, a cathode tap is used, marked B. With some coils, a turn can be prised up, bared, and a thin lead can be soldered to it. If this is impossible, extra turns can be added, wound in the same direction. The tap is then the junction between the existing winding and the new turns, while A is the beginning of the existing winding, and C is the end of the new winding. Only a few turns are required. This, again, depends on the coil, but ten turns should be adequate.

To test the b.f.o, an ordinary broadcast station can be tuned in. The b.f.o. is then switched on, and VC4 and the coil core can be adjusted until an audible beat note is heard.

Any other coil tunable to 470kc/s (about 640m) is also suitable. If the coil does not have an adjustable core, C36 should be a preset trimmer, alternatively the total capacity needed can be made up by means of preset and fixed capacitors in parallel.

The coupling capacitor C39 is of very small value, and can be made from twisted insulated wires. If so, tune in a fairly weak c.w. signal, and adjust the coupling or twist, until a good audio note is obtained. The value is in no way critical.

D.D.T. and Output

Wiring to the double-diode-triode V5, and output stage V6, will be quite straightforward.

As a loudspeaker with suitable output transformer fitted to it was used, no output transformer was included in the receiver. Two sockets, as shown in Fig. 3 allow the loudspeaker to be connected. The receiver should not be switched on with V6 inserted, unless the loudspeaker with transformer is connected. If a loudspeaker without transformer is to be used, the transformer can be incorporated in the receiver, near the mains transformer. In this case, the transformer primary is wired to tags 3 and 4 of V6, and the secondary is taken to the loudspeaker sockets on the rear chassis runner. The transformer ratio for a 2-3Ω loudspeaker is approximately 45:1.

Noise Limiter

This is V9, and the switch shorts pins 3 and 4 when the limiter is not in use. The marker/limiter

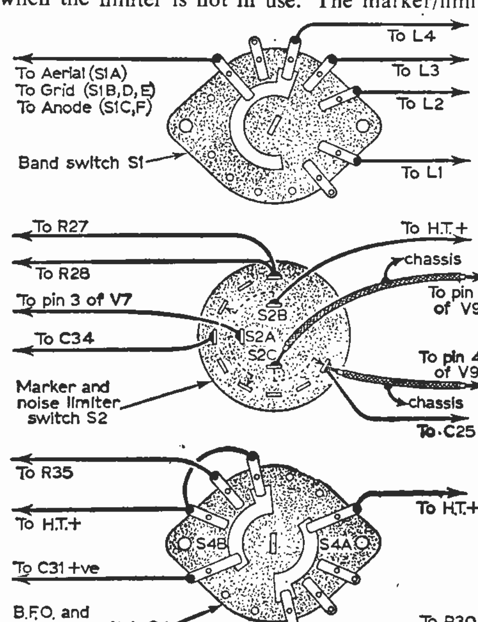


Fig. 4—Details of the switch wiring.

switch is shown in Fig. 4 and one section of the switch is connected as indicated. Leads to the associated resistors should be short and direct, and all wiring here should be clear of the heater circuit. When the limiter is out of action, results should be normal. This setting of the switch is employed for general reception.

Noise of a static nature will often be encountered, especially on some short-wave bands, and the limiter switch may then be turned to the central position. There should then be a considerable reduction in noise level.

Tuning Meter

The tuning meter can be plugged into the sockets provided, which must be shorted when no meter is used. A satisfactory meter of simple type can be arranged by taking the leads to a 1mA instrument, with a shunt which will allow the meter to read full-scale, with VR1 at maximum sensitivity, and no signal tuned in. The shunt can be made from a length of resistance wire, or a preset wire-wound resistor or potentiometer may be employed. The actual type of meter is of no importance, provided its full-scale reading is less than the anode current of V4, so a 5mA instrument is also suitable.

When a signal is tuned in, the meter reading will fall. Correct tuning is therefore that giving the lowest reading. When trimming and aligning, adjustments can be directed towards obtaining the lowest meter reading, as this gives a more accurate indication than can be achieved by ear.

Any modification which changes signal strength will alter the meter reading, so it is easy to compare the results obtained with different aerials, and so on.

A test meter set to its 10mA or a similar range, may be employed as a temporary tuning meter. Readings will depend on the aerial and other factors, but a change in current of some 5mA should be expected, with a strong signal.

A bridge circuit meter can also be used. This is rather more complicated, and by no means essential. A typical circuit is shown in Fig. 6. Here, the meter reads zero, with no signal, and the reading rises in proportion to signal strength.

Crystal Marker

The crystal used was a 100kc/s type, with octal base, to fit an octal valveholder. If crystals with a different pin arrangement are used, the holder should be chosen to suit.

V7 is the marker valve, and Fig. 4 shows the marker switch wiring. TC2 is an air-spaced 100pF trimmer, totally insulated from the chassis. An air trimmer can be held with 6B.A. bolts. A small air-spaced variable capacitor of ordinary type can be mounted on a strip of paxolin, which is in turn held to the chassis by long bolts having extra nuts or spacers. The spindle should be slotted, so that it can be adjusted with an insulated blade.

If the receiver has a long-wave band, obtained by wiring in three l.w. coils, to spare switch contacts, the BBC Light Programme on 200kc/s (1,500m) may be used to check the crystal frequency. If there is no l.w. band, the standard frequency transmissions radiated on 2·5Mc/s (120m) may be used for this purpose. For most easy checking, the signal obtained from the marker should be of somewhat similar strength to the signal of the station used as a frequency standard. It may thus be necessary to disconnect C34, and probably use a short, temporary aerial, if receiving the Light Programme. This depends on the signal strength, and is not critical, except that adjustment is difficult if signals are not of somewhat similar power.

With a 100kc/s crystal, the marker signal will appear at 100kc/s intervals throughout the tuning ranges, growing weaker as higher harmonics are used. To check crystal frequency, tune in the station chosen, and switch the marker on. Any difference between the marker harmonic and station frequency will be heard as a low audio

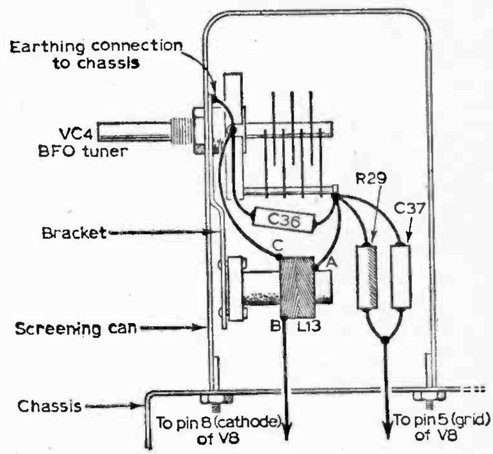
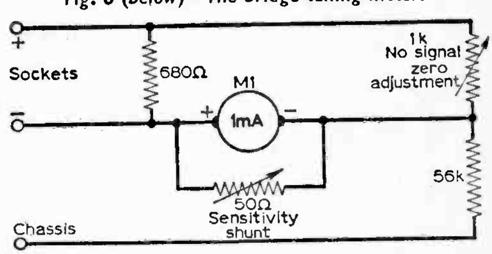


Fig. 5 (above)—The beat frequency oscillator.

Fig. 6 (below)—The bridge tuning meter.



tone, and it may be only a few c/s. TC2 is adjusted to bring the marker crystal to zero beat, or nearly so. No further adjustment is required.

In normal use, the marker provides exact calibration points. For example, the 80m amateur band extends from 3·5Mc/s to 3·8Mc/s and marker harmonics will appear on 3·5, 3·6, 3·7 and 3·8Mc/s. A bandspreading scale will show this, smaller divisions being equally spaced.

The bandsetting scales can be marked at 100kc/s intervals, with bandspread capacitor pointer vertical. To calibrate the scales, remove the aerial. On the s.w. bands, markings at 500kc/s points will suffice. High 100kc/s harmonics become very weak, and closely spaced. A 500kc/s or 1Mc/s crystal avoids this, but is not suitable for lower frequency calibration. If required, 500kc/s check

(Continued on page 950)

THE LINEAR L1/10

A 10-WATT HIGH FIDELITY ULTRA LINEAR AMPLIFIER WITH INTEGRAL PRE-AMP

Full advantage has been taken of latest component miniaturisation developments to produce a 10-watt Hi-Fi push-pull amplifier incorporating tone control pre-amplifier stages within the measurements of 9 x 7 x 5ins.

In addition two high impedance input sockets are provided for microphone and gram., etc. With selector switch and vol. control, five B.V.A. valves are employed ECC83, ECC83, EL84, EL84, EZ81, H.T. and L.T. power supply point is included for a radio tuner.

FREQUENCY RESPONSE
± 1 d.b., 30-20,000 c.p.s.

MAXIMUM POWER OUTPUT
in excess of 14 watts.

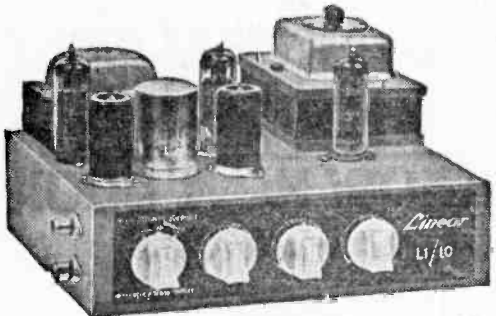
SENSITIVITY
L.P. 220 m.v. for 10 watts. 78 r.p.m. 220 m.v. for 10 watts. Radio/Microphone 40 m.v. for 10 watts.

TREBLE LIFT CONTROL
+ 10 d.b. to —22 d.b. at 12,000 c.p.s.

BASS CONTROL
+ 14 d.b. to —10 d.b. at 50 c.p.s.

HUM LEVEL
Referred to maximum output and including integral pre-amp.—70 d.b.

NEGATIVE FEEDBACK
21 d.b. in main loop.



HARMONIC DISTORTION Less than 0.1% measured at 8 watts at 1000 c.p.s. Weight 10 lbs. Power consumption 90 watts. For 200-230-250 v. 50 c.p.s. A.C. mains. Outputs for 3-and 15-ohm speakers. Chassis finish stoved Gold hammer.

HIGHEST QUALITY Retail Price
MAXIMUM RELIABILITY AT A PRICE YOU CAN AFFORD **13 GNS.**

Send S.A.E. for descriptive literature

Also Available—THE L.45.A compact High Quality 4-5 watt amplifier. Size approx. 7-5-5½in. high. Sensitivity is 28 millivolts so that the input socket can be used for either microphone or gram., tape, radio tuner etc. B.V.A. valves used are ECC83 EL84, EZ80. Controls are: Vol. Treble and Bass with mains switch. The Tone controls provide full compensation for long playing records. Output matching for 3 ohm loudspeaker. Retail price £5.19.6.

THE LT45 TAPE DECK AMPLIFIER. A complete unit (power pack and oscillator incorporated) ready for connection to A.C. mains. 3 ohm loudspeaker and practically any make of deck. Negative feedback equalisation adjustment by multi-position switch for 1⅞, 3¾ and 7½in. per second. Retail price 12 gns.

DIATONIC 10-14 WATT. High Fidelity amplifier with integral pre-amplifier. Retail 12 gns.

CONCHORD 30 WATT. Hi-Fi amplifier with two separately controlled inputs. Retail 16 gns.

L50 50 WATT AMPLIFIER. Size approximately 14 x 10 x 8in. Sensitivity 25 mV. Output for 3 and 15 Ω speakers. Retail price 22 gns.

L5/5 STEREO AMPLIFIER 5 x 5 watt 12 gns.

TRADE ENQUIRIES to

LINEAR PRODUCTS LTD. ELECTRON WORKS, ARMLEY LEEDS

R.C.S. CRYSTAL RECEIVER 8/6 P. & P. 1/6.
Covering medium wave band. Ideal for the beginner! All components including case (suitable headphones 9/6). Easily converted to 1-transistor or 2-stage transistor receiver.

SAME HIGH QUALITY NEW LOW PRICES
BACKED BY FULL AFTER SALES SERVICE

R.C.S. TAPE TUNER 25/- P. & P. 1/6.
Record your favourite programmes. Variable Medium wave tuning. Triple wound Super Hi-Q coil. Chassis and components colour coded. Easily constructed. Size 3 x 1½ x 1in. All parts, instructions and layout plans.

THE PERSONAL SET
For Private Listening

An amazing little set, with built-in ferrite rod aerial bringing in medium wave at wonderful volume. Sturdy case. Size only 1½ x 3 x 4ins. Fits into the palm of the hand. Drilled chassis colour coded for easy assembly.

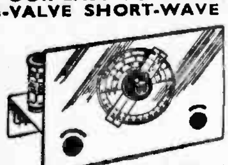
Total Building Costs (including earpiece) **32/6** P. & P. 1/-.

AMAZING RESULTS from OUR LATEST 5-STAGE TRANSISTOR RECEIVER
A highly sensitive receiver using top grade transistors and components. Fully tunable over medium wave.
★ Can be built in 1 hour.
★ High flux moving coil speaker.
★ Built-in ferrite rod aerial.
★ Specially designed coils for maximum signal strength
★ Volume on/off control.
★ Eyeletted circuit board.
★ Easy to follow building plans.

Total Building Cost **59/6** P. & P. 2/6.

All parts available separately.
Send S.A.E. for **FREE** Layout plans and parts lists on any of these sets.

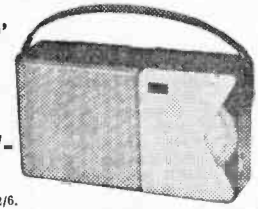
LISTEN TO THE WORLD on "TELSTAR"
OUR EASY TO CONSTRUCT 1-VALVE SHORT-WAVE RADIO



Total Building Costs **35/-** P. & P. 2/-.

★ Receives speech and music from all over the world.
Construction price includes valve and one coil covering 40-100 metres.
Can be extended to cover 10-100 metres.
Can be converted to 2 or 3 valve. And all mains loudspeaker operation.

The 'REVILO'
5-STAGE POCKET TRANSISTOR PORTABLE

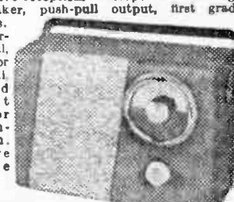


Total Building Costs **90/-** (Including earpiece) P. & P. 2/6.

In attractive two-tone contemporary case, with gold plated speaker grille and attractive dial. Size only 5½ x 3¼ x 1¾ins. No aerial or earth required—completely self contained. Genuine 3in. high flux PM speaker. Socket for personal listening. First grade transistors. Push-pull output—250 milliwatts. Volume control with on/off switch. Condenser tuning. Easy assembly on eyeletted circuit board.

The "BOBETTE"
5-STAGE SUPER SENSITIVE TRANSISTOR PORTABLE

Simple to Build. All First Grade Components. A truly portable transistor radio giving full medium wave reception. Incorporates 5in. High Flux Speaker, push-pull output, first grade transistors. High-Q ferrite aerial, socket for car aerial, pre-tagged circuit board for easy construction. Attractive two-tone case.



Total Building Costs **95/-** P. & P. 2/6

R.C.S. PRODUCTS (RADIO) LTD. 11 OLIVER RD., LONDON, E17 (Mail Order Only)

by C.M. and E.C.D.

semiconductors

TALKING POINTS ON CIRCUIT PRACTICE

No. 1—D.C. Stabilisation of Transistors

ONE hears a good deal from time to time about the troubles experienced by people experimenting with transistors.

There is no lack of information about the technical aspects, for those whose maths are up to it. But one aspect appears to have been neglected; that is: the precise know-how of how to handle them in practice.

This is not altogether a simple matter. Transistors pose problems which are not quite the same as valves. It can be even less simple if the theory of their operation is incompletely apprehended and, indeed, most of the literature on this subject pre-supposes a technical knowledge at least up to H.N.C. standard.

In consequence, one hears complaints about transistors "ruined in soldering them"; or already defective when bought; of circuits which don't work, or which "run hot".

These problems are not limited to amateurs. As an example we know of at least one commercial firm manufacturing transistorised apparatus which complained that 50% of its diodes were defective when supplied—there was, of course, nothing wrong with the diodes but there was a great deal wrong with the firm's "experts", trained, no doubt, on valve circuitry, who hadn't a clue when it came to transistors and whose own methods of testing them were in fact causing the damage.

Really there is nothing mystifying about transistors once you get used to handling them. But you do have to know your way around and it is probably true that the "way around" is only now beginning really to be understood even by the people making them.

SOLDERING METHODS

For instance, this question of soldering. Transistors will stand up to the iron, properly applied. What they will *not* stand is too *much* heat applied for too long a time. They should be "spotted" on; a quick, clean joint made first time and finished with. (Tin the terminal and sweat the transistor lead to it quickly and cleanly.)

Transistors are made with long leads—leave them long. Sleeve the leads so they won't short to the rim of the capsule. If the joint is made quickly and the iron removed before it has time to damage the transistor there will be no trouble.

Hold the transistor lead close to the iron with a pair of long nosed pliers during the operation, the pliers will draw off the heat and stop it running up the lead to the transistor. But speed is the essence of the job.

In fact far fewer transistors are ruined in soldering than is generally supposed.

But they won't stand up to being put in, taken out again, put in again, on that score however—what will? With all electronic soldering the secret is "once only", and finish!

Diodes are often soldered with a spring in them again a precaution against heat. That is, a loop is made in the lead and this loop is held in the nose of the pliers while soldering.

A final point, transistors can be spoiled by light. too . . . if the capsule is glass it will be painted

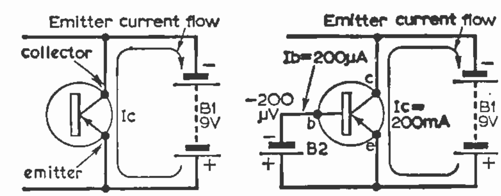


Fig. 1 (left): Here the main flow of current is from positive to negative.

Fig. 2 (right): Here there are two currents flowing

to exclude light. Don't scratch the paint. If the capsule is metal that problem does not arise.

In order to handle transistors properly it is essential to understand how they work.

The transistor is basically a development of the old cat's whisker crystal except that hertzite or galenium crystals would not amplify, whereas the transistor does. Its properties are those of a solid

The basis of the thermionic valve is that current passing through it from anode to cathode can be made a function of the grid, that is, it can be controlled in amplitude by conditions on the grid In the transistor, current passing through it in one direction can be made a function of current passed through it in another—can be controlled in amplitude by varying the conditions of the second current.

But here the analogy between valve and transistor ends. The valve is a voltage device, controlled and operated by volts. The transistor is a current device, controlled and operated by current. One finds that it is here that people seem to meet with the greatest difficulty in understanding how a transistor functions. It must be admitted that the majority of technical literature is not very easy to understand on this issue.

BIAS ARRANGEMENTS

A transistor must be biased just as a valve is. But not by volts. A transistor is biased by the amount of *current* put *through* it. An understanding of this process is an absolute necessity if you are going to do anything with transistors at all. Most of the phenomena which cause so much trouble to the inexperienced spring from this factor; most of the peculiarities of the transistor are rooted in it, so are the difficulties that probably arise when trying to find out what is wrong with a piece of transistorised apparatus which refuses to work properly.

Consider Fig. 1. There is a collector, an emitter and a base. For the nonce these may be regarded as analogous to the anode, the cathode and the grid of a valve provided it is always remembered that in transistors the anode (or collector) is *negative;* that its voltage is likely to be of the order of only some 4·5 instead of the two or three hundred you would find on the anode of a valve and that, whereas varying the voltage on the anode of a valve would have a considerable effect upon the amount of current which would flow in the anode-cathode circuit, in the case of the transistor, once you have exceeded the minimum rated voltage—somewhere around half a volt perhaps—it does not matter how many volts you put on the collector up to the rated maximum, the current flow in the collector-emitter circuit will be substantially the same whatever the collector volts.

In Fig. 1 the main flow of current in the battery circuit will be through the emitter, into the transistor, out of the collector and back to the battery . . . from positive to negative, that is, using the normal terminology. This current will be of an order of milliamperes or even amperes.

It has already been said that this current does not depend upon the voltage on the collector. On what, therefore, does it depend? Returning to the valve analogy again for a moment, it depends upon conditions on the *base*, which functions here as the control grid of a valve.

How does it control? In the valve the control grid would be a few volts negative or positive to the emitter (cathode), thereby causing the collector-emitter (anode-cathode) current to be greater or less as the case might be. Not so with the transistor!

BASE CURRENT

Consider next Fig. 2. Here is included a second battery, B2, sensed so as to make the base, while remaining positive in relation to the collector, slightly negative in relation to the emitter. Current will now flow through the transistor through a second path—namely, from emitter (positive) through the transistor and out of the base (negative). There are now *two* currents flowing through the transistor simultaneously. Rather as there would be in a valve if grid current was allowed to flow.

It is this second current which biases the transistor.

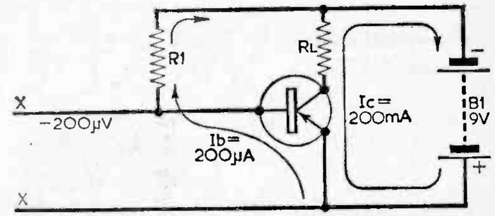


Fig. 3: The battery, B2, of Fig. 2 is replaced here by a resistor.

The value of the current which will flow in the collector-emitter circuit is a function of the value of current flowing in the base-emitter circuit. Varying the current in the base-emitter circuit will cause proportionate but greatly amplified changes in the collector-emitter circuit.

This may still appear to be voltage biasing . . . since there needs to be volts on the base to obtain it, obviously. Avoid thinking that way . . . it is the *current* through the base which operates the transistor; with no current there would be no bias.

So far the picture presents no particular difficulty. In order to obtain the standing quiescent d.c. current in milliamperes or amperes required in the collector circuit then all that needs to be done is to pass a definite value of current through the transistor via the base-emitter circuit. Having stabilised the d.c. or quiescent conditions by selecting the correct base-emitter current to give the quiescent collector current wanted, if now an a.c. signal is fed in between emitter and base the r.m.s. variations on the base will vary the base potential, thus vary the base current, which will in turn vary the collector-emitter circuit current. Owing to the resistance of the transistor in the collector-emitter sense being greatly more than its resistance in the base-emitter sense the variations in the output will be greater, that is amplified, than those in the input. As the base-emitter current/collector-emitter current transfer characteristic is substantially a straight line over the operating part of the curve the amplification will be substantially linear.

From here the picture complicates somewhat. To begin with, while the current in the collector-circuit will be of the milliampere order, the current required in the base-emitter circuit to procure it is only of the order of microamperes. In order to obtain a current of microamperes, obviously the voltage required on the base to produce it will be microvolts.

This presents one of the difficulties experienced by the trial-and-error experimenters. To obtain a bias of, say, 200 microvolts on the base (in relation to the emitter, which in the diagrams is shown taken direct to earth, which is positive) is not quite the same thing as getting, say, 3V on the grid of a valve!

A further difficulty arises in that this voltage *is* critical. If the base is a couple of hundred microvolts more negative than it should be the current in the collector circuit rises above the safe limits and the transistor may be ruined; 200 microvolts less than it should be and no current flows at all —the transistor is "cut off". There are other phenomena, too, which we will leave for the moment. First let us go ahead and see how we *get* that microvolt bias on the base.

In Fig. 3 the battery B2 is replaced by a

PCR COMMUNICATION RECEIVERS

Manufactured by Pye and Philips. One of the Army's most versatile and sensitive sets. RF stage and 2 of I.F., using 6 British I.O. type valves. Large 180 degrees illuminating and calibrated Dial. Flywheel Tuning with locking device. Aerial Trimmer. Tone and Vol. Controls. Band Switch from panel jacks for speaker or phones. In black metal case, size 17in. L x 8in. H x 10in. D. Model PCR covers 6-18 Mc/s. 200-550 metres and 850-2,000 metres and has internal 5-in. speaker. £6.19.6. Model PCR2 has similar L & M waveband coverage. Short wave 6-22 Mc/s, but no speaker. £5.19.6. Model PCR3, as PCR2 but has 2 short wave bands 2-7 and 7-23 Mc/s, and medium wave band 190-550 metres. ONLY 8 Gns. Add 10/6 carr. all models. Designed to operate from bulky EXTERNAL power supply, but any set can be fitted with BRAND NEW COMPONENTS INTERNAL PACK for 200-250 v. A.C. at extra cost of £2.

All receivers used but excellent condition and aerial tested before despatch.

S.A.E. FOR ILLUSTRATED LEAFLET

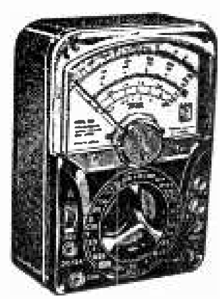
TEST METERS FOR EVERY PURPOSE & POCKET

2,000 O.P.V. MODEL TP-10. Reads A.C. & D.C. Volts up to 1,000; D.C. Current to 500mA; Resistance to 1 Meg; Capacitance to 1μF; Decibels from—20 to ±36; Output jack for Audio Measurements. Size 3½in. x 5in. x 1⅛in.

£3.19.6.

20,000 O.P.V. MODEL TP-5S, Reads voltage up to 1,000 D.C. at 20,000 ohms per volt and A.C. at 10,000 o.p.v.: D.C. Current to 500mA; Resistance to 10 Megs.; Capacitance to 0.1μF; Decibels from —20 to ±36. Size 3½in. x 5¼in. x 1⅛in.

£5.19.6.



30,000 O.P.V. MODEL 500. Volts to 1,000; D.C. at 30,000 O.P.V. A.C. at 20,000; 12 Amps D.C. Current; 60 Megs Resistance; —20 to ±56 Dbs; Internal buzzer short circuit warning Size 3⅝in. x 6⅜in. x 2⅛in.

£8.19.6.

All New Stock, with leads, prods. and internal batteries. 6 months' guarantee backed by full service facilities. Details S.A.E.

FOR CALLERS ONLY

10 VALVE CANADIAN RECEIVER No. 52. Covers 1.75-16 Mc/s (19-170 metres) in 3 bands. Built-in 3-valve Crystal calibrator, and internal speaker. Circuit and instructions supplied. Store soiled and untested, and accordingly will only be sold to callers. ONLY 50/-.

HRO SENIOR TABLE MODEL RECEIVERS. Complete with 9 coil sets covering 50 Kc/s to 30 Mc/s. Used, very good condition, aerial tested. ONLY £17.10.0 (carriage, etc., 30/-). A few late Model 5T with I.O. valves, £22.10.0., plus carriage.

COMBINED VIBRATOR/MAINS UNIT. The Power Pack of the Army R.107 Receiver. Has vibrator for 12 v. D.C. operation, and mains transformer for 100/250 volts A.C. Output 12.6 volts 3 A. L.T. and 250 v. at 100 mA H.T. Complete with vibrator, 6X5G rectifier, and connecting data. Ideal for driving T.C.S. or Type 52 Receivers, etc., or mobile equipment. BRAND NEW IN MAKERS' CARTONS ONLY 45/- (Carr. 5/6).

R107 RECEIVER R.F. UNIT. Brand new tuning sections of the famous R107 receiver. A 3-stage unit, complete with 4 gang condensers and dial. Calibrated 1.2 to 17.5 Mc/s in 3 bands, coil pack and wave-change switch, aerial trimmer. Less valves. Ideal front end for constructing a superhet receiver. Complete R107 circuit supplied. BRAND NEW IN MAKER'S CARTONS, ONLY 35/-. Carr 5/-.

AVOMETER MODEL 7 Reconditioned and in perfect order with leads, internal batteries, and instructions. ONLY £11, (reg. post 5/-).

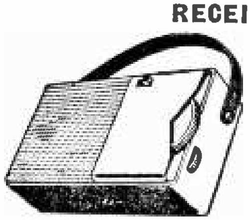
AVOMETER MODEL 7 LEATHER CASES, fitted with carrying handle & long strap. BRAND NEW. ONLY 32/6 (Post 2/6).

20/- CONSTRUCTOR'S PARCEL. Assorted colours wiring wire, solder, resistors, condensers, volume controls, tag panel. ALL NEW. (Post 2/6).

RESISTORS, 100 assorted values our choice. NEW 10/-.

CONDENSERS. 100 assorted mica & silvermica. NEW 12/6.

"P.W." 6 TRANSISTOR PERSONAL RECEIVER



Designed by the technical staff of *Practical Wireless:* easy to build, using printed circuit and 1st Grade Matched Transistors and Diode. Full Medium and Long Wave coverage to internal speakers. All parts sold separately (new components only) enabling you to buy as required and full detailed price list will be sent on request. Constructional details 1/6.

Newly designed OSMOR Cabinet and reduced price. TOTAL COST INCLUDING BATTERY and CABINET NOW £7.19.6.

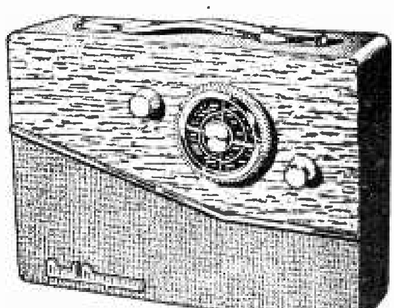
"P.W. TROUBADOUR 7" Parts List, S.A.E.

THE "GOOD COMPANION" Mk. II

USING TRANSFILTERS, THE LATEST MANUFACTURING TECHNIQUE TO SAVE ALIGNMENT DIFFICULTY

THE FINEST COMBINED PORTABLE and CAR RADIO YET DESIGNED FOR THE HOME CONSTRUCTOR

- 750 mW output.
- 6 transistors and diode.
- Full Medium and Long Wave coverage.
- Quality speaker.
- Brilliantly styled 2-tone cabinet, size 11 x 8 x 3in.
- Very fine tuning with calibrated dial.



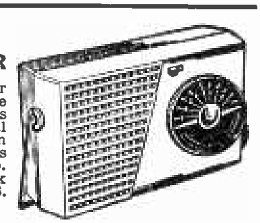
- Latest printed circuit. ● Internal high gain aerial with car aerial socket. Easy to follow construction data (available separately 3/6). All parts sold separately and full illustrated details will be sent on request.

Total Cost **£9.19.6.**

With alternative luxury cabinet using 7 x 4in. speaker, £10.19.6. Either type, plus 5/- post and ins. (Battery 3/6 extra).

"POCKET 4" TRANSISTOR RECEIVER

Uses miniature speaker, proper tuning condenser, and volume control. Built-in aerial makes unit efficient and portable. Ideal for the beginner. Full medium wave coverage. All components and case for only 42/6 (p. & p. 2/6). Ten-page constructional book free with parts or separately 1/6. S.A.E. for parts price list.



HARRIS ELECTRONICS (LONDON) LTD

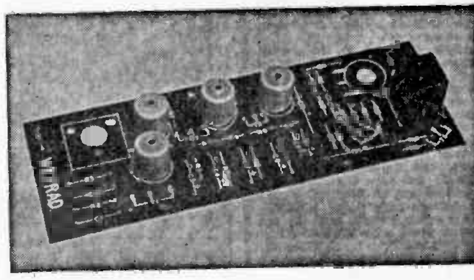
138 Grays Inn Road, London W.C.1

Phone TERminus 7937

Please include carriage costs on all items. (Open until 1 p.m. Saturdays). We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by Bus from King's Cross.

WEYRAD

6-TRANSISTOR 2-WAVE SUPERHET RECEIVER
MODIFICATIONS NOW AVAILABLE FOR 500mW OUTPUT



ROD AERIAL—RA2W
6 in long, ⅜ in. diameter, connections to tags on Coils. For 208pF tuning capacity. Complete with Car Aerial Coil 12/6

OSCILLATOR COIL—P50/1AC
M.W. covered with 176pF tuning capacity, L.W. by extra padder 5/4

I.F. TRANSFORMERS
1st and 2nd Stage—P50/2CC ... ... 5/7 (2 required)

3rd Stage—P50/3CC 6/-

DRIVER TRANSFORMER—LFDT4 ... ... 9/6

OUTPUT TRANSFORMER—OPT1 ... ... 10/6

PRINTED CIRCUIT—PCA1 ... ... 9/6

In response to many requests we have redesigned the output stages to give 500mW and to enable a standard 3 ohm Speaker to be used. Full details of the simple changes are given on a separate leaflet available on receipt of stamp.

CONSTRUCTORS BOOKLET WITH FULL DETAILS 2/-

TRANSISTOR A.F. AMPLIFIER TYPE A.F.1—LOW IMPEDANCE INPUT, 3-TRANSISTOR, 500mW OUTPUT, FULLY ASSEMBLED WITH VOLUME CONTROL 63/6

WEYMOUTH RADIO MANUFACTURING CO., LTD.
REGENT FACTORY, SCHOOL STREET,
WEYMOUTH, DORSET

FREE TO AMBITIOUS ENGINEERS
— THE LATEST EDITION OF ENGINEERING OPPORTUNITIES

Have you sent for your copy?

ENGINEERING OPPORTUNITIES is a highly informative 156-page guide to the best paid engineering posts. It tells you how you can quickly prepare at home for a recognised engineering qualification and outlines a wonderful range of modern Home Study Courses in all branches of Engineering. This unique book also gives full details of the Practical Radio & Electronics Courses, administered by our Specialist Electronics Training Division—the *B.I.E.T. School of Electronics*, explains the benefits of our Employment Dept. and shows you how to qualify for five years promotion in one year.

We definitely Guarantee
"NO PASS—NO FEE"

Whatever your age or experience, you cannot afford to miss reading this famous book. If you are earning less than £25 a week, send for your copy of "ENGINEERING OPPORTUNITIES" today—FREE.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY *(Incorporating E.M.I. Institutes)*
(Dept. SE/21), 29 Wright's Lane, London, W.8

WHICH IS YOUR PET SUBJECT?

Mechanical Eng., Electrical Eng., Civil Engineering, Radio Engineering, Automobile Eng., Aeronautical Eng., Production Eng., Building, Plastics, Draughtsmanship, Television, etc.

GET SOME LETTERS AFTER YOUR NAME!

A.M.I.Mech.E.
A.M.I.C.E.
A.M.I.Prod.E.
A.M.I.M.I.
A.I.O.B.
A.F.R.Ae.S.
B.Sc.
A.M.Brit.I.R.E.
City & Guilds
Gen. Cert. of Education
Etc., etc.

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, Etc., A.M.Brit.I.R.E. City & Guilds
Radio Amateurs' Exam.
R.T.E.B. Certificate
P.M.G. Certificate
Practical Radio
Radio & Television Servicing
Practical Electronics
Electronics Engineering
Automation

INCLUDING TOOLS!

The specialist Electronics Division of B.I.E.T. (incorporating E.M.I. Institutes) NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T. SCHOOL OF ELECTRONICS

POST COUPON NOW!

Please send me your FREE 156-page "ENGINEERING OPPORTUNITIES"
(Write if you prefer not to cut page)

NAME ____________________

ADDRESS ____________________

____

____

SUBJECT OR EXAM THAT INTERESTS ME ____________________ SE/21

THE B.I.E.T. IS THE LEADING ORGANISATION OF ITS KIND IN THE WORLD

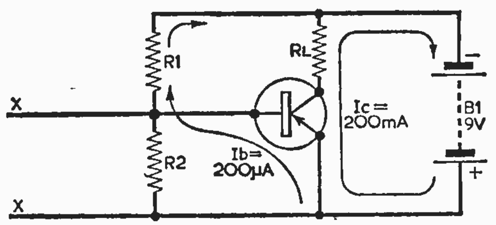


Fig. 4: Here R1 is extended, thus making a potential divider.

resistor (R1) from the negative line of the supply. Now, on the assumption that we want a current of 200μA through the base-emitter path and we have a voltage of −9V on the supply line (with the emitter at 0V positive), and the published data for the transistor in question tells us that in order to get a base current of 200μA we need a negative potential on the base of, say, 200μV, it is a simple matter to calculate what value of resistor, R1, will be needed to drop −9V to −200μV. That is, to drop the whole nine volts except the odd 200μV.

Provided the resistor is accurate—and it will have to *be* accurate within 1%—the correct conditions will be obtained. Also provided the resistor is *high stability* and does not vary under load the conditions will remain stabilised. The correct d.c. base current will flow to produce the correct required collector current—somewhere in the centre of the output curve probably. If we feed an r.m.s. signal in at the points X—X across base and emitter it will swing the base current and an amplified and linear copy of it will result in the collector circuit. Provided, of course, that it does not swing the base so far negative as to cause the collector current to exceed its maximum or too far positive so as to stop collector current flowing altogether — "clipping" and "bottoming", which will be dealt with later.

DOWN TO MICROVOLTS

For the sake of the experts who may be reading this we will not complicate matters by considering "leakage currents" at this stage.

Sufficient should have been said to make this matter of current bias clear to those who may not completely have understood it and also to point what is one of the first hurdles to the man who wants to experiment with transistors . . . that we are dealing with *micro*volts on the base, not volts, and they *must* be precise! It is not very easy to obtain microvolts within fine limits by a process of trial and error. With transistors, therefore, the thing is to make precise calculations first, then make sure that all one's components, especially resistors, are accurate and will remain so under operating conditions. If calculations are correct there is no reason why apparatus should not work for the first time of asking—which will be a great deal easier than trying to find out why it *doesn't* work, as may be the case if trial-and-error methods are used.

The values given here are, of course, only approximations, nor do they include leakage currents, but all the essential information is in the published data for any actual transistor, although there are many circuits in which the bias is obtained in the manner just explained; this method is wholly unsatisfactory in practice! If anything goes the slightest degree wrong there will be more transistors burned out—without the aid of the soldering iron.

Which leads to a consideration of certain peculiarities of transistors. These are: impedances, temperature effects, transistor spreads . . . the whole question of d.c. stabilisation.

IMPEDANCE EFFECTS

Consider again the circuit in Fig. 3. The value of volts dropped by the biasing resistor R1 must depend upon the amount of current through the base, which will be the sum of the leakage current for that particular transistor and the actual current at the bias volts. The leakage current can be taken as the current which would flow if the collector were open circuited, but at this stage that may be ignored. The amount of current flowing through the base will depend upon the resistance or impedance of the base-emitter internal path through the transistor.

Now a transistor is not resistive—that is, it does not obey Ohm's law. Therefore this impedance is not stable. In fact it varies with frequency (considering d.c., we are at zero frequency, of course), it varies in sympathy with the output impedance, which is also not stable. It varies under load. Also it varies from transistor to transistor due to production spreads, which can be considerable, hard though the manufacturer tries to keep them within close limits.

This means that the input impedance is going to vary during operation and is unlikely to be identical between different transistors. Therefore the base biasing potentials are going to vary during operation and, if a transistor has to be changed, the conditions set up for one may be miles out for the new one. One cannot afford to be miles out with transistors.

A reasonably stable bias is needed on the base, one which will not vary greatly from transistor to transistor and one which is as little dependent upon the varying impedance of the base itself under load as possible. This cannot be obtained by using the series resistance shown. Every variation in base impedance, and therefore in current, is going to cause considerable variation in the voltage dropped across the resistor, which must be large in order to drop the necessary volts at a current of only microamps.

There are a number of recommended ways of obtaining a reasonably stable condition on the base each with its own particular merits or demerits for certain applications . . . but we are going to confine ourselves to the preferred method.

The resistor R1 is extended by means of a second leg, R2, to earth (emitter), thus making it into a potential divider (see Fig. 4). Consider this condition: if the impedance of the divider is made sufficiently low it will swamp the impedance of the transistor under drive and the voltage at the base tapping will remain reasonably constant regardless of the current taken by the base or, more properly, regardless of variations in it, which will be small in comparison to the current taken through the divider as a whole.

That is, the potential at the tapping point can be made more dependent upon the total current through the divider than it is upon the amount drawn by the base. Changes in transistors will also have much less effect. Thus there is a reasonable degree of d.c. stabilisation of conditions on the base!

TEMPERATURE EFFECTS

A transistor is not stable against *heat*. Transistors are rated at a temperature of round about 45°C.

There are two ways in which temperature can be considered. One is the room temperature, or ambient temperature, which will determine the lowest temperature these components can operate at. But in actual operation they will heat up according to the value of the current passing through them. Unless steps are taken to limit the rise in temperature within the safety value there will be more destroyed transistors.

Consider what may happen in the circuit of Fig. 3 with the series base resistor and the emitter down to earth. If the transistor is allowed to take too much current, perhaps by fault conditions on the base or because calculations were wrong in the first place, it will heat up. The hotter it gets the more current it takes . . . until by a process analogous to internal combustion and termed "thermal runaway" it exceeds the safety value and destroys itself.

This will not be prevented by using mica washers, heat sinks and so on, which merely increase the amount of current the transistor can take without getting too hot.

Consider, however, the circuit of Fig. 5, in which there is now an emitter resistor, Re. Under normal operating conditions the volts dropped across this resistor by the emitter current will be, say, 1V at quiescent current value.

The base bias will have been calculated so that the base potential is some 1·2V to earth—that is, 200μV to emitter as before.

Now in the event of a rise in quiescent collector current through any cause—temperature or otherwise—the volts dropped by the emitter resistor will also increase; the voltage at the base tap on the potential divider remaining substantially unaffected. Thus the emitter moves more negative to base, which is the same as saying the base

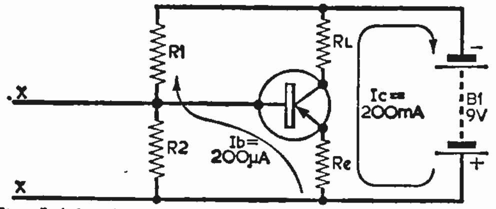
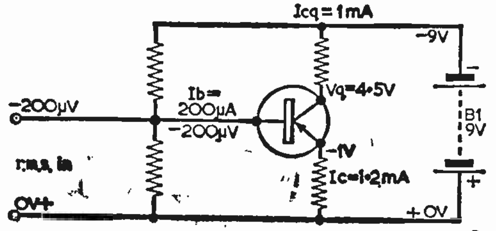


Fig. 5 (above): An emitter resistor, Re, is included in this circuit.

Fig. 6 (below): This circuit should remain stable under most conditions.



moves positively to the emitter, so tending to reduce the current in the collector circuit to its original value and thus prevent thermal runaway. Remembering, of course, that moving the base negatively *increases* collector current, whereas moving it positively *decreases* it. (If the base becomes positive to the emitter then the collector current will cease entirely, the transistor enters cut-off condition and the flow of base current reverses and now flows *in* to the base and *out* of the emitter. This gives rise to some interesting phenomena.)

This final circuit, which is the preferred circuit for d.c. stabilisation, gives substantial protection against thermal runaway effects as well as compensating for transistor spreads and impedance variations.

Once d.c. stabilised a transistor stage can be used in any sort of a.c. configuration. The emitter or the collector can be grounded to a.c. even though not earthed to d.c.

So the rule is: establish the conditions of d.c. stabilisation before you do anything else. If the hook-up does not work, check the d.c. conditions. The collector current can be read by checking the voltage drop through the collector load; the emitter voltage can be checked by reading the volts dropped across the emitter resistor. As a transistor obeys Kirchoff's Law the base current could be read as the electrical difference of collector and emitter currents were that difference large enough to measure, which normally it will not be. But the *value* of the collector current, in milliamps, will enable the base biasing current to be ascertained by making reference to the published data for the transistor.

The base voltage to earth can be read if there is an emitter resistor; this should be slightly more negative than the emitter itself.

This is by no means the whole story. A glance at the circuit (Fig. 5) will suffice to show that the potential divider R1, R2 is not quite what it appears to be on the surface. In practice the biasing potential is almost wholly determined by R1 because the input impedance of the transistor itself is in effective shunt with R2 and, as seen, this is of a low order, some 100Ω perhaps. Thus R2 is really only a bleeder.

Nevertheless with this circuit for d.c. stabilisation, if calculations have been accurate having regard to the published data on the transistor in use, the stage should work—as far as d.c. is concerned—first go off.

Trouble shooting with transistors has its own problems. The impedances are far lower than those associated with valves, so are the voltages; on the base you are dealing with micro values. If the value of a resistor is taken in situ it will probably only read the impedance of a transistor in shunt with and, as the whole set-up is critical within fine limits, transistors can be wrecked when trying to find out why they won't work.

Once d.c. conditions have been established go ahead to the next stage and consider the a.c. applications.

If the circuit shown in Fig. 6 is used, and in addition arrange that the collector load is of a value which drops at least half the supply voltage (in this case 4·5V, which is half of 9V), it will result in a set-up which should work and remain stable under almost any conditions. ■

"ROAMER" 7 (5 Wavebands) PERFORMANCE WILL AMAZE YOU!

★ (7 Transistor plus 2 Diode designs)

★ Med/Long Waves, Trawler Band and 2 S.W. to approx. 17 metres.

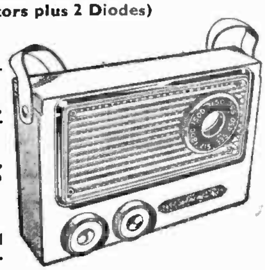
★ Rich-toned 5in. Speaker.
★ Sockets for car radio use.
★ Telescopic aerial for S. Waves.
★ FERRITE ROD AERIAL FOR M/L.
★ Full After Sales Service.
★ Air spaced gauged Tuning Condenser.
★ Uses latest Mullard Transistors.

Total cost **£7.9.6** P.P. 5/6.
Or Less Case £6.9.6

★ Push-Pull output for room filling volume.
★ Two tone Cabinet with gilt trim.
★ Case size 12 x 8½ x 3½in.
★ Parts price list and Plans 3/-.

THE SUPER SEVEN

★ ★ (7 Transistors plus 2 Diodes)



★ 2 R.F. STAGES.
★ Mullard and Surface Barrier Transistors.
★ Coverage of Medium, Long Waves, Trawler Band.
★ Use as domestic radio, car radio or fit with strap for carry-about.
★ No aerial required.
★ 3-inch speaker but will drive a larger speaker.
★ 400 milliwatts output stage.

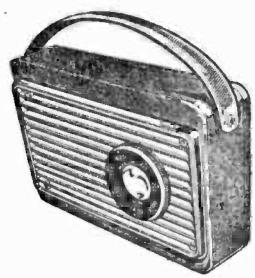
May be built for **£5.19.6** plus 3/6 post, etc. SIZE: 7½ x 5½ x 1½in.

Or with telescopic aerial for trawler band £6.5.6

PARTS PRICE LIST AND EASY BUILD PLANS 2/-

NEW TRANSONA-6

★ (6 Transistors, plus 2 Diodes)
★ M/L & T. BAND



400 Mw Mullard push-pull output Transistors, Powerful magnet 3in. high grade speaker. Push-pull transformers. This is a top performing receiver. Many 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 **£4.19.6** P.P. 3/-. Size 6½ x 4½ x 1½in.

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

PARTS PRICE LIST AND EASY BUILD PLANS 1/6

All components used in our receivers may be purchased separately if desired. Parts Price List only, S.A.E.

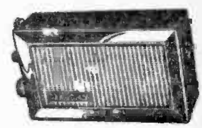
AFTER SALES SERVICE

Radio Exchange Co.

27 HARPUR STREET, BEDFORD
Phone: 2367
Closed 1 p.m. Sat. Opp. Co-op.

BEGINNERS POCKET 5

(MW/LW and TRAWLER BAND) (7 Stages)
(5 Transistors, plus 2 Diodes)



Designed round supersensitive **FERRITE ROD AERIAL** and 3in. moving coil speaker. Attractive case in black with speaker grille in red. On test Home, Light, Radio Luxembourg and many Continental stations were received.

Total cost of all parts **£2.19.6** P.P. 3/-

EASY BUILD PLANS AND PARTS PRICE LIST 1/6

"THE MELODY SIX"

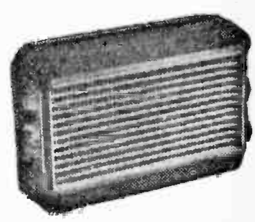
★ Ferrite road aerial.
★ 6 new type transistors and top quality components. Attractive case in blue and red and carrying strap with gold trim.
★ 3in. Speaker.
★ M.W/L.W.
★ No aerial required.

£3.19.6

P.P. 3/-
Price list and plans, 2/-.

"BEGINNERS" PUSH-PULL FIVE

(5 Transistors, plus Diode)



★ 2¾" Super-tone Loudspeaker.
★ Ferrite rod aerial.
★ Tuning condenser.
★ Volume control.
★ Case with speaker grille in red.
★ Fully tunable over med/long waves and T-band.
★ Simple assembly diagrams.
★ 250 Milliwatts output stage.

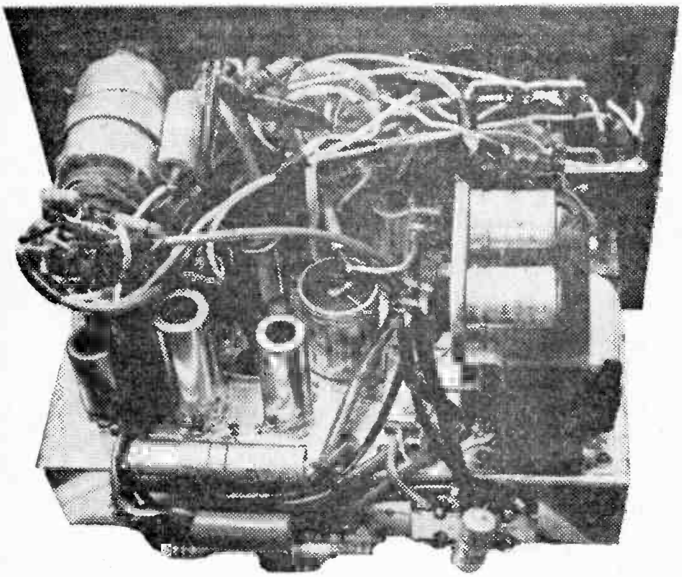
Can be built for **59/6** P.P. 3/-, or with 3in. speaker 68/-

★ PARTS PRICE LIST & PLANS etc. 2/-

"Home, Light, AFN, Lux., all at good volume."—G.P., Durham.

THE AUDITRON

By M. L. Michaelis, M.A.



(Continued from page 842 of the January issue)

THE shift controls have a time-lag of about one second before the trace fully follows movement of the controls VR3 and VR4. This is due to the charging time of C28 and C38. It could be avoided by returning R15 and R16 to the final anode (pin 8) of the c.r.t., and applying the shift voltages in the same manner to the other two plates. This was round to worsen the hum level on the trace slightly, and to worsen astigmatism slightly, yet should by all means be tried, as conditions could easily be different with individual Auditrons, whether the specified tube is employed or not.

The Bridge Circuit

Fig. 3 (page 514, October issue) shows the arrangements for measuring capacities of from about 1,000pF to 30μF, and inductances from about 1 to 20H, by means of the "bridge" arrangements built as an integral part into the Auditron.

It is a fact that, in a.c. bridge arrangements of conventional type, not only are the voltages equal, but also the *phases* are equal, for the two pints between which the null-indicator is connected, once the point of balance has been reached. Thus, in principle, a null-indicator can be used to react to voltage or to phase differences, though almost always voltage indication is used in normal null-indicators, because this is normally by far the easiest to achieve. A phase-indicator normally requires a cathode-ray oscilloscope, which would involve costs and complications out of all proportion if one merely desired to build a bridge alone. However, it is well worth while if matters lie the other way, namely that an oscilloscope exists, and we want to modify this to *include* a bridge function, as here. Phase-Null indication has, namely, some advantages in sharp definition of the Null (Balance), as it involves the closure of an ellipse to a straight line at true balance, opening up again beyond, which is a visually very distinctive action. The human eye is very sensitive to any departures from the straight line!

The actual bridge itself is one of the conventional arrangements for a.c., though novel in detail. R17 and R18 form an a.c. bleeder on the 110V a.c. line, tapping off sufficient amplitude to give about 2cm deflection on the X plates, using the mains sinewave. C13 and R12 form the "standard" arm of the bridge, giving a definite phase shift (in fact, 45°, because the impedances of C13 and R12 have been chosen to be approximately equal at mains frequency) for the bridge X deflection, compared to the incoming mains voltage. It is seen that S1e and S1f, two wafers of the function switch, cut off the a.c. supply to R17 and short R12, in all positions except "three", which is the "bridge" setting.

The other arm of the bridge is given by the unknown capacitor or inductor to be measured, connected between the terminals "LT AC" and "Pot" of the "bridge" connections on the panel. This is fed from the a.c. heater line, which is in phase with the 110V a.c. line feeding the other bridge arm. The completion of the second arm is given by the fixed and variable resistors selected on S3a, a wafer of the bridge range switch S3.

Normal Use of the Auditron Bridge

The normal use of the Auditron Bridge is for checking and measuring capacities larger than 1,000pF. The capacitor is first of all checked for *leakage* before making a capacity measurement, because leaking capacitors would still give a capacity reading, apparently, i.e., a phase balance may still be found, but at the wrong point. Thus it is first necessary to make sure that the insulation is reasonable. This is done by first connecting the capacitor with one end to the bridge terminal labelled "h.t.", and the other end to the prod of the signal amplifier probe, having turned the signal amplifier gain to zero beforehand, because only the valve-voltmeter function is needed at this stage of proceedings. If the capacitor insulation is reasonable, the valve-voltmeter in the signal amplifier of the Auditron should, as soon as the above connections are made, give a sharp kick to about +250V (for all except the smallest capacities), and thereafter *return to zero* at once, or within a short time, according to the capacity.

Leaks having resistances of 20MΩ or less will have been shown up by this method, and a capacitor passing this test should be suitable for most normal purposes. Note that the applied test voltage in this test was about 250V which should be permissible for most normally used condensers. If the capacitor is of lower voltage rating, then adopt a modified procedure described later in this discussion.

Capacity Measurement

The capacitor undergoing tests is next connected between "LT AC" and "Pots", and the prod of the probe is connected also to "Pots". The signal amplifier gain is turned up until an oblique ellipse of reasonable size is observed on the c.r.t. screen.

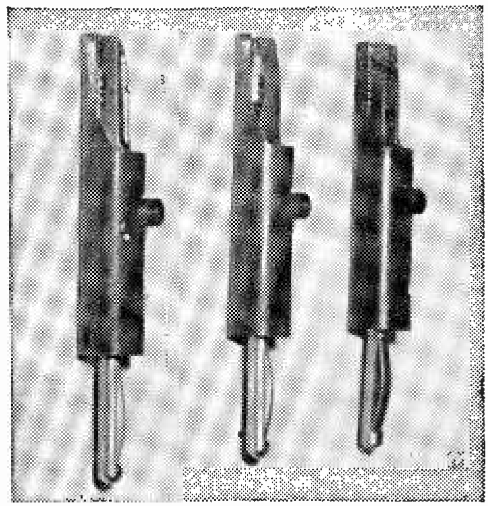
S3 is switched to that range including the nominal (or estimated) value of the test capacitor. The corresponding potentiometer then in circuit, VR5, VR6 or VR7 is turned until the ellipse *exactly* closes up to a pure straight line going obliquely across the c.r.t. screen, and the capacity value is then simply read off from the scale attached to the potentiometer. If one has no previous idea of what value the capacity might have, one has to search through the various ranges, yet there is a right and a wrong way of doing this. If, even at full signal amplifier gain, the oblique ellipse is lying very flat, giving little departure from a horizontal trace, it is a sign that the capacity of the test capacitor is much less than the bridge range set at the time. If the ellipse is large and distinct, yet makes no attempt to close to a line over the entire range set, then the capacity of the capacitor is much greater than the range set. Always adjust the signal amplifier gain (VR13) such that the figures are as large as possible, yet still do not fold over at the ends (distortion in the signal amplifier due to overload).

Arrangement of Potentiometers

When making the calibration scales to be attached to the "bridge" section of the Auditron panel, the five positions of S3 should be marked clearly with the capacity range covered in each case, and an arrow pointing to the potentiometer knob operative for each position. Position 1 operates with VR5, and will cover about 1 to 30μF. R19 is here a safety resistor, to avoid short-circuits if the test condenser has a dead-short fault and VR5 is turned to minimum. In such a case, without R19, a total short would be present on the heater line, which would most likely burn out the bottom end of VR5.

Position 2 operates with VR6, and should cover about 0·1 to 1·0μF. R28 here serves the double function of safety resistor as above, and limits the high capacity end of the range to reasonable overlap with the next range.

Positions 3, 4, 5 all operate with VR7, which thus carries three scales. In position 3 coverage is about 0·02 to 0·25μF. Position 4 merely switches in an additional series resistor, changing the range from about 0·01 to about 0·02μF. Finally, in position 5, the same range of 0·01—0·02μF is still operative, but a standard capacitor of 0·01μF is placed in parallel with the unknown one, so that the actual range, as far as the external capacitor on test is concerned, has become zero to 0·01μF. Balance clarity is too weak for anything except very rough indications below 1,000pF, thus this range is calibrated 1,000 to 10,000pF. Capacities smaller than 1,000pF should be measured by resonance methods with a coil, using a grid-dip meter, or by other standard methods. For ranges 3, 4, 5 R21 performs the functions of safety resistor and scale range limiter.



Banana plug/crocodile clips of the type used by the author
(See page 942)

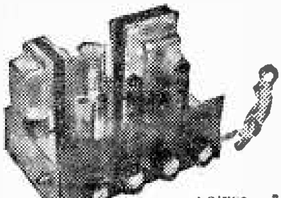
Paper Capacitors rated at less than 250V

To obtain test voltages less than the full h.t. of 250V, the "H.T." and "Pots" terminals should be shorted together. VR6 carries a voltage scale, in addition, from about 12 to 100, giving the indicated voltages at the shorted terminals, for the relevant slider positions. VR5 carries a similar additional scale from about 1 to 12V.

For the initial leakage test, therefore, S3 should be switched to the desired voltage range, and the potentiometer adjusted to the rated voltage of the condenser, after shorting "H.T." and "Pots". One end of the capacitor is then connected to "H.T." as before, and the other end to the prod of the probe, and the same procedure used as before.

R2 is a limiting safety resistor, to prevent excessive currents under all circumstances of faulty

MULLARD 3-3 HI-FI AMPLIFIER



valves, 3 watt, 3 ohm and 15 ohm. Output. A really first-class Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86, EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

TECHNICAL SPECIFICATION—Freq. Response: ± 1dB. 40 c/s.-25 Kc/s. Tone controls: Max. Treble Cut 12 dB. at 10 Kc/s. Max. Bass Boost 14 dB. at 80 c/s. Sensitivity: 100 Mv. for 3 w. output. Output Power (at 400 c/s); 3 w. at 1% total harmonic distortion. Hum and Noise Level: At least 70 dB. below 3 w.

COMPLETE KIT (incl. Valves, all components, wiring diagram and special quality sectional Output Trans.). **ONLY £6.19.6.** Carr. 5/-. Complete wired and tested, 8 gns. **Bronze Escutcheon Panel, Printed Vol., Treble, Bass, On-off, supplied with each Kit.**

Wired O/P socket power and additional smoothing for Tuner Unit, 10/6 extra.

Recommended Speakers—WB HF1012 95/-. Goodmans AXIOM 110 £5, etc.

COLLARO STUDIO TAPE RECORDER KIT

SPECIAL BARGAIN OFFER. Comp. Kit only Carr. 12/6. **£25.0.0**

Famous mfrs. surplus offer—Listed 42 gns. A quality Tape Recorder Kit based on Mullard famous design—EF86, ECC83, EL84, EM84 and Rectifier. Specially designed Kit for Collaro latest Studio Deck. Freq. response ± 3 dB. 60 c/s—10 kc/s. Amp. and Power Pack already wired, inter unit wiring only required. Cabinets size: 18 x 16¼ x 6in. finished in contemp. 2 tone blue Rexine with gilt Speaker Escutcheon. Magic Eye indicator Circuit and Tech. H/Book, supplied free with kit. *Send 2/6 now for full details of to-day's outstanding Tape Recorder Bargain.*

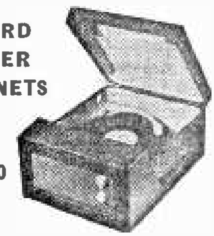
Cabinet £3.15. P. & P. 6/6.
Amplifier Kit £8.19.6. P. & P. 5/-.
Speaker 7 x 4 16/6. P. & P. 2/-.
If above items are purchased together. **£12. 19. 6** P. & P. 10/-.

BARGAIN 4-SPEED PLAYER UNITS

Single Players Carr. 3/6
Garrard 4 S.P. £6-19.6
Garrard TA Mk.2 £7.19.6
Collaro "Junior" 75/-
B.S.R. Latest TU12 79/6
E.M.I. Junior '985' 89/6
Auto-Changers Carr. 5/-.
Collaro "C 60" £7.15.0
B.S.R. (UA14) £7.10.0
Garrard "Auto-slim" £8.12.6
Garrard Model RC209 £9.19.6

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

RECORD PLAYER CABINETS



Cabinet Price **£3.3.0**
Carr. & Ins. 5/-.

Contemporary style, rexine covered cabinet in two tone maroon and cream. Size 18½ x 13½ x ht. 8½in., fitted with all accessories including baffle board and anodised metal fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 x 13in. supplied.

2-VALVE 2-WATT AMPLIFIER Twin stage ECL82 with vol. and neg. feedback Tone control. A.C. 200/250 v. with knobs, etc., ready wired to fit above cabinet. £2.17.6. P. & P. 1/6.
6in. Spkr. & Trans.. 22/-. P. & P. 2/-. Complete Kit, including UA14 Unit as illustrated, £12.19.6, carr. 7/6.

JACK PLUGS. Standard 2½" Igranic Type, 2/6. Screened Ditto, 3/3. Miniature 1½", 2/3. Screened Ditto, 2/6.

ENAMELLED COPPER WIRE—¼lb. reels, 14g-20g, 2/6; 22g-28g, 3/-; 30g-40g, 3/9. Other gauges quoted for.

Ersin Multicore Solder 60/40 3d. per yard. ¼lb. 2/6, etc.

Condensers—Silver Mica. All values, 2pF to 1,000pF, 6d. each Ditto. Ceramics 9d. Tub. 450V T.C.C., etc., 0.001 mfd. to 0.01 and 0.1/350V., 9d. 0.02-0.1/500V. 1/-. 0.25 Hunts 1/6. 0.5 T.C.C. 1/9, etc., etc. **Close Tol. S/Micas**—10% 5pF-500pF 8d. 600-5,000pF 1/-. 1% 2pF-100pF 9d. 100pF-500pF 11d. 575pF-5,000pF 1/6. **Resistors**—Full Range 10 ohms-10 megohms 20% ¼ and ½ W 3d., 1 W 5d. (Midget type modern rating) 1W 6d., 2W 9d. Hi-Stab 10% ¼W 5d., ½W 7d. 5% ½W 9d., 1% ½W 1/6.

JASON FM TUNER UNITS Designer-approved kits of parts:
FMT1, 5 gns. 4 valves, 20/-.
FMT2, £7. 5 valves, 37/6.
JTV MERCURY 10 gns.
JTV2 £13.19.6. 4 valves, 32/6.
NEW JASON FM HANDBOOK, 2/6. 48 hr. Alignment Service 7/6. P. & P. 2/6.

TYGAN FRET (contemp. pat.) 12 x 12in. 2/-. 12 x 18in. 3/-. 12 x 24in. 4/-. 18 x 24in. 6/- etc.

Speaker Fret — Expanded bronze anodised metal ⅜in. x ⅛in. diamond mesh, now 4/6 sq. ft., Multiples of 6in. cut max. width, 4 ft.

Electrolytics All Types New Stock

TUBULAR		CAN TYPES	
25/25V	1/9	8+8/450V	4/6
50/12V	1/9	8+16/450V	5/-
50/50V	2/-	32+32/275V	4/6
100/25V	2/-	50+50/350V	6/6
8/450V	2/3	60+250/275V	12/6
16/450V	3/6	100+200/275V	12/6
16+16/45V	5/6		
32+32/450V	6/6		

Transistor Components

Midget I.F.'s—465 Kc/s. 9/16in. dia. 5/6
Osc. Coil—M/W, 9/16in. dia. 5/3
Osc. Coil—M. & L.W. 5/9
Midget Driver Trans. 3.5:1 6/9
Midget O/Put Trans. P.P. to 3 ohms, 6/9.
Ferrite Aerial M. & L.W., Car aerial coil, 9/3.
Elect. Condensers—Midget Type 1mfd-50mfd ea. 1/9. 100mfd. 2/-: 12V wkg.
Condensers—.01mfd. to .04mfd 9d.: .05mfd. to .1mfd. 1/-: .25mfd 1/3: .5mfd. 1/6.
Tuning Condensers—JB "OO" 208 pF. + 176 pF 8/6. with Trimmers 9/6. Single 365pF 7/6. Sub min. ¾in. J.B. Dile min. .0001, .0003 or .0005 7/- each.
Midget Vol. Control—with edge control knob. 5K ohms with switch, 4/9, less switch 3/9.
Speakers P.M.—2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms 13/6, 2½in. E.M.I. 3 ohms 17/6. 7 x 4in. Plessey 35 ohms, 23/6.
Ear Plug Phones—Min. Continental type, 3ft. lead, jack plug and socket. High Imp. 8/-. Low Imp. 7/6.

SPECIAL BARGAIN OFFER

A self-contained Portable Unit incorporating latest BSR 4 speed Auto Changer Record Player and famous High Fidelity "Ful-Fi" Xtal Pick Up with Turnover Cartridge, fitted with LP and 78 Sapphire Styli. Internal 2 valve Amplifier of modern design with variable Tone and Volume Controls. This, together with a quality P.M. Speaker ensures a high standard of reproduction. The whole is housed in a robust wooden Cabinet attractively styled in 2 Tone contemporary leather cloth with contrasting polka dot relief.

Standard Model **£12.10.0** Carr. & Ins. 7/6

Kit consists of 3 sub assemblies already wired. Grub screw connections between Units only necessary—absolutely no soldering.

Autochanger Unit—BSR Model UA20. Amplifier—valves UCL82, UY85 and 7 x 4in. Elliptical Speaker. Cabinet size 17 x 14½ x 8½in.

Originally built to be sold at 17 Gns.

Recommended Buy!

RECORDING TAPE—Reduced Prices

Famous American Columbia (CBS) Premier Quality Tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

	Standard	Long Play	Double Play
5in.	600ft. 13/-	900ft. 17/6	1,200ft. 31/6
5¾in.	900ft. 16/-	1,200ft. 19/6	1,800ft. 37/6
7in.	1,200ft. 21/-	1,800ft. 28/6	2,400ft. 47/6

P. & P. per reel 1/-; 6d. on each additional reel.

SPECIAL BARGAIN. 3in. Message Tape, 150ft. 3/9. P. & P. 6d.
3in. L.P. 225ft 4/9, 3in. D.P. 30 f 6/6
Plastic Tape Reels .. 3in. 1/3, 5in. 2/-, 5¾in. 2/-, 7in. 2/3
Plastic Spool Containers 5in. 1/6, 5¾in. 2/-, 7in. 2/3

COAX 80 OHM CABLE High grade low loss Cellular air spaced Polythene—¼in. diameter. Stranded cond. Famous mfrs. Now only 6d. per yard. **Bargain Prices—Special Lengths—**
20 yd. 9/-. P. & P. 1/6.
40 yd. 17/6. P. & P. 2/-.
60 yd. 25/-. P. & P. 3/-.
Coax Plugs 1/-. Sockets 1/-. Couplers 1/3. Outlet Boxes 4/6.

VALVES

New Boxed — All Guaranteed

1T4	6/-	ECC83	8/-	PCC84	9/6
1R5	7/6	ECL82	10/6	PCF80	9/6
1S5	7/6	ECL80	10/6	PCL83	12/6
3S4	7/6	EF80	8/-	PCL84	12/6
3V4	7/6	EF86	12/6	PL81	12/6
DAF96	9/-	EL84	8/6	PL82	9/6
DF96	9/-	EM81	9/6	PL83	10/6
DK96	9/-	EY51	9/6	PY32	12/6
DL96	9/-	EY86	10/-	PY81	9/6
ECC81	8/-	EZ81	7/6	PY82	7/6
ECC82	8/-	GZ32	12/6	U25	12/6

TRANSISTOR BARGAINS

Brand	New—BVA	1st Grade	
OC44	8/6	GET114	6/6
OC45	8/-	OC72	7/6
OC81	7/6	OC70	7/6
2/OC81	15/6	OC71	6/-
XA102	10/-	OC78	7/6
XA101	9/6	GEX34	2/9
XB103	7/6	OA70	2/9
XC101	8/6	OA81	2/9

Special offer: One OC44. two OC45: 21/6. One OC81D. two OC81's (matched pair) 19/6.

TRS Est. 1949

Send for detailed bargain lists, 3d. stamp.
We manufacture all types Radio Mains Transf. Chokes, Quality O/P Trans., etc. Enquiries invited for Specials, Prototypes for small production runs. Quotations by return

RADIO COMPONENT SPECIALISTS

70 Brigstock Rd., Thornton Heath, Surrey. THO 2188. *Hours: 9 a.m.-6 p.m. 1 p.m. Wed. Terms C.W.O. or C.O.D. Post and Packing up to ½lb. 9d.; 1lb., 1/3; 3lb., 2/3; 5lb., 2/9; 8lb., 3/6.*

test components or mistaken connections.

After checking the insulation of a low voltage paper capacitor in this way (or any other non-electrolytic type of capacity within the ranges covered), a capacity measurement may be made in the same way exactly as for higher voltage ratings, because the applied voltage is then only 6·3V a.c. maximum. Naturally, the shorting lead between "H.T." and "Pots" must be removed again prior to the capacity measurement.

Quantitative Insulation Measurement

As will have been made clear in another article which appeared in past months in this magazine, dealing with noisy volume controls, those capacitors used for coupling from the anode circuit of a stage of amplification to the grid of the next stage can sometimes give trouble if the insulation is not better than 500MΩ. The Auditron can be used, in the "bridge" setting, to check whether a capacitor satisfies this condition.

After successfully completing the above described "reasonable" insulation check the capacity measurement, multiply the observed capacity (in μF's) by 500. This gives the *shortest* tolerable time-constant (in seconds) of the self-discharge rate of the capacitor across its own leakage, for the purposes envisaged, and the Auditron can now be used to check that this time-constant is with certainty exceeded.

For this purpose, proceed exactly as for the "reasonable" insulation test. Now set the signal amplifier gain, by means of the Zener diode calibrator to give a vertical-deflection sensitivity of two-thirds as many volts per centimeter as the test voltage used. Now touch the prod of the signal probe on to the free end of the test capacitor in the normal way, and wait until the initial valve-voltmeter deflection has died away to invisibility. Then remove the prod of the probe, leaving the capacitor hanging with one end free, and wait the calculated "minimum-time-constant" period (e.g. for a typical coupling capacitor of 0·05μF, this would be 0·25 seconds). Then immediately touch the prod on to the free end of the capacitor again. If the jerk of the trace on the c.r.t. screen (upwards) is then less than one centimeter, the capacitor has insulation better than 500MΩ, and is thus satisfactory. If the jerk is greater, the capacitor is of doubtful quality for coupling purposes.

Insulation Tests for Electrolytic Capacitors

All tests and measurements on electrolytics must use a polarising voltage of the correct sense, and this is automatically provided in the "reasonable insulation" test here. Thus leakage checks for electrolytics can be performed in the same way exactly as for other types of capacitor. Observe that the test voltage does not exceed the rated voltage (though it may be less, but not less than half of the rated voltage), and observe correct polarity. The positive lead of the electrolytic should go to the "H.T." terminal, and the negative lead to the prod of the probe.

The "reasonable insulation" test, showing leaks of about 20MΩ or less resistance, is normally adequate, and represents all that can be expected in the way of insulation from many large capacity electrolytics. However, there is nothing against applying the above described time-constant observation method to test for even better insulation. This is desirable in those cases where electrolytics are to be used for coupling purposes, such as in certain types of frame-timebase circuits in television circuits.

Capacity Measurements for Electrolytics

It is not possible to use the normal bridge operation and calibration for capacity measurements on electrolytics, because no d.c. polarisation is then available. A different method is thus to be used, which is particularly possible because of the high capacity of electrolytics.

This method proceeds in the same manner as the "reasonable insulation" test, and may be performed simultaneously with the latter right at the start. Apart from observing that the valve-voltmeter deflection should return fully to zero if the insulation is satisfactory, the *time* it needs to *halve* its initial deflection should be noted, in seconds, with the switch marked "C" on the probe set to position "time". This time, in seconds, gives the capacity of the electrolytic, in μF's.

The same procedure is to be used for non-electrolytic types with capacities exceeding 30μF, i.e. not covered by the highest bridge range.

The switch "C" should be left at position "scope" for all other uses of the Auditron.

Capacitors found in modern transistorised equipment are often electrolytics of about 6 to 12V rating and have capacities of hundreds or thousands of μF's. The above described method of capacity measurement (primarily intended for h.t. smoothing capacitors) would thus take too long with these components, apart from insufficient sensitivity on the valve voltmeter at the low working voltages.

These capacitors should thus be charged from a suitable tap on a grid-bias battery, observing polarity and keeping to within the voltage rating. Allow about 15 seconds for charging. Then connect the charged capacitor to a suitable range on a good multimeter, i.e. a voltage range of about 5 or 10V f.s.d., and having at least 4,000Ω/V.

The time in seconds should be noted, required for the initial meter deflection to recrease to one third of its value. Dividing this by the meter resistance for the used range, expressed in MΩ, gives the capacity of the capacitor in μF. Thus. for example, if a 6V working capacitor is charged to 6V and 110 seconds are needed for the initial meter deflection of 6V to fall to 2V, using the 10V d.c. range of total resistance 40kΩ (0·04M), the capacity is clearly 2,500μF. Insulation should be tested in these cases by first touching the charged capacitor on to the meter terminals, long enough to observe the deflection, then disconnecting the capacitor again, and after a time—long compared to the capacity—measurement time, i.e. at least ten minutes—re-connecting and noting that the reading should not have changed appreciably.

The fact that tests on low-voltage high-capacity electrolytics can be performed in this simple manner with an ordinary multimeter explains why no attempt has been made to cover this function on the Auditron, it being thus superfluous there. All the other numerous capacitor test facilities embodied in the Auditron, as described above, are seen, however, to be far more convenient there than with other arrangements, justifying their incorporation.

Choke-Coil Inductance Measurements

Inductances cause a phase shift in the opposite sense to capacitors thus, when connected between the "LT AC" and "Pots" terminals on the Auditron bridge, they will *increase* the phase difference between the two points of the bridge diagonal, instead of compensating it to zero as in the case of capacitors at balance.

The criterion here to be used for "balance" is when the phase difference has thereby been augmented to 90°, manifested by an erect or horizontal positioning of the ellipse on the c.r.t.-screen, according to the Y-amplifier gain set. In other words, the ellipse ceases to be oblique. In this condition, a suitable setting of the Y-amplifier gain enables a perfect circle to be produced on the c.r.t.-screen, which is the final true indication of "balance" with a choke.

The only setting of S3 giving a useful range here is position 1, which was for 1 to 30μF and here covers about 1 to 20H. This range of inductance is useful for checking smoothing chokes, audio-output transformers, etc.

Measuring Small Inductances

The bridge-facilities on the Auditron have been designed to cover those capacity and inductance measurements normally required and not conveniently covered by employment of the grid-dip meter mentioned in an earlier article.

All r.f. coils, for anything from long waves down to v.h.f., r.f. chokes, i.f. transformers, etc. should be measured with a grid-dip meter.

Calibrating the Bridge Controls

The bridge controls should be calibrated against capacitors of accurately known values. As standard inductances, a number of chokes and transformers as different as possible should be selected, their total impedance at mains frequency determined by measuring the current they take when connected to a suitable low voltage a.c. supply, and using Ohm's Law. The inductance is then given by the following formula:—

$$L = \frac{\sqrt{Z^2 - R^2}}{314} \text{ Henry}$$

Z = Total impedance at 50c/s mains frequency (ohms).

R = d.c. resistance of windings (ohms) (use ohms-range of multimeter).

The voltage calibrations of VR5 and VR6, for test-voltages for low rating capacitors, should be made as follows. For each scale mark desired, the potentiometer resistance needed to give the corresponding voltage with R2 as bleeder from 250V input should be calculated by direct proportion. The multimeter should then be connected between "Pot" and chassis (Auditron disconnected from the mains), and the knob of VR5 or VR6 turned until the desired resistance is noted on the meter. The voltage mark concerned is then made against the pointer position of the potentiometer knob.

Alternatively a valve-voltmeter can be used for direct calibration of the voltage between "Pot" and chassis when "H.T." and "Pot" terminals are shortened, and the Auditron switched to "bridge". The built-in valve voltmeter can be used for this purpose for the higher range 12V to 100V, but is not sensitive enough for the lower range.

The three bridge terminals on the panel of the Auditron are coloured wander plug sockets of the insulated type. Three miniature insulated crocodile clips with a banana plug at one end and the jaws at the other, made as small integral units (see photograph) were purchased. These can be plugged into the wander plugs, and the test capacitor held between the respective jaws.

A Probe for the Auditron

As mentioned earlier in this series, the Auditron should normally never be used without its specially constructed probe at the signal amplifier input, i.e. only in exceptional circumstances should a signal be fed direct from its source, via a screened or unscreened cable, into the signal-amplifier input.

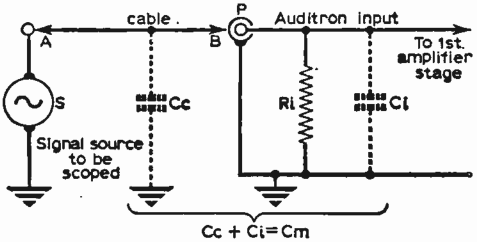


Fig. 13: Equivalent circuit showing the stray capacities operative if a signal source is connected directly to the input of an oscilloscope amplifier.

Also no oscilloscope should be operated without its proper test-probe at the signal amplifier input. Probes are generally not exchangeable between various oscilloscopes since these must be carefully balanced to suit the particular signal amplifier with which they are to be used.

Fig. 13 depicts the important aspects of the signal amplifier input circuit if it is attempted to feed in a signal direct, without using a probe. Ri represents the d.c. impedance of the amplifier input, which is 135kΩ in the case of the Auditron. Ci represents the total effective internal stray capacity of the amplifier input, up to and including the coaxial input plug-socket P. The value of Ci is unknown and must be measured in a completed amplifier.

AB represents a length of cable, screened or unscreened, used to connect the signal source to the amplifier input P. Cc represents the stray capacity of the cable to earth. Cc and Ci, acting in parallel, can be lumped together as a single stray capacity, Cm, once it has been decided what length and type of input cable to use.

Two yards of good coaxial cable with a capacity not exceeding about 1 to 2pF per inch can be used for the Auditron signal input. Choose a fairly thin, easily flexible, coaxial cable. With such a cable Cc+Ci (Cm) comes out at around 150pF.

(To be continued)

Trade News

NEW STYLED HI-FI CABINET

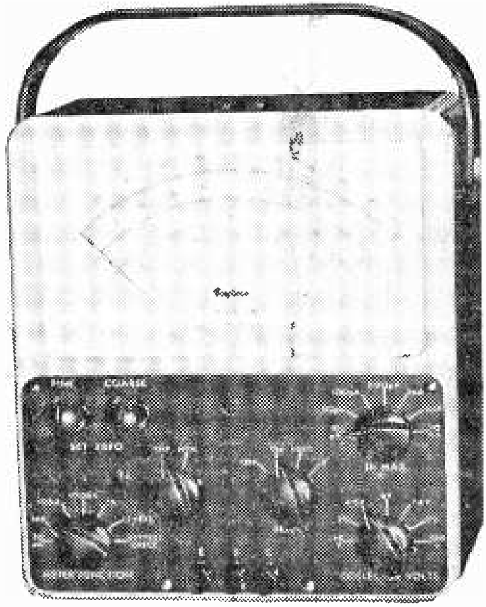
A NEW radiogram cabinet has just been brought on to the market by G.K.D. Limited and which has been specifically designed to house Leak hi-fi units.

G.K.D. have called this new cabinet the "Southdown" and have managed to combine good styling and compactness with generous space allowance for any combination of Leak equipment. This has been achieved by incorporating a spring-loaded drawer which, when opened, reveals a panel for mounting tuner or pre-amplifier units.

The manufacturers are *G.K.D. Limited, King Street, Houghton Regis, Bedfordshire.*

(Above) The new radiogram cabinet from G.K.D. Ltd.

(Right) Telonic's new sweep generator.



This new transistor tester is made by Taylor Ltd.

TRANSISTOR TESTER

A NEW transistor tester — model 44 — is announced by Taylor Electrical Instruments Ltd. This portable tester is capable of measuring accurately the characteristics and performance of modern transistors.

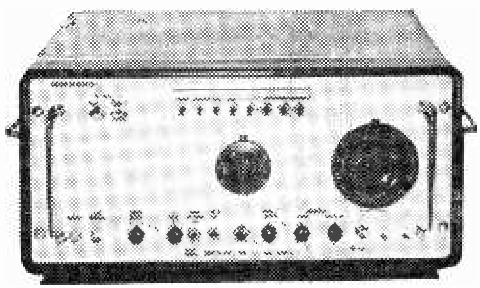
Several new features have been introduced in this model, including facilities for varying the collector voltage, base current and collector current independently.

The tester is made by *Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Buckinghamshire.*

SWEEP GENERATOR

A NEW sweep generator is now available covering a wide spectrum of r.f. frequencies with a sweep width over its entire range. The new instrument, model SP-1200, manufactured by Telonic Industries Inc. (U.S.A.), has a centre frequency range of 5Mc/s to 1,200Mc/s and a sweep width also 5 to 1,200Mc/s.

The English agents for Telonic equipment are *Livingston Laboratories Ltd., 31 Camden Road, London, N.W.1.*



Club News

REPORTS OF CURRENT ACTIVITIES

AMATEUR RADIO SOCIETY OF CHESHAM AND DISTRICT

Hon. Sec.: Capt. C. G. Stephenson, G3CLJ/T, 21 Lynton Road, Chesham, Buckinghamshire.

Each Tuesday evening morse, first aid, practical construction and other subjects are taught and on Fridays the Society arranges RAE theory lectures. Sunday meetings are devoted to practical operating.

At the recent Annual General Meeting it was disclosed that the Society's membership had increased 600%.

BRIDLINGTON AMATEUR RADIO SOCIETY

Hon. Sec.: P. Cartwright, G3POC, 55 Hermitage Road, Bridlington, East Yorkshire.

This Society has recently moved into new premises in the centre of the town in North Street. Any persons interested in becoming a member would be most welcome.

On Wednesday evening the Society runs morse classes for those wishing to gain experience in this subject.

Arrangements are already going ahead for another mobile rally to be held in June.

BURTON-ON-TRENT AND DISTRICT RADIO SOCIETY

Hon. Sec.: H. Harrison, 38 Baker Street, Burton-upon-Trent, Staffordshire.

Lectures have been arranged for members on the first Wednesday of each month, and on December 5th an RAE lecture was given.

The meeting on December 12th was devoted to a film show.

LOTHIANS RADIO SOCIETY

Hon. Sec.: W. T. Sutherland, GN3JWS, 47 Great King Street, Edinburgh 3.

On December 13th members attended an R.S.G.B. tape recorded lecture on "World Wide Telecommunications".

Later in the month, on the 27th, members enjoyed a "Social evening".

MITCHAM AND DISTRICT RADIO SOCIETY

Hon. Sec.: B. Blandford, 1 Biggin Avenue, Mitcham, Surrey.

A very successful Christmas Meeting was held on December 14th. A Christmas Draw was arranged with many inviting prizes.

During the evening judging for the annual Constructional Contest took place and the Society trophies were presented.

PLYMOUTH RADIO CLUB

Hon. Sec.: R. Hooper, 2 Chestnut Road, Peverell, Plymouth, Devon.

In the recent competition for the "Ernie Hillyard" trophy, the winner was judged to be Colin Jones with his radio teletype converter. Second was John Fallen with a stereo amplifier, and third was Ted Fallen with a grid dip oscillator.

A party of members attended the opening night of the Torbay Radio Club on Saturday, December 9th.

Future Event:

January 19th—Dinner and social evening.

CITY OF BELFAST Y.M.C.A. RADIO CLUB

Hon. Sec.: R. H. Payne, 25 Arundel Street, Belfast 12.

The club meets every Wednesday and Saturday and a varied programme of lectures and visits has been arranged. There are also constructional facilities available to members.

A slide show and Christmas party was enjoyed by all who attended on December 19th.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: C. E. Godsmark, 211 Manwood Road, London, S.E.4.

The annual Constructional Contest was held on December 14th at the clubrooms.

The 1·9Mc/s net on Christmas morning was controlled by G3GHN, the club station.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec.: A. J. Wilkes, G3PQQ, 141 Overslade Crescent, Coundon, Coventry.

This Society is now settled at its new headquarters and the newly purchased 150W transmitter is also installed.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.

Probably the most enjoyable meeting for many members was the Christmas Party held on December 19th. There were no more meetings for December but a club net on 160m was operated on Christmas Eve and New Year's Eve.

The first meeting in the New Year was held on January 2nd, and was a surplus sale.

"CORONATION STREET OR CQ.ZL..."

THE radio ham, perhaps more than any other hobbyist, needs to belong to a club to attain full enjoyment of his chosen pastime. To be a lone-wolf will not do, for the very act of listening or transmitting—which, after all, must be considered the fulfilment of whatever else he may decide is intimated in the title of "radio ham"—brings him into immediate contact with his fellow enthusiasts.

Yet in spite of this undeniable fact, the PRACTICAL WIRELESS offices receive many letters from readers who obviously do not belong to a radio club and whose particular problem could be solved simply by joining such a society.

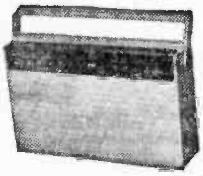
For instance, we receive many queries about ex-government sets and, as most readers will know, information about this equipment is very hard to come by. In fact most information originates with the more ambitious enthusiasts who are prepared to service such equipment "blind". And where do these individuals gather and compare notes?—in the radio clubs of course, and it is in these clubs therefore, that the most comprehensive data on ex-government sets is to be found (except in government records, that is).

The radio clubs also offer unrivalled opportunities for instruction on the practical side of operating as a licensed amateur, and this is very important for any potential ham. Also important are the number of social events that take place from time-to-time, not to mention rallies, d.f. contests, lectures, construction competitions, etc., etc.

This time of the year is the busiest for all amateurs whether on the air or at the workbench, and so the choice is yours, "Coronation Street" or "CQ. ZL . . .", but for those who do not belong to a radio society, we would suggest that you seriously consider joining your local club, if only for the ragchews and film shows! There are many clubs listed on this page and most secretaries will be pleased to give you details of their activities and also extend a welcome to go along to the next meeting to see "just what goes on".

New !—For you to build

THE COROVER '6'



This superhet receiver uses the very latest circuitry, 6 transistors and two diodes and is fully tunable over both medium and long wavebands. First stage uses three Mullard AF.117 alloy diffused transistors with OA.79 and OA.91 diodes, output—OC.81D and two OC.81's in push-pull. I.F. frequency 470 Kc/s. Large internal ferrite rod aerial gives excellent reception over all ranges. 3 inch high flux speaker has a maximum output of 330mW. Operates on four 1.5 v. pen torch batteries. All components are mounted on a single printed circuit board. Attractive plastic case with carrying handle—fitted sockets for personal earpieces, tape recorder and car aerial. Size 6¼ x 4 x 1¼in.

MAY BE BUILT FOR £5.19.6 All Parts sold separately.
P. & P. 4/- extra. (Data and instructions 2/6, free if all parts bought).

THE 'SPRITE'

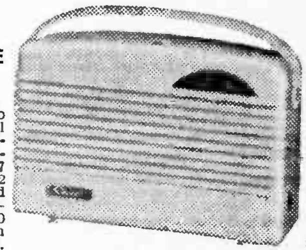
A six transistor superhet Miniature Pocket Radio of Commercial Quality. Fully tunable over Long and Medium wavebands. Uses printed circuit and High sensitivity internal ferrite rod aerial. I.F. frequency 470 Kc/s. Transistors: 3-Philco 2067's, 2-Mullard OC81M, OC81DM and OA90 diode. 3 inch speaker. Works on single PP3 battery. Supplied with the complete RF and IF stages, Driver and Output stages, ready built and mounted on the printed circuit; for final assembly you only have to fit the wave-change switch, tuning condenser and drive, volume control, earphone socket and aerial rod. In very attractive plastic case, size 4 x 2½ x 1in.

COMPLETE AS ABOVE 89/6 All parts sold separately.
Real Calf Leather Case, wrist strap and Personal Earphone with case. 10/- extra.
P. & P. 3/6 extra. (Data and instructions 2/6, free if all parts bought.)

Wirecomp's Finest Ever Value Offer—

THE 'REALISTIC 7'

FULLY TRANSISTORISED PORTABLE RECEIVER



This super set—made to the highest professional standards—is now available to the home constructor. Comprises 7 Mullard Trans. OC44, 2 OC45's, OC71, OC81D, and 2 OC81's, plus OA70 Crystal Diode. Delivers 350 milliwatt output to 4in high flux speaker—I.F. frequency 470 Kc/s.—fully tunable over medium and long wave-bands. All components mounted on single printed circuit board, size 5¼ x 5¼in. Attractive two-tone plastic cabinet with carrying handle—size 7 x 10 x 3¼in. with easy to read dial and socket for car aerial, choice of Red/Grey, Blue/Grey or all Grey. Complete with full instructions. **All parts sold separately.**

WIRECOMP'S PRICE £6.19.6 Including Free P.P.9 Battery — Value 3/9
P. & P. 4/6 extra. (Circuit diagram 2/6, free if all parts bought.)

WIRECOMP ELECTRONICS

378 HARROW ROAD, LONDON, W9.
TEL: CUNNINGHAM 9530
Hours of business: 9 a.m. to 6 p.m. Open all day Saturday, Opposite Paddington General Hospital
Buses 18B and 36 pass the door.

Estd. 1940

"MONEY MONEY MONEY!" *

There's bags of it in Radio and TV if you know your stuff! and if you don't we will teach you, in our laboratory or by correspondence.

Mr. J. SYKES
(M.I.E.E., M.Brit.I.R.E., M.I.N.)
Principal

BRITISH NATIONAL RADIO SCHOOL
Red Lion Court, Stalbridge, Dorset

Britain's premier Radio Correspondence School specialising in City and Guilds examinations.

* *With apologies to Sinclair Lewis.*

ERSIN MULTICORE SOLDERS

for a first class joint every time

Wherever precision soldering is essential, manufacturers, engineers and handymen rely on MULTICORE. There's a MULTICORE SOLDER just made for the job you have in hand. Here are some of them.

THE NEW HANDY DISPENSER

Easy to find in the tool box—simple to use. The solder is in a continuous coil which can be used direct from the handy free-standing dispenser—in fact, it is virtually a third hand for those tricky soldering jobs. Containing 15 feet 5-core 18 s.w.g. Ersin Multicore Savbit alloy. **2/6**

HOME CONSTRUCTORS 2/6 PACK

In addition to the well-known Home Constructors Pack (containing 19ft. of 18 s.w.g. 60/40 alloys) a similar pack is now available containing 40ft. of 22 s.w.g. 60/40 alloy especially suitable for printed circuits.

BIB WIRE STRIPPER AND CUTTER

Strips insulation without nicking wire, cuts wire cleanly, splits extruding flex. **3/6 each**

MULTICORE SOLDERS LTD

MULTICORE WORKS, HEMEL HEMPSTEAD, HERTS. (BOXMOOR 3636)

CM5

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 commercial 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.

SAVE OUR STYLUS?

SIR,—In reply to Mr. Davenport's letter in the December issue, may I respectfully suggest that if he were to study microphotographs of record grooves, he would soon realise the serious damage caused by the dirt and dust which adheres to fingermarks on a long playing record. This dirt not only causes excessive surface noise on a lightweight pick-up, which has been specially designed to give the highest quality with the lowest record wear, but also damages the stylus. This in turn deforms the grooves of every record which is afterwards played by it, therefore causing over £50 of unnecessary damage to even a modest collection of 30 records.

If Mr. Davenport cannot tell the difference in quality between the average "3W-or-bust" record player with a cheap multi-purpose 5in. loudspeaker, and a 30W hi-fi stereo system whose tweeters and bass reflexes alone can do credit to frequencies ranging from cascading strings down to a deep organ diapason, then I am afraid that he is missing a great deal of enjoyment and pleasure indeed. — J. D. MAITLAND (Preston, Lancashire).

SIR,—In answer to Mr. Davenport's letter in the December issue, I would have thought that, although he is obviously not an hi-fi enthusiast, he would not have condemned his friend's disc and stylus cleaning activities. In addition to the effect of dust on the quality of reproduction obtained, it can also be very damaging to the surfaces of modern microgroove records, and the expense of 30s. or £2 for replacing records carelessly damaged in this way is, in my opinion, considerable.—D. L. MILLER (Plymouth, Devon).

HI-FI FANATICS

SIR,—How right your correspondent D. R. Davenport is to criticise these self-styled hi-fi fanatics.

From such contact as I have had with these people, I am convinced that it is not an appreciation of music that drives them to buy expensive record reproducing equipment, but rather a very juvenile type of pleasure in showing off audio set-ups to friends. Their wariness of people touching their records and equipment I am sure arises from nothing more than a desire to reserve the pleasures and mysteries of hi-fi for selective cliques.

Recording and equipment manufacturers must bless this gullible section of the public who so readily buy their products, just so long as they can impress their friends with "frequency response", "rumble filters", "negative feedback tone circuits" and all the other little non-committal technical terms which clever salesmanship dictates shall be tagged to these products.—N. L. NICHOLLS (Northampton).

THE QUANTUM THEORY

SIR,—With reference to Mr. Robbins' letter in the October issue. I suggest that he, as well as Mr. Craske has misconstrued the Quantum theory entirely.

Mr. Robbins' statement that photon simultaneously exhibits wave and particle properties is entirely erroneous. The term photon, from the Greek meaning "light", came into general use around 1928. It is frequently regarded as synonymous with energy quantum, but is strictly the quantity, or quantum of radiation associated with a single quantum of energy. It may in fact be described as an "atom" or "particle" of radiation. By Max Plank's equation, a photon of radiation of frequency, V, carries an amount hV, of energy: h being the Plank constant.

Also, the wave and particle conceptions are not as Mr. Robbins states, analogies used to explain certain phenomena. They are in fact fundamental characteristics of nature. The diffraction and interference properties of radiation necessitate a wave structure, whereas photo-electric phenomena and the Compton Effect imply that radiation consists of particles.

The fact is that everything exhibits wave character or particle character depending on the circumstances. But as such, they do not exhibit simultaneously, as shown by Heisenberg's "Uncertainty Principle".

Electromagnetic radiation is definitely a wave motion, covering the enormous range from about 10^{-10}cm for Gamma rays to 10^{8}cm for the longest known radio waves. These radiations are fundamentally the same, all travelling at the speed of light, differing only in their wavelength. Also their energy content is calculated by the Quantum theory; the energy Quantum being proportional to the frequency.

Further by means of Plank's constant and the mass-energy equations of Albert Einstein, DeBroglie showed that a particle of mass M, moving with a velocity V, is associated with a wavelength λ, given by $\lambda = \frac{h}{MV}$; where h is the Plank constant. Therefore wave-particle duality of matter, is an inherent concept of nature.

To enunciate an example: positron electron annihilation results in a loss of mass and a liberation of energy. This energy appears in the form of Gamma radiation. The rest mass of an electron is close to $9{\cdot}11 \times 10^{-28}$ gram, the positron presumably being the same, consequently positron electron annihilation results in a loss of $2 \times 9{\cdot}11 \times 10^{-28}$ gram. Using Einstein's mass-energy equation, the accompanying liberation of energy will be $E = 9{\cdot}11 \times 10^{-28} \times 2 \times 8{\cdot}99 \times 10^{20} = 1{\cdot}64 \times 10^{-6}$ erg = 1·02 million electron volts. Hence the total energy accompanying annihilation is 1·02 million electron volts. From the Quantum theory equations, the resulting wavelength equals $\dfrac{1{\cdot}24 \times 10^{-10}}{1{\cdot}02} = 1{\cdot}21 \times 10^{-10}$cm, which is $0{\cdot}0121 \times 10^{-8}$cm or 0·0121Å. To conserve momentum as required by laws of mechanics, two equal Quanta are expelled in opposite directions. The energy of each Quantum is then $\dfrac{1{\cdot}02}{2}$ million electron volts and the corresponding radiation wavelength is 0·024Å. The mass-equivalent of a photon of wavelength 0·024Å treated as a particle moving at the speed of light can be calculated from the DeBroglie equation in the form $M = \dfrac{h}{\lambda V}$ and equals $9{\cdot}11 \times 10^{-28}$ gram.

Hence when a positron and electron annihilate one another, the photons produced have the same effective mass, so that mass in the broadest sense is conserved.—A. Redman (Shipley, Yorkshire).

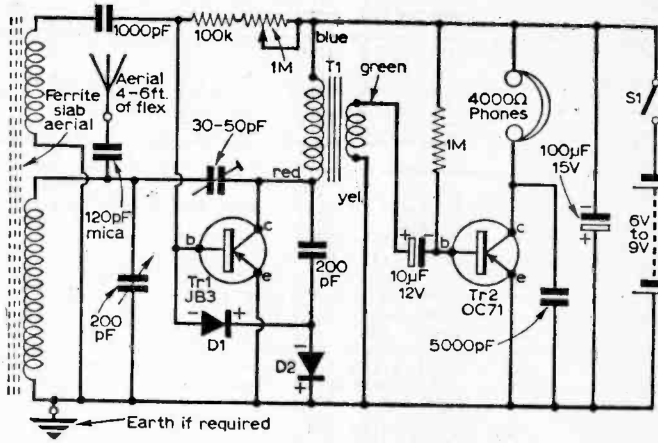


Fig. 1: See Modified T.R.F.

MODIFIED T.R.F.

SIR,—I wonder if this circuit (Fig. 1) of a receiver I have just built would interest any of your readers. The original design was by J. G. Ransome and was published in the December 1961 issue of P.W. under the title of "Transistor T.R.F. Receiver". However, I am using only two transistors instead of three and headphones instead of a loudspeaker. A few feet of thin flex serves as a throw-out aerial.

Reception on medium waves is amazing, with several Home Service transmitters coming in at good strength. After dark, Athlone and many foreign stations are received exceedingly well.—H. E. Chamberlain (Newark-on-Trent, Nottinghamshire).

GENERAL PURPOSE COMMUNICATIONS RECEIVER

(Continued from page 926)

calibration points can be obtained by temporarily taking the b.f.o. output to the aerial circuit, and tuning the b.f.o. to 500kc/s, by means of the 100kc/s 5th harmonic.

The 160, 80, 40 and 20m amateur bands are covered, and commercial 49, 40, 31, 25, 19 and other bands, including ship-to-shore, etc. The marker signal is c.w., and operates the tuning meter, but is only able to produce an audible signal if the b.f.o. is on.

To tune a narrow band of frequencies accurately, the bandspreading pointer is placed on a 100kc/s marking (pointer vertical) and the bandsetting capacitor is adjusted to the marker harmonic, as this gives more accurate setting than possible by visual means. Harmonics beyond the 40th or 50th ecome difficult to locate. Normal reception is of ·irse possible with the marker stage omitted. n image frequencies become apparent on vavelengths (these are 940kc/s, i.e., 2 x i.f. ·y, above the tuned frequency) they should be relatively weak unless the trimmers are adjusted to them in error.

The receiver should give very good results on all bands, and the iron dust cores of the coils may be adjusted with an insulated blade for best results. Initially, set TC1 nearly open, and tune in a low wavelength station. The panel trimmers VC1C and VC2C should tune quite sharply, for best reception. If best results are obtained with either of these trimmers fully open, screw TC1 up slightly, to increase its capacity.

A station of fairly high wavelength in the band is then tuned in, the panel trimmers being left untouched, and the coil cores are adjusted for best results, and to secure the required band coverage. Actual coverage depends to some extent on the positions of the cores. It will be found that at other parts of the tuning range, slight re-adjustment of the panel trimmers will improve reception, especially with very weak signals, and on the short-wave ranges. If TC1 is at a suitable capacity, and the coil cores are correctly positioned, little re-adjustment of the panel trimmers will be needed, throughout the tuning range. Alignment should be undertaken as carefully as if preset trimmers were fitted, but any slight errors will not result in lost efficiency, as the panel trimmers can be adjusted finally to suit. ■

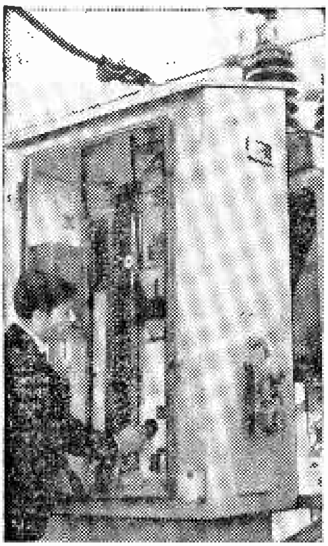
Questions and answers for budding engineers

Q. What age should I be for this advertisement to concern me?

A. Around 16 to 19 if you want to join Electricity Supply from school. If you're an engineering graduate, or diploma-holder, you'll probably be in your early twenties. (Older, if you're a parent or teacher!)

Q. Where can I find an engineering career offering me plenty of scope?

A. Electricity Supply offers *dozens* of good jobs. Few individual firms can hope to match the variety you'll find in the Electricity Supply industry.

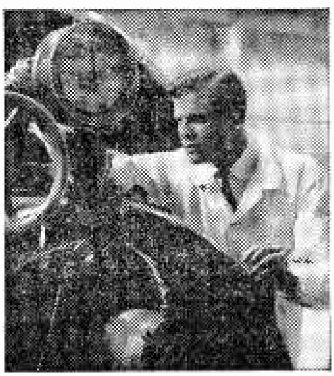


Q. What is Electricity Supply?

A. It's the national industry responsible for generating electricity, transmitting it, distributing it throughout the country and advising how it can be used.

Q. What qualifications must I have?

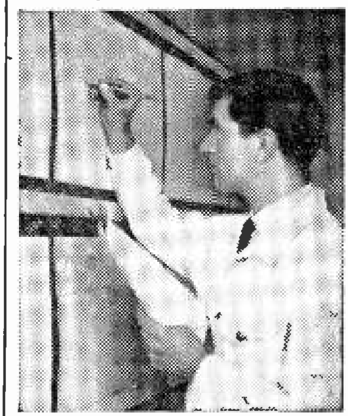
A. School-leavers need either a good Ordinary level G.C.E. including Maths, English, and a Science subject; or two Advanced level passes in Maths and Physics. Graduates need a British degree in electrical or mechanical engineering. Or you need an engineering diploma. You can apply in your last year at school or college — preferably in the January-March period before you take your final exams.



Q. What sort of training do I get?

A. For school-leavers, there's a 5-year apprenticeship. It consists of planned practical experience in the various departments, accompanied, for 'O' level entrants, by day release to a technical college and, for 'A' level recruits, by a 'sandwich' course, both leading to engineering qualifications.

Graduate trainees have a 2-year practical training in one of the main sections of the industry. The training of diploma-holders is planned to take into account past practical experience.



Q. Where do I go from here?

A. It's impossible to tell you here all about an industry that has to *double* its output every ten years. But jobs include everything from running a Power Station to bringing power to a new estate. For full details, write (giving age and exams you've passed) to: The Education and Training Officer, The Electricity Council, 155 Winsley Street, London, W.1.

THE DEMAND FOR ELECTRICITY DOUBLES EVERY TEN YEARS

RECEIVERS & COMPONENTS

"HEATHKITS" can now be seen in London and purchased on easy terms. Free brochure. DIRECT TV REPLACEMENTS LTD., Dept. P.W. 7/9, 138 Lewisham Way, SE14. Tideway 6666.

SPEAKER REPAIRS. Cones/Fields fitted. Clock coils wound. L. S. REPAIRS, Pluckley, Ashford, Kent.

TRANSISTORS. Marked and tested, packets of 10; unmarked but tested, packets of 16; unmarked and untested packets of 40. Duds suitable as Diodes, packets of 80. All packets 20/- each. Any two packets 37/6. C.W.O. K. R. WHISTON, Dept. TPW, New Mills, Stockport.

EXCEPTIONAL VALUE: Picture Tubes, brand new, Mazda 19in., CME1901, Mullard 19in., AW47-90/91, £4/10/-; Mullard 23in., AW59/90, £6/10/-; carriage (insured) paid. 12 months' guarantee. Note, all brand new. We also supply most other sizes completely regunned at £4/17/6, guaranteed 12 months. TOMLINS, 156 Lewisham Way, New Cross SE14. TID 3857.

NEW VALVES, 12 months' guarantee

ECC81/2/3, EF80, EB91	4/11
EZ80/1, EL84, EM84, ECL86, ECL80 ...	7/6
ECL82, PCL82, PL81, U.25, PCF80......	9/11

P. BEARMAN (Tubes)

3 PANK AVENUE, NEW BARNET HERTS.

Tel: BARnet 1934/3185

A1 POST-FREE BARGAINS. First-grade TRANSISTORS: OC44 8/9, OC45 7/3, OC70 OC71 5/3, OC72 OC74 OC78 OC81 7/-, OC170 8/9, OC171 9/3. All other Mullard types stocked. VALVES set tested: EB91 EF91 EF50 EF80 9d., 6F1 10F1 1/- L63 20D1 ECL80 3/-, PY81 PZ30 B36 4/-, PCF80 PL82 PL83 PY80 PY82 KT33C 4/3, PL38 N37 KT36 4/9, PCL83 6/-, PY32 6K25 5/9, 185BT 27SU U25 9/6. 10% discount on six, 25% on 12, any combination. Ready-made Transistor Set 32/-. A1 RADIO COMPONENTS, 14 The Borough, Canterbury, Kent.

ALL TYPES LINE OUTPUT TRANSFORMERS SUPPLIED (RETAIL AND TRADE). Finest service in the country. Send S.A.E. for return of post service. Terms C.W.O. or C.O.D. Trade enquiries invited. D. & B. TELEVISION (WIMBLEDON) LTD., 131 Kingston Road, Wimbledon, SW19. CHErrywood 3955.

CANADIAN MARCONI 52 RECEIVERS

An excellent Communications Receiver covering 1.75 to 16 mc/s in 3 bands. 1 R.F., 2 I.F. stages. 10 valves plus 3 valve crystal calibrator, 10, 100 and 1,000 kc/s. Crash Limiter, Broad/Sharp Selectivity, 500 Mic/amp. valve check/Signal Level meter. 3 in. speaker phone jacks, power required 150 v. H.T. 12 v. a.c. or d.c. L.T. PRICES: Receiver only £5.10., carriage £1. Receiver in steel cabinet with Installation kit comprising power unit ZE12 for a.c. mains 230 or 115 v. or 12 v. D.C., all connecting cables and spares, two pairs padded Headphones and aerial wire. £9.10., carriage £1. Send S.A.E. for detailed leaflet.

G.W.M. RADIO LIMITED

40/42 Portland Road, Worthing, Sussex.

RATES: 7/3 per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton St., London W.C.2.

RECEIVERS & COMPONENTS
(continued)

NEW VALVES, guaranteed: EY86, 7/9; EZ40, 6/6; PCC84, 7/-; PCF82, 7/-; PCL84, 7/3; PL81, 8/6; PY81, 7/-; 6X4, 5/-; plus 6d. p. and p. each. S.A.E. for lists. LEWIS, 46 Woodford Avenue, Ilford, Essex. Telephone CRE 5685.

TRANSISTORS, A.F. 2/-, R.F. 2/9. Post free. Money back guarantee. D. J. MANSELL, 67 Cartway, Bridgnorth, Shrops.

NEW 10.7Mc/s I.F.T.s, usual square can, 3/- each. S.A.E. for latest lists. AJAX ELECTRONICS, 572 Fulham Road, London SW6.

CONDENSERS. Fantastic Bargain! 500,000 miniature condensers, ½in. long, ⅜in. diameter. Tested 750V. Capacity .0001 to .04uf 7/6 per 100, post free. Ideal for transistor sets. MILWARD, 17 Peel Close, Drayton Bassett, Staffordshire.

SONO BUOY TX type 87 with 3 3A4, 1 1L4, 1 B7G crystal approx. 10Mc/s output at 60Mc/s converts to model control TX, only 15/- less valves and xtal 6/-; Sono Buoy Amplifier, type 455 with 3 1T4, 2 1L4 valves, 2 CV488 crystal diodes, only 10/- less valves 5/-; 6V-24V d.c. Miniature Motors with gear box giving approx. 2-8 r.p.m. according to input voltage, 15/- all carriage paid. I will buy surplus American Radio Equipment, Manuals. Write for quotation: CLARKE, 29 Leighinmohr Avenue, Ballymena, N. Ireland.

FOR SALE

EXCEPTIONAL Transistor Portable Tape Recorder, value £6/19/6, complete with crystal microphone, earphone, spools, tape, batteries, instructions, presentation box (extra tapes 100 4/6. Ideal gift, £6/19/6. Satisfaction guaranteed. Postage, packing 2/6. TOMLINS, 156 Lewisham Way, New Cross, SE14.

ASK your dealer for American Ferrodynamics. "Brand Five" Recording Tapes—the best tape value!

FOR SALE
(continued)

TRANSISTORS 100% TESTED

Red Spot Audio, 1/6 each, 14/- doz.
A.E.I. Branded Audio XB103 and R.F. XA102, 2/3 each, 25/- doz.
XC141 (11 watt) Audio, 6/6 each, 12/- pair.

All Guaranteed. Post Free.

Transistor Condensers 1/3 each. 8μF, 25μF, 50μF.

EP10K Multimeters only £4.10 each.
100 c. Slim Mics, only 32/6 each.

Large Stocks of Ex-Govt. Equipment.

B. W. CURSONS

78 BROAD STREET
CANTERBURY. *Phone* 5442

GRUNDIG MA1 Transistor Tape Preamplifiers suitable for use as microphone transformer, pick-up and tape head booster. Listed at 4½ gns., offered at £2/17/6. Send for full details and free lists. LEE ELECTRONICS, 400 Edgware Road, W2. (Paddington 5521.)

AUTOCHANGERS

Garrard Autoslim ...	£8. 5.0
B.S.R. UA16	£8.10.0
GU7 latest B.S.R. Single Player	£5. 0.0

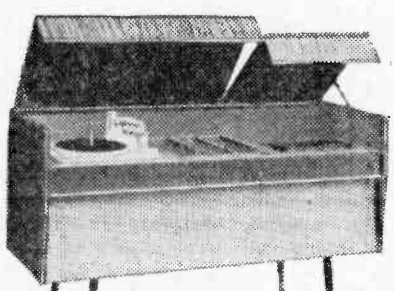
MICROPHONES

ACOS MIC45 (fist mike in metal case)	22/6
ACOS Stick Mike 39/1 ...	32/6

BROADWAY ELECTRONICS

92 Mitcham Road, Tooting, S.W.17.

AMATEUR LICENCE Morse Course. The new Rhythm Method of teaching takes the drudgery out of learning Morse and is the quickest known! For full explanatory booklet: S.A.E. G3CHS, 45 Green Lane, Purley, Surrey.



GP90—FOR STEREO OR MONAURAL
48in. wide, record storage.
Control Panel and Deck 17¾ x 16in.
Tygan grille. Cash Price £19.19.0.

SPECIAL OFFER

LIMITED QUANTITIES in OAK, WALNUT AND MAHOGANY

CASH PRICE **£19.19.0** plus 15/- delivery

Ferrules and adjustable glides 15/- Extra

or Special NO INTEREST Terms
39/- deposit plus 15/- delivery and 10/- weekly for 36 weeks.

Full length motor board with record storage omitted at same price.

A. L. STAMFORD LTD. Dept. C 29

98 Weymouth Terrace
HACKNEY RD., LONDON, E.2.

TELEVISION TECHNICIANS

LINE OUTPUT TRANSFORMERS

SCAN COILS ETC.

LABORATORY TESTED

ALBA: T301, T304, T394, T484, T494, etc.	46/6
BUSH: TV11A, 11B, 12A, 12B, TVG12A, 12B, TRG12A, 12B	44/-
TVG26, TV32, TV33, TVG34, TVG34A, T36, TV36, TVG36, TV36C, TVG36C, TV43	88/6
TV53, TV56, TV57, TV58, TV62, TV63, TV66, TV67, etc.	94/-
TV80 with EY51	109/-
COSSOR: 930 and T931, 933-4-5, 937, 938A, and F, 939 and A and F	61/6
943T, 940-946, 945, 945B	58/6
954F, 947, 949	68/6
DECCA: D17 and C	68/6
DM1, DM2C, DM3, DM4/C	74/-
DM5, DM14, DM17, 444, 555	74/-
DEFIANT: TR1453, TR1753	58/6
DYNATRON:	
EKCO: T893, TC8102, T8105, T8114, TRC124, TC138, T8188, T8193	54/-
TRC139, TC140, T141, TV142	78/6
T161, TC162, T164, T165, etc.	78/6
TC208, TV209, T231, T221, T231F, T248, T283, T284, T293, etc.	58/6
FERGUSON: 103T, 105T, 113T, 135T, 145T	65/6
941T-953T inclusive	58/6
991T-997T inclusive	68/6
203T-246T inclusive	68/6
306T, 308T	64/-
FERRANTI: 14T3, 14T3F, 13TA	47/6
17K3 and F, 17T3 and F	47/6
17K4 and F, 178K4 and F	47/6
17T4 and F	47/6
14T5, 178K5, 17K5	47/6
G.E.C.: BT1251, BT1252, BT1746, BT1748, BT4743	48/6
BT4643, BT5147, BT5246-48	88/6
BT5348-BT5643R inclusive	48/6
and	88/6
H.M.V.: 1824 and A to 1831 inclusive	66/6
1840, 1841, 1842-1848	66/6
All models available.	
INVICTA: T118, T119, T120	54/-
All other models available.	
K.B.: LFT50, LVT50, LFT60, MV60	106/6
All models available.	
MARCONI: All models available.	
MASTERADIO: Most models in stock.	
McMICHAEL: Most models in stock.	
MURPHY: V200, V202C	56/6
V240, V250	94/6
PETO SCOTT, PHILCO: Most models in stock.	
PAM: 908, 909, 952, 953, 958	54/-
PHILIPS: 1768U, 2168U	104/-
1100V, 1200V	74/-
1220U, 1236V, 1238V	74/-
114UF, 114UM, 115U	74/-
1437U, 1446U	74/-
Most models in stock.	
PILOT: Most models in stock.	
PYE: CTM4, FV4C, FV4COL	54/-
V4, VT4, V7, VT7	54/-
LV30, FV1, FV1C	68/6
C817F, CTM17F, CW17	68/6
CW17C, CW17CF, CW17K, etc.	68/6
Most models in stock.	
RAYMOND: Most models in stock.	
REGENTONE: All models available.	
R.G.D.: 6017T, 7017, C54, etc.	58/6
Most models in stock.	
SOBELL: T817, T346	64/-
Most models in stock.	
STELLA: ST5721U	104/-
ST8617U, ST8621U	104/-
ST8917U	104/-
ST6414U, ST6417U	74/-
ST8314U	74/-
ULTRA: 86 series, 185 series, with U25, etc., complete	78/6
Most models in stock.	
VIDOR: CN4217-CN4231 inclusive	64/-

Post and Packing 3/6. C.W.O. Only

Also: Used O.P. Txs., Scan Coils, etc.

ALL GUARANTEED 90 DAYS
(All enquiries S.A.E.)

WYNDSOR TELEVISION

TECHNICAL DIVISION

ST. ALBANS RD., BARNET, HERTS.
BAR 1769

FOR SALE
(continued)

BARGAIN, EIGHT 45 rev/min Brand New Pop singles (value over 50/-) for £1. S.A.E. for details to: R. FLETCHER (P.W.), 24 Old Hall St., Burnley, Lancs.

SUPERHET RADIO CHASSIS

These well-made sets were made for the Government for Forces entertainment, using 6K8, 6K7, 6Q7, 6V6. Slow motion tuning, Choke smoothing, 200-550 meters, size 11 x 5 x 2in., printed scale. BRAND NEW only **57/6**, post 5/-. Case, with 8in. speaker to fit, **27/6.**

12 Volt Vibrator Unit (P.C.R. series), 100 mA output to 250 volts, double choke smoothed, bridge rectified, spare vibrator, indicator bulbs, battery clips, fusewire. BRAND NEW in makers' cartons, case size 6 x 8 x 10in., **22/6,** carr. 5/6.

Clearance Offer, R107 Sets, 9 valves 1.2-17.5 Mc/s, internal speaker and power unit for 12 volts, 100-250 A.C. **£9.15.0.** Air tested, realigned, **£2.10.0** extra. Carr. 30/-. R107, in maker's crates, Brand New, **£17.10.0.**

CR.200, 15-560 Kc/s. Brand New, **£12.10.0,** carr. 30/-.

R109(A). 2-12 Mc/s, 5 spare valves, 2 pairs headphones, HT-LT voltmeter, manual, circuit, Brand New in maker's boxes, **£6.15.0,** carr. 10/-.

1466 Receivers, 30-40 Mc/s, 6 valves, **27/6,** carr. 5/6.

19 Mk2 TX-RX. With 12-volt power unit. New, **£4.10.0,** carr. 10/-.

J. T. SUPPLY (Dept.N),

309 MEANWOOD ROAD : LEEDS 7

WANTED

A PROMPT CASH OFFER for your surplus Brand New Valves and Transistors. R.H.S., Beverley House, Mannville Terrace, Bradford 7.

WANTED: NEW Valves and Transistors, any quantity. S. N. WILLETTS, 43 Spon Lane, West Bromwich, Staffs. Tel: WES 2392.

VALVES WANTED
IMMEDIATE CASH SETTLEMENT
Loose or boxed but must be new
Phone, write or call—
RADIO FACILITIES, LTD.
38 Chalcot Road, London, NW1
PRImrose 9090
THE VALVE SPECIALISTS

WANTED: TEST GEAR, Meters, Valves, Components, Communication Sets, Amplifiers. HUGGETTS LTD., 2-4 Pawson's Road, West Croydon, Surrey.

WANTED VALVES & TRANSISTORS

Must be new and boxed.
Payment by return.
WILLIAM CARVIS LTD.
103 North Street, Leeds 7

WANTED
(continued)

ABSOLUTE TOP PRICES paid for Valves, Transistors, Components, etc. in quantity. Try us first. Cash by return. WOLVERHAMPTON RADIO AND TV SUPPLIES, 42 Darlington Street, Wolverhampton. Tel.: 20315.

NEW VALVES WANTED

Any type, any quantity
CASH PAID
R.S.T. Valve Mail Order Co.,
211A Streatham Road,
Mitcham, Surrey
Telephone: MITCHAM 6202

EDUCATIONAL

Radio Television & Electronics

Learn at home with the world's largest home study organisation, Brit.I.R.E.; City & Guilds; P.M.G.'s certs., etc. Also Practical Courses with equipment. No books to buy.

Write for FREE prospectus stating subjects to

I.C.S.
(Dept. 541), Intertext House, Parkgate Road, London, S.W.11.

LEARN RADIO AND ELECTRONICS the new and practical way. Hosts of absorbing experiments carried out at home under expert guidance to teach you Radio in a new enjoyable and interesting way. Construction, servicing and fault-finding on equipment made easy for the first time! No previous experience needed. No mathematics used. Free brochure from: Dept. 11, P.W., RADIOSTRUCTOR, Reading.

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

DON'T FUMBLE with Formulae. Master Mathematics quickly and easily the Understandable Way.

1st lesson and details FREE

The Dryden School of
UNDERSTANDABLE MATHEMATICS
11F2 Dryden Chambers, Oxford St., London, W.1.
Name.................................
Address.................................

EDUCATIONAL
(continued)

"HOW AND WHY" of Radio and Electronics made easy by a new, non-maths practical way. Postal instruction based on hosts of experiments and equipment building carried out at home. New courses bring enjoyment as well as knowledge of this fascinating subject. Free brochure from: Dept. P.W. 12, RADIOSTRUCTOR, Reading.

THE Incorporated Practitioners in Radio and Electronics (I.P.R.E.) Ltd. Membership Conditions booklet 1/-. Sample copy of I.P.R.E. Official Journal 2/- post free. Secretary, 20 Fairfield Road, London N8.

£'s MADE

By repairing Radio and TV Sets as a job or as a spare time business. Our practical course will show you the way. No previous experience is required.

SEND FOR FREE BOOK TODAY!

RADIOSTRUCTOR

Dept. G77 READING, BERKS

WIRELESS. See the world as a Radio Officer in the Merchant Navy; short training period, low fees; scholarships, etc. available. Boarding and Day students. Stamp for prospectus. WIRELESS COLLEGE, Colwyn Bay.

BECOME "TECHNICALLY QUALIFIED" in your spare time. Guaranteed Diploma and Exam. Home-study Courses in Radio, TV, Servicing and Maintenance, R.T.E.B., City and Guilds, etc. Highly informative 120 page Guide—FREE! N.I.E. (Dept. 363), 148 Holborn, London EC1.

SERVICE SHEETS

SERVICE SHEETS for all makes of Radio and TV 1930-1962. Prices from 1/-, with free fault-finding guide. Catalogue of 6,000 models 1/6. 125 Radio/TV sheets covering many popular models 20/-. S.A.E. inquiries: HAMILTON RADIO, Western Road, St. Leonards, Sussex.

WHY TOLERATE DELAY when we can supply your Radio or TV Service Sheet by return of post at 4/- each, plus postage. List 1/-. Also Manuals for sale and hire. List 1/-. S.A.E. with inquiries please. Mail orders only to S.P. DISTRIBUTORS, 44 Old Bond Street, London W1.

FAULTFINDER FILES, showing common faults that each receiver is prone to and other useful servicing information, 2/- each. List 9d., plus postage. Mail orders only. S.P. DISTRIBUTORS, 44 Old Bond Street, London W1.

SERVICE SHEETS: Radio, TV, 5,000 models. List 1/-. S.A.E. inquiries: TELRAY, 11 Maudland Bk., Preston.

SERVICE SHEETS
(continued)

SERVICE SHEETS, Radio and TV, 4/- each. List 1/-. All orders dispatched on day received. Also manuals for sale and hire. List 1/-. S.A.E. please. SULTAN RADIO, Pantiles Chambers, Tunbridge Wells, Kent.

RADIO SERVICE SHEETS 1936-1962 1/- each. Postage extra. Enclose stamp with enquiries: 85 Charminster Avenue, Bournemouth.

SERVICE SHEETS; also Current and Obsolete Valves for sale. JOHN GILBERT TELEVISION, 1b Shepherd's Bush Road, London W12. Phone: SHE 8441.

METAL WORK

METALWORK. All types cabinets, chassis, racks, etc., to your specifications. PHILPOTT'S METALWORKS LTD., Chapman St., Loughborough.

SITUATIONS VACANT

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, G.C.E., etc., brings high pay and security. "No pass—no pay" terms. Over 95% successes. For details of exams and courses in all branches of Engineering, Building, Electronics, etc. write for 148-page handbook, free. B.I.E.T. (Dept. 242B), London W8.

TV AND RADIO, A.M.Brit.I.R.E., City and Guilds, R.T.E.B. Cert., etc. on "No pass—no fee" terms. Over 95% successes. For details of exams and courses (including practical apparatus) in all branches of Radio, TV and Electronics, write for 148-page handbook, free. B.I.E.T. (Dept. 242G), 29 Wright's Lane, London W8.

CITY AND GUILDS (Electrical, etc.) on "No pass—no fee" terms. Over 95% successes. For details of Electrical Engineering, Applied Electronics, Automation, etc., send for our 148-page handbook, free and post free. B.I.E.T. (Dept. 242A), 29 Wright's Lane, London W8.

BOOKS & PUBLICATIONS

FIND TV SET TROUBLES IN MINUTES from that great book, "The Principles of TV Receiver Servicing", 10/6 all book houses and radio wholesalers. If not in stock from Secretary, I.P.R.E., 20 Fairfield Rd., London N8.

THOUSANDS OF BARGAINS can be found weekly in the Radio, TV, Mechanics and Scientific Sections of EXCHANGE AND MART, 5d. every Thursday.

PIN-POINT TV TROUBLES IN TEN MINUTES. The title can be imitated, but the contents never! The book that really tells you how to fix televisions. Over 340 Cross indexed pages. MUST be able to earn you more than it's cost within two weeks or your money refunded! Price 63/- incl. postage. Write for free trial to SIM-TECH BOOKS, West End, Southampton, Hants.

SOUND RECORDINGS

TAPE BARGAINS in all sizes. Example: Top brand 5¾in. 1,200ft 19/6 p. and p. 1/3. S.A.E. for list. Large choice of New and Used Recorders. E. C. KINGSLEY AND CO., 132 Tottenham Court Road, London, W1. EUS 6500.

MISCELLANEOUS

ELECTRONIC MUSIC?

Then how about making yourself an electric organ? Constructional data available—full circuits, drawings and notes! It has 5 octaves, 2 manuals and pedals with 24 stops—uses 41 valves. With its variable attack you can play Classics and Swing.

Write NOW for free leaflet and further details to **C. & S., 20 Maude Street, Darlington, Durham.** Send 2½d. stamp.

The Plessey Company (UK) Limited has vacancies for

TESTER TROUBLE SHOOTERS AND ELECTROMECHANICAL INSPECTORS

with experience of multichannel transmitters and receivers. Alternatively, candidates with a very sound knowledge of radio and TV would be acceptable. Consideration will also be given to applicants with considerable theoretical knowledge but no practical experience.

These vacancies present excellent opportunities and we are prepared to train ex-Servicemen with experience of maintenance and repair of wireless transmitters and receivers, and radar, etc.

Very good working conditions and facilities. First-class rates of pay. Applicants with the requisite experience are invited to write to or call at—

The Employment Bureau
The Plessey Company (UK) Limited
Vicarage Lane, Ilford, Essex.

Fly as an Air Electronics Officer in the R.A.F.

The domain of the Air Electronics Officer is the whole range of electrical and electronics equipments in an operational aircraft. This covers high frequency long range communication equipment (both voice and wireless telegraphy), VHF communications (short range radio telephone), ASV (air to surface vessel) radar, and the 'black boxes' for the electronic defence of the aircraft.

Having completed your highly-specialised training courses—during which you do about 123 hours flying, including two flights abroad—you fly in the V-bombers of Bomber Command or on Coastal Command reconnaissance.

You are a key man doing a key job—where success depends entirely on your own skill, training and flexibility. There is nothing run-of-the-mill about it. You have a career you can be proud of—and there lies satisfaction.

You are well paid from the very beginning—you earn £976 as a Flying Officer of 21. At 25 as a Flight Lieutenant, drawing full allowances, you could earn over £1,800. You travel the world, meeting old friends on almost every airfield, making new friends wherever you go. You live well in the Officers Mess, and have the opportunity of taking part in almost any sport you can name.

If you are under 26, fit, and hold or expect to gain G.C.E. at 'O' level (or equivalent) in 5 acceptable subjects including mathematics and English language, you are eligible for a Direct Entry commission. Write for further details, giving date of birth and educational qualifications to Group Captain J. A. Crockett, R.A.F., Air Ministry (PW906A) Adastral House, London, W.C.1.

THE FUTURE IS WITH THE R.A.F.

The Royal Air Force

ULTRA VIOLET BULBS

Easy to use source of UV for dozens of practical and experimental uses.
12 volt 36 watt AC/DC SBC 6/6. P. & P. 1/-.
12 volt 60 watt AC/DC SBC 8/6. P. & P. 1/-.
Transformer to suit the above: Input 200-240 A.C. Output 12 volt A.C. 36 watt. 16/6. P. & P. 2/6. Input 200-240 A.C. 12 volt A.C. 60 watt. 22/6. P. & P. 3/6.

Set of 4 colours **FLUORESCENT Paint.** Red, Yellow, Green and Blue in ½ oz. tins Ideal for use with the above Ultra Violet Bulbs, 9/6. P. & P. 1/6.

BUILD AN EFFICIENT STROBE UNIT FOR ONLY 37/6.
The ideal instrument for workshop, lab, or factory. This wonderful device enables you to "freeze" motion and examine moving parts of stationery. We supply a simple circuit diagram and all electrical parts including the NSP2 Strobe tube which will enable you to easily and quickly construct a unit for infinite variety of speeds, from 1 flash in several seconds to several thousands per minute. New modified circuits bring price down to 37/6 plus 3/- P. & P.

NSP2 CV2296 STROBOTRON FLASH-TUBE made by Ferranti, brand new, I.O. base. Price 15/-. P. & P. 1/-.

MAGNETIC COUNTERS
10 IMPULSES PER SECOND

Very latest **High Speed** type ex P.O., guaranteed perfect. type No. 100B, coil 2,300 ohms, for 48 volt D.C. operation (will work on 36 volt). overall size 4 x 1 x 1in. Also available, type 101A which can be used as an interesting accessory with our Strobe unit. Either type price 15/-. P. & P. 1/6.

Variable Voltage Transformer

Input 230 v. A.C. Output 0—260 v. at 2.5 amp. Fully shrouded. New. £5.19.6. inc. carriage. Also available from stock, 5, 8, 10 and 20 amp. Write for details.

ORP 60 MULLARD CADMIUM SULPHIDE PHOTOCELLS
With mounting and leads including circuit for making light sensitive switches, 7/6. Post paid.

SIEMENS H.S. RELAY. Very latest type sealed. H96E. 1,700 ohms plus 1,700 ohms. single C/O contacts. Price 16/6 each, plus 1/- P. & P.

Miniature LEDEX Switch. 24 volt D.C. operation. Two bank 11 position plus Homing Contact. A miniature and compact form of uniselector. Ex brand new equipment, 32/6. P. & P. 2/-.

7 R.P.M. Geared Motor. 12 volt D.C. Double Gearbox. Consumption ½ amp. size 3½ x 2½ x 2in. Weight 15 oz. Small and extremely powerful, 32/6. P. & P. 2/6.

230 VOLT A.C. GEARED MOTORS
Type B16G 80 r.p.m., .26 lb. inch, £1.19.6., P.P. 2/-. Type D16G 5 r.p.m., 1.7 lb. inch, £2.9.6., P.P. 2/6. Type D16G, 13 r.p.m., 1.45 lb. inch, £2.12.6. P.P. 2/6.

12 v. D.C. Reversible Motor with tremendous power weight ratio. 3 position switch. Weight 2.1 ounces. Size 1½ x 1¼in. dia. Speed 7,000 r.p.m. Self lubricating. 15/-, plus 1/-. P. & P.

AVO METER MODEL 7. Individually tested on all ranges and guaranteed. Inclusive of Test Leads. £11.0.0 each. P.P. 5/-. Case 20/-.

SPEAKER
A beautifully made Speaker and Control Unit for the famous Collins TCS communication equipment. Can be used with any top-grade communication setup. Comprising a super 5in. 3 to 5 ohm speaker, 600 ohm matching transformer, constant impedance type volume control. 3 control switches. Fitted in robust crackle finished case. 29/6. P. & P. 4/-.

SERVICE TRADING CO.
All Mail Orders also callers.
47-49 High Street, Kingston on Thames
Tel.: KINgston 9450
Personal callers only
9 Little Newport Street, London W.C.2
(off Leicester Square)
Tel.: GERrard 0576

Become a Television expert this easy way

The Bennett College offers you a complete course

THE Bennett College offers you personal tuition in a course that's non-mathematical and particularly easy to follow. It contains clear diagrams which cover everything you want to know from beginning to end (and even includes the basic principles of sound radio if you wish).

The complete home-study course covers everything: Production of the signal, scanning and reproduction of picture from signals. Aerials, types and purposes. The cathode-ray tube. Time-base oscillators, and output circuits. Synchronisation. Video frequency amplifiers. The TV tuner, turret incremental, etc. Television test gear. Television faults.

For more details, please fill in the coupon below. Your studies cost very little and the book you need is included in the cost.

To THE BENNETT COLLEGE (Dept. 104NTV), Sheffield

Please send me details of the new
TELEVISION SERVICING COURSE

NAME ____________________

ADDRESS ____________________

____

____________________ AGE ______

COMPLETE TELEVISIONS

14 INCH £7.10.0 — 17 INCH £11.10.0

- ★ 12 Months' free replacement on tube, valves and components.
- ★ Ex Rental and repossessed televisions.
- ★ All channels available.
- ★ Demonstrations daily.
- ★ Legs—39/6 per set.
- ★ Part exchange allowance on Radios, TV's etc.

Personal collection advised, or Insured. Carr. 14in., 20/-, 17in., 30/-.

SPEAKERS 7/9 EACH

6in. 8in. 7in. x 4in.
Money back guaranteed.
Enquire for other sizes.
Ex. mfd. salvage. P.P. 2/3.

VALVES 9d each
Thousands of ex-service stock and ex-government. All good. MOST TYPES AVAILABLE. Post 3d. FOR FREE LIST.

RENTAL TUBES
14in., 35/-, 36/24, 14KP4, 141, 5/-. Carr. Ex Rental stock.
12in., 15/-. Carr. 5/-.

Extension speakers, 19/9. 2 tone covered cabinet, 6in. PM speaker, switch and flex. Ideal for kitchen, sick room, etc., P. & P. 3/9.

TAPE RECORDER AMPLIFIER £7.19.6. 5 Valve, 3.5w. output. Size $8\frac{1}{2}$ x 3 x $4\frac{1}{2}$ins. suitable for Cabinet. Ins. Carr. 4/6.

RECORD PLAYER AMPLIFIER 39/6. 3 watts output, A.C. mains isolated, P.P. 3/9.

TAPE CABINET 69/6. For Collaro Studio Deck. Carriage 5/-.

DUKE & CO (London) Ltd

**621/3 ROMFORD RD.
MANOR PARK, E.12**
ILFord 6001/3
Liverpool St. Stn. to Manor Park only 10 mins.

VALVES *SAME DAY SERVICE* NEW! TESTED! GUARANTEED!

SETS 1R5, 1S5, 1T4, 3S4, 3V4. DAF91, DF91. DK91. DL92. DL94 .. Set of 4 for 19/-
DAF96. DF96. DK96. DL96 .. .. 4 for 26/6

1A7GT	11/-	6LD20	8/-	30P4	12/6	EBC33	5/-	EY51	7/6	U25	12/-
1D5	7/6	6P25	8/-	30PL13	12/3	EBC41	8/-	EY86	7/-	U26	9/3
1H5GT	9/-	6P28	11/6	35A5	15/9	EBF80	8/-	EZ40	6/9	U50	5/6
1N5GT	9/-	6Q7G	6/-	35L6GT	8/3	EBF89	8/9	EZ41	7/-	U52	4/6
1R5	6/-	6Q7GT	8/-	35Z3	15/-	EBL21	13/6	EZ80	6/3	U78	4/6
1S4	8/-	6SL7GT	5/9	35Z4GT	5/6	EBL31	17/-	EZ81	6/6	U191	14/6
1S5	5/3	6SN7GT	4/9	50L6GT	7/9	ECC40	13/6	GZ32	8/6	U281	10/6
1T4	3/6	6U4GT	9/9	185BT	21/6	ECC81	4/9	KT61	9/6	U282	15/-
1U5	5/9	6V6G	4/6	AZ1	12/6	ECC82	4/9	KT71	8/-	U291	16/6
2P	22/6	6V6GT	7/3	AZ31	9/6	ECC83	7/-	MU14	6/6	U301	17/-
3A5	9/-	6X4	4/6	B36	7/6	ECC84	7/9	MX40	13/6	U801	21/-
3Q4	7/-	6X5GT	6/9	CBL1	12/-	ECC85	7/9	N18	7/-	UABC80	6/6
3S4	6/-	6/30L2	9/-	CCH35	13/6	ECF80	7/-	N37	11/-	UAF42	8/3
3V4	7/-	7B6	9/-	CL33	12/3	ECF82	8/6	PCC84	7/6	UBC41	7/9
5U4G	4/6	7B7	8/-	CY1	12/6	ECH35	7/3	PCC89	9/3	UBF80	8/3
5V4G	8/-	7C5	7/9	CY31	8/6	ECH42	8/9	PCF80	7/9	UBF89	8/-
5Y3GT	6/-	7C6	7/6	DAC32	9/-	ECH81	7/9	PCF82	8/-	UBL21	14/6
5Z4G	9/-	7H7	7/6	DAF91	5/3	ECL80	7/6	PCF86	9/6	UCC84	13/3
6AL5	3/9	7S7	9/-	DAF96	7/6	ECL82	9/-	PCL82	9/-	UCC85	7/6
6AM6	3/6	7Y4	6/-	DCC90	9/-	ECL86	10/-	PCL83	10/6	UCF80	14/6
6AQ5	6/3	10C1	12/-	DF33	9/-	EF9	15/-	PCL84	10/-	UCH21	13/6
6AT6	6/-	10C2	16/6	DF91	3/6	EF37A	6/9	PCL85	10/6	UCH42	8/-
6BA6	5/9	12AT6	7/-	DF96	7/6	EF39	4/6	PENA4	11/-	UCH81	8/9
6BE6	5/9	12AT7	4/9	DH76	4/9	EF40	11/6	PEN36C	8/-	UCL82	9/9
6BG6G	14/6	12AU7	4/9	DH77	6/-	EF41	7/9	PL36	11/6	UCL83	13/3
6BH6	6/3	12AX7	4/9	DH81	9/-	EF42	7/6	PL81	9/6	UF41	7/6
6BJ6	5/9	12K7GT	4/9	DK32	11/-	EF80	4/9	PL82	7/-	UF89	7/-
6BW6	8/-	12K8GT	9/6	DK91	6/-	EF85	5/9	PL83	7/6	UL41	8/-
6CD6G	27/3	12Q7GT	4/9	DK92	7/6	EF86	8/9	PL84	8/6	UL84	6/6
6F1	10/-	19BG6G	14/6	DK96	7/6	EF89	7/-	PL820	12/6	UR1C	8/-
6F13	9/6	20F2	17/-	DL33	8/-	EF91	3/6	PX4	10/-	UU7	9/-
6F14	9/6	20L1	17/6	DL35	9/6	EL33	9/6	PX25	9/-	UY21	11/-
6K7G	1/11	20P3	18/9	DL92	6/-	EL41	9/6	PY32	11/6	UY41	6/6
6K7GT	5/-	20P4	20/-	DL94	7/-	EL42	9/-	PY80	7/6	UY85	6/6
6K8G	5/-	20P5	15/9	DL96	7/6	EL84	6/6	PY81	7/-	VP4B	9/6
6K8GT	9/-	25L6GT	7/-	DM70	6/6	EM34	7/3	PY82	6/6	VP41	5/-
6K25	12/6	25Z4G	7/6	EABC80	4/9	EM80	8/-	PY83	7/9	W76	4/9
6L6G	6/6	27SU	17/6	EAF42	8/6	EM81	8/6	PZ30	12/6	W77	3/9
6L18	10/-	30L15	11/-	EB91	3/9	EM84	9/6	TH21C	15/-	Z77	3/6

READERS' RADIO

**24 COLBERG PLACE, STAMFORD HILL
LONDON, N.16 STA. 4587**

Post 6d. per valve extra.
Any Parcel Insured Against Damage in Transit 6d. extra.
Any C.O.D. Parcel 3/- extra.

RADIO BOOKS

BASIC ELECTRICITY ELECTRONICS

in Simple straight-forward words and Clear Explanatory Pictures. The Reader is taken Step by Step from Picture to Picture

**LEARN WHILE YOU PAY
FOR ONLY 2/6 PER WEEK**

Officially used by the ARMY, NAVY and AIRFORCE, used by Trainees in the Radio and Electronic Industry.

Write for FREE Illustrated Prospectus giving details of instalment plan.

OSCILLOSCOPE Book	5/6
USING an Oscilloscope	7/-
OSCILLOSCOPE Equipment	5/6
MULLARD Transistor Radios	5/6
MULLARD Ref. Transistor Circts.	13/6
EXTRA Equipment Tape Recorder	6/6
COIL Design and Construction	5/6
TRANSISTOR Superhet	8/-
TRANSISTOR Audio Amplifiers.	6/6
TRANSISTOR Circuits for Radio Control of Models	8/-
RADIO Servicing Instruments	5/6
HIGH Fidelity L/Speaker Enclosures	5/6
BOYS' Book of Crystal Sets	3/-
SERVICING Transistor Receivers	8/-
ELECTRONIC Novelties	5/6
ELECTRONIC Gadgets	4/-
RADIO Valve Data "Wireless World"	7/-
BEGINNERS' Guide to Radio	8/6
MODERN Transistor Circuits for Beginners	8/-
TRANSISTOR Test Equipment	4/-
MAGNETIC Recording. Wire and Tape	5/-
COLOUR Television. 40 Colour plates	17/-
RADIO Engineers' Pocket Book	11/6
RADIO Test Equipment	3/-
40 CIRCUITS using Germanium Diodes	3/6
HI-FI Tape Recorder	3/-
TRANSISTOR Circuits for the Constructor (Bradley) Nos. 1, 2, 3 and 4	4/- each

All above books include postage.
SEND STAMP FOR LISTS

SELRAY BOOK CO.

60 HAYES HILL, HAYES, BROMLEY KENT. Tel. HURstway 1818

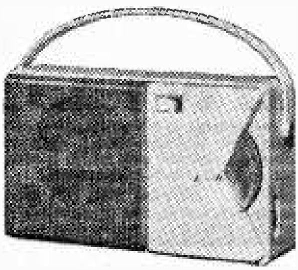
TRANSISTOR SET CASE. 11½ x 8 x 3in. with carrying handle finished in two-tone grey with gold trim, price 22/6. Set of suitable knobs, 5/- extra.
LEATHERCLOTH COVERED RECORD PLAYER CASE, suitable for single player unit, etc. Size 14½ x 13 x 6¾in., supplied with uncut motor-board, carrying handle, gold trim, available in red/grey and two-tone grey. Price 44/-.
LEATHER CLOTH CASE, as above but suitable for automatic record player, size 14½ x 14½ x 8½in., available in blue/grey, red/grey, price 56/-. Uncut motorboard.

Miniature Jack plug and socket 2/6 set.
Miniature Slide Switch 2 pole change over 2/6.
Transformers LT.44/700 Driver and Output 8/- pair.
Top Quality co-axial Cable semi airspaced 6d. yard.
All Co-Axial Accessories available from stock.

PERSONAL EARPHONE

A really sensitive dynamic earphone of exceptionally fine quality. Provides clear reproduction of music as well as speech. Fully guaranteed and complete with ear insert, 3 feet cord, sub miniature plug and socket. **Model CR5** Crystal Earpiece high amp. **Model MR-4.** Magnetic earpiece low amp., 6/- each.

"PRACTICAL WIRELESS" POCKET TRANSISTOR SUPERHET



COMPLETE KIT £7.19.6.

BUILD YOUR OWN PORTABLE RADIO

FUN TO BUILD!
FUN TO OWN!

★ Up to the minute styling, precision-engineered circuitry and extraordinary tonal quality highlight the design of this popular kit. You'll be proud of its "big set" performance—and doubly proud to have built it yourself!

★ Advanced GEC drift-field transistors, high impedance 2½in. speaker, powerful reflex circuit.

★ Built-in ferrite rod aerial, extremely efficient circuit. Uses popular 9V battery (Ever-Ready pp.4) available everywhere.

★ Attractive high impact ivory case is virtually unbreakable. Two controls—off-on/volume and tuning. Ready drilled circuit board.

The perfect kit for beginners interested in transistor circuits. 52/6.
Complete set of parts and step-by-step pictorial instructions.

★ ALL PARTS SOLD SEPARATELY ★

LOUDSPEAKER CABINETS

Baffle type, walnut finish:—

Type suitable for an 8" unit Price 21/-
Type suitable for a 10" unit Price 25/6
Type suitable for a 7" x 4" unit Price 17/6

AUTOMATIC RECORD CHANGERS

BSR UA14 .... £6.19.6
COLLARO C60 .... £7.19.6
GARRARD AUTOSLIM £7.19.6

SINGLE PLAYERS

EMT. 4 Speed with pick-up £3.15.0
BSR GU6 .... £4.19.6
GARRARD TA MKII £8.10.0
EMI BATTERY VERSION £5.9.6

J.B. DILEMIN CONDENSER

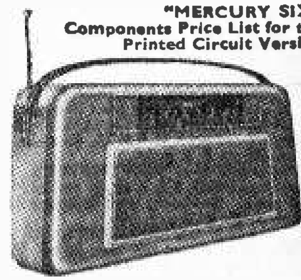
Solid Dilectric available in 300pF or 500pF, 7/6 each.

A NEW EDITION OF THE ALPHA 60-PAGE HI-FI CATALOGUE

A really up-to-date catalogue illustrating and providing Technical Data on all the latest equipment. Price 2/6, post 6d.

Our new 1962/63 48-page catalogue, profusely illustrated, is now available. Please send 1/- in stamps for your copy. Trade Catalogue also available for which please attach your Business Letter Heading.

"MERCURY SIX" Components Price List for the Printed Circuit Version



COIL SET (OSC. and 3 I.F.s) 22/-
DRIVER TRANSFORMER. Type PW/DT 8/3
OUTPUT TRANSFORMER. Type PW/OT. 8/-
FERRITE ROD AERIAL. Type PW/FR 8/6
2-GANG CAPACITOR, Type "OO" 12/6
VOLUME CONTROL, EGEN 10K. S/P SWITCH 6/6
SWITCH 3/6
TRANSISTOR Type Y.C. (set of six) 43/-
XTAL DIODE Type GD9 ....
SPEAKER 22/5
CASE complete with handle, front grille, studs 25/-
CAPACITORS 17/6
RESISTORS 5/-
TRIMMERS, Type MT.31/4A, 1/3 ea. 3/9
PRINTED CIRCUIT BOARD 14/6
COMPLETE DIAL ASSEMBLY (BOXED) 14/6
HARDWARE (Screws, Nuts, Washers, Spacers, Battery Clips, Aerial Cradle) 5/9
Postage and Packing 2/6
INSTRUCTION HANDBOOK 2/6

COMPLETE KIT £9.9.0

TRANSISTORS AND DIODES

Transistors		OC75	8/-	OCP71	25/-	OA73	3/-	GEC51	
OC35	18/-	OC77	12/-	*Matched Prs.*		OA79	3/9	Audio	3/6
OC36	21/6	OC78	8/-	2xOC72	16/-	OA81	2/6	Red	
OC44	6/-	OC81	8/-	2xOC78	16/-	OA85	3/-	Spot	3/6
OC45	6/-	OC84	8/6			OA91	13/-	White	
OC70	6/6	OC170	9/6	*Diodes*		OA95	3/6	Spot	5/-
OC71	5/-	OC171	10/6	OA5	6/-			GEX34	3/-
OC72	8/-	OC201	31/-	OA10	8/-	*Sundry Types*		GEX35	3/-
OC73	16/-	OC202	26/-	OA70	3/-	PXA102	4/-	XD201	1/-

A set of Transistors comprising 1 OC44, 2 OC45, 1 OC81D, 2 OC81, 32/6 set.
Set of Audio Transistors, 1 x OC81, 2 x OC81, Driver Matched Pair, 15/6 set.

ALPHA RADIO SUPPLY CO.

103 LEEDS TERRACE
WINTOUN STREET
LEEDS 7

TERMS: Cash with Order or C.O.D. Postage and Packing Charges extra. Single valves 9d., Minimum Parcel Post charges 2/-. Please include sufficient postage with your order. Minimum C.O.D. fees and postage 3/6. These Postal Rates apply to U.K. only. For full terms of business see inside cover of catalogue. Personal shoppers 9 a.m. to 5 p.m. Mon. to Friday, Saturday 10 a.m. to 1 p.m.

G2AK: This Month's Bargains

★ SHADED POLE MOTORS ★

230v. or 110v. operation. Ideal for fans, blowers or models. One only, 12/6, plus 2/- p. & p. Or pair, £1, plus 2/6 p. & p.

AERIAL EQUIPMENT

TWIN FEEDER. 300 ohm twin ribbon feeder, similar K25, 6d. per yard. K35B Telecon (round) 1/6 per yard. Post on above feeder and cable 1/6 any length.
COPPER WIRE, 14 G., H/D 140ft. 17/-; 70ft. 8/6. P. & P. 2/-. Other lengths *pro rata*.
RIBBED GLASS. 3in. aerial insulators, 1/9 each. Shell ins 2in. 9d. each. P & P: 1/6. Up to 12.
CERAMIC FEEDER SPREADERS. 6in. type F.S. 10d. each. P. & P. 2/-.
CERAMIC "T" PIECES, Type A.T. for centre of dipoles, 1/6 each. P. & P. 1/-.
2 METRE BEAM 5 ELEMENT W.S. YAGI. Complete in box with 1 - 2½in. mast head bracket. **PRICE 49/-.** P. & P. 3/6.
SUPER AERAXIAL CABLE. 75 ohms, 300 watts, very low loss, 1/8 per yard. P. & P. 2/-. 50 ohm, 300 watt coax, very low loss, 1/9 yd. P. & P. 2/-.
ABSORPTION WAVEMETERS. 3.00 to 35.00 Mc/s in 3 switched bands, 3.5, 7, 14, 21 and 28 Mc/s. Ham bands, marked on scale. Complete with indicator bulb. **A MUST** for any Ham shack, 22/6 post free.
VARIABLE CONDENSERS. All brass with ceramic end plates and ballrace bearings, 50 pF, 5/9. 100 pF, 6/6. 160 pF, 7/6. 240 pF, 8/6, and 300 pF, 9/6. All fitted with rear extension for ganging, P. & P. 1/-. Also Flexible Couplers. 1/- each.
B.I. 8 MFD. 1,200 v. D.C. Wkg. Capacitors, 12/6 each. P. & P. 2/-.

CHAS. H. YOUNG LTD.

★ THE COMPONENT SPECIALISTS

Dept. "P", 110 Dale End, Birmingham 4. (*CEN* 1635)
(No C.O.D. under £1 please). (*By return service*)

RECONDITIONED TV SETS

ALL MAKES ★ ALL FULLY SERVICED ★ ALL GUARANTEED ★ NOT EARLY CONVERTED MODELS

14" from £6.0.0 to £9.0.0

3-month Guarantee on Tube and Valves

17" from £11.10.0 to £20.0.0

12-month Guarantee on Tube, 3-month on Valves

WE ALSO STOCK SLIM-LINES

from £23.0.0 to £33.0.0

These sets are as new

PERSONAL COLLECTION ONLY TO ENSURE SATISFACTION

REBUILT TV TUBES

All our TV Tubes are reprocessed to a high standard and are covered by a **12 MONTHS' GUARANTEE.** Each tube is fitted with a new, top-grade electron gun, which is identical with the original, ensuring exact plug-in replacement.

21", £6. 17", £5.10.0. 12", 14" and 15", £4.10.0

★ *Personal collection advised, carriage by arrangement only.*
£1 refunded from the above price if you return your old tube.

PARK LANE RADIO LTD.

548 ROMFORD ROAD, MANOR PARK, E.12
Phone: ILF 6044

FIELD'S RADIOCENTRE

67 LONDON ROAD — **94 HURST ST.**
CROYDON, Surrey — **BIRMINGHAM 5**
CRO 1512 — MID 7072

CALLERS WELCOME.

All mail orders to CROYDON address. Dept. P.W.

SHORT WAVE CONDENSERS. Ex. R.F. Unit No. 26 and 27. Brand new. 75 plus, 75pFd, silver plated. 2/6, plus 1/- P.P.

CARBON HAND MIKES. New with Press switch as used with No. 18 set. 5/- each. P.P. 2/-.

SMOOTHING CHOKES. New. Ex-Govt. 10 henry, 100 mA. Fully shrouded, 5/- each, P.P. 2/-

PRINTED CIRCUIT KIT. With Plastic Bath, 100 sq. ins. board and all chemicals, with full instructions. 17/6 inc. postage.

F.M. LOFT AERIALS. Single dipole type, 12/6. P.P. 2/6.

COAXIAL CABLE. Low loss type, 10 yds. 5/-, P.P. 2/-; 15 yds. 7/6, P.P. 2/6.

THROAT MICS. New, boxed as used on W.S.38. 3/6, P.P. 1/6.

TUNING CONDENSERS, AIR SPACED. With slow motion drive 0.0003 plus 0.0005 on one gang. Can be used separately. 3/6, P.P. 1/-.

MICROPHONE STANDS. Two section telescopic, extend to 6 ft. Chrome-plated stem, heavy base. As used with BM3, DX29, MC70, DM176, MICS. £2.5.0, P.P. 4/-.

PRINTED CIRCUIT BOARD. 12 x 6in. 4/-, inc. postage.

ALUMINIUM SHEET, 16 x 16in., 18 gauge, 6/-, P.P. 1/6.

TRANSISTORS

Revitalize your set. Fit the famous TS1 by BRIMAR in place of those red spots. ONLY 3/6 each.
White Spot 2/6, OC44 6/-, OC45 7/-, OC70 6/-, OC71 6/6, OC72 7/- (14/6 pr.), OC76 8/-, OC81D 7/-, OC81 7/-.
Crystal Diodes. 10,000 sold and never a complaint, ONLY 1/- EACH.
EVERY TYPE OF MULLARD TRANSISTOR DIODE AND OTHER COMPONENTS AT LIST PRICE. By Return.
Connecting wire. 6 assorted colours, 1 yard each colour, 1/9, 2 yards 2/9, 10 yards 10/6.
Resistors, all values, 10% ½ watt, 6d. ea.
Ferrite Rod, 3 x $\frac{5}{16}$in. 1/6.

—all prices post paid—

OAKFIELD RADIO

121 MACCLESFIELD ROAD, HAZEL GROVE, STOCKPORT, CHESHIRE

SAVE POUNDS BARGAIN LIST 6d.

MAIL ORDER ONLY

RES/CAP. BRIDGE 39/6

p. & p. 2/6

Checks all types of resistors, condensers
6 RANGES
Built in 1 hour. Direct reading
READY CALIBRATED
Stamp for details of this and other kits.

RADIO MAIL (Dept. PH)
Raleigh Mews, Raleigh Street, Nottingham

SOUTHERN RADIO SUPPLY LTD.

11 LITTLE NEWPORT STREET
LONDON W.C.2. GER 6653

All goods still available as previously advertised

Everyman's guide to astronomy—a fascinating book—

FOCUS ON STARS

Julius D. W. Staal, F.R.A.S.

Today, probably more than ever before, astronomy is a vital study. This fascinating book by a distinguished astronomer is an account of the universe which will be a practical inspiration to both the layman and the amateur astronomer. The reader will experience a real pioneering excitement as astronomical calculations are made step by step and the wonderful workings of the heavens are unfolded. Clear and simple diagrams are used to illustrate the cause of the tides, the complex motion of the earth, the seasons of the other solar planets, eclipses, the nature of galaxies. Monthly star charts give a unique all-the-year-round guide. The author was previously at the London Planetarium.

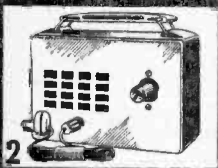
292 pages, 16 plates, numerous figures and 12 star charts.

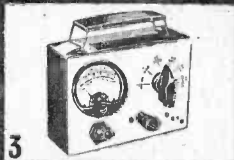
40s. FROM ALL BOOKSELLERS

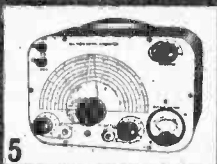
... or, in case of difficulty, 41s. 6d. by post from George Newnes Ltd., Tower House, Southampton St., London, W.C.2.

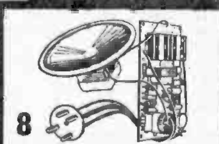
NEWNES

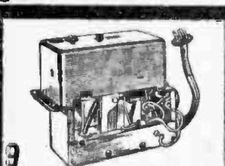
Just a few of our BARGAINS

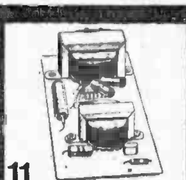


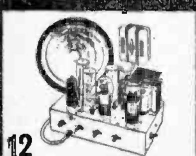


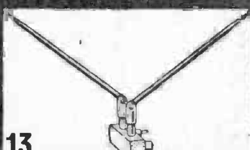


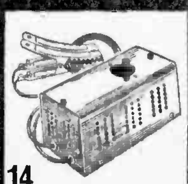












1. **SUPER 5 TRANSISTOR POCKET RADIO INCORPORATING PRINTED CIRCUIT & MINI-EARPIECE.** No Aerial or Earth required 4½ x 3¼ x 1½in. Output 200 M.W. 5 first quality transistors. High flux moving coil speaker. M/L Internal high gain ferrox aerial. £2.19.6. P. & P. 3/6. Circuit diagram 1/6, free with parts. All parts available separately.
2. **TRANSISTORISED POCKET RADIO** with printed circuit, mini-earpiece, high gain ferrox slab aerial. No aerial or earth required. To build yourself for completely personal listening. 4½ x 3¼ x 1½in. Luxembourg in favourable areas. Only 21/-. P. & P. 2/6. All parts available separately.
3. **A.C./D.C. POCKET MULTI-METER KIT.** 2in. moving coil meter scale, calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milliamps 0-10, 0-100. Ohms ranges 0-10,000, 0-100,000, 24/6. P. & P. 2/-. Wiring diagrams 1/-, free with parts.
4. **SIGNAL GENERATORS.** Cash £7.5.0, or 30/- deposit and 6 monthly payments of 21/6. P. & P. 5/6. Coverage 100 kc/s to 100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics. Case 10 x 6½ x 5½in. Three miniature valves and Metal Rectifier. A.C. mains 200/250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent. Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output. Magic eye as output indicator. Accuracy 2 per cent.
5. **SIGNAL GENERATORS.** Cash £5.5.0. P. & P. 5/6. Coverage 120 kc/s to 84 Mc/s. Case 10 x 6g x 4½in. Size of scale 6½ x 3½in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch variable A.F. output and moving coil output meter. Accuracy ±2 per cent.
6. **STAAR 45. 9 v. BATTERY RECORD PLAYER** complete with pick-up and deck. A completely portable player. Head protected by plastic dome with a brush which cleans the stylus as it rises into playing position. 45 r.p.m. Auto on/off switch governed motor, attractive two tone grey finish, £2.14.6. P. & P. 2/-.
7. **CARRYING CASE** for **STAAR 45** or **COMPLETE KIT** beautifully styled in two tone with record compartment. Specially designed to take player and amplifier. Just screw in and connect up. All parts available separately. Case only 22/6. P. & P. 4/-. Complete kit £5.10.0. P. & P. 5/-.
8. **TRANSISTORISED AMPLIFIER,** suitable **STAAR 45.** Output 1 watt. Size 4½ x 2½in. Printed circuit, tone/volume controls plus 4 transistors. Push-pull output complete with 3in. moving coil speaker. Built and tested, 49/6. P. & P. 2/-.
9. **CHANNEL TUNER I.F.** 16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—PCF80 and PCC84 (in series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker, 10/-. P. & P. 3/-.
10. **B.S.R. MONARCH UA8 WITH FUL-FI HEAD.** 4-speed, plays 10 records, 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour brown. Dimensions: 12½ x 10½in. Space required above baseboard 4½in. below baseboard 2½in. Fitted with Ful-Fi turnover crystal head, £6.19.6. P. & P. 5/6.
11. **PUSH-PULL OUTPUT STAGE** inclusive of transistors with input and output transformers to match 3 ohms speech coil, suitable for use with the POCKET RADIO. Kit of parts, including transistors, 19/6. P. & P. 2/-. Wiring diagram 1/6, free with parts.
12. **8-watt PUSH-PULL 4 VALVE AMPLIFIER plus METAL RECTIFIER.** A.C. mains 200-250 v. Size 10½ x 6½ x 2½in. 5 valves. For use with all makes and types of pick-up and mike. Negative feed back. Two input, mike and gram, and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 kc/s. 2 db down to 20 kc/s. Output 8 watts at 5 per cent total distortion. Noise level 40 db down all hum. Output transformer tapped for 3 and 15 ohms speech coils. For use with Std. or L.P. records, musical instruments such as guitars, etc. Suitable for small halls, £8.19.6. P. & P. 6/-. Crystal mike to suit 15/-. P. & P. 2/-. 8in. P.M. Speaker to suit. 12/6. P. & P. 2/-.
13. **INDOOR AERIAL for ITV/BBC/FM.** Complete with standard co-axial plug. Heavy chrome extending dipoles—7ft. fully extended. Plugs straight into TV or VHF Tuner. Fully directional, 10/6. P. & P. 1/6.
14. **NO MORE FLAT BATTERIES.** Charge your own battery overnight with this wonderful little charger. Output 6 and 12 volts, 2 amps. Input 200-250 v. A.C. mains. Mains fuse incorporated. Attractive silver hammer finished case, 6 x 3 x 3ins. Complete with leads and battery clips only 21/-. P. P. 3/6.

RADIO & T.V. COMPONENTS [ACTON] LIMITED

21b HIGH STREET ACTON, LONDON, W.3.

ALL ENQUIRIES S.A.E.
GOODS NOT DESPATCHED OUTSIDE U.K.

Brand new, individually checked and guaranteed

VALVES

AL60	6/-
AR8	5/-
ARDD5	2/-
ARP3	3/-
ARP4	3/6
ARP12	3/-
ARP21	5/6
ARP24	3/6
ARP34	4/-
ARTH2	7/-
ATP4	2/9
ATP7	5/6
AU1	5/-
AU4	5/-
AW3	4/-
AZ31	7/-
BS4A	5/6
BT45	15/-
BT9B	20/-
BT83	22/6
CV54	5/-
CV71	3/-
CV102	1/-
CV264	20/-
CV4014	8/-
CV4015	7/-
CV4025	10/-
CV4046	40/-
CY31	6/-
D1	1/6
D41	3/3
D77	4/3
DA30	12/6
DAF70	35/-
DAF91	6/-
DAF96	7/6
DD41	4/-
DET5	15/-
DET19	3/6
DET20	2/-
DF39	4/-
DF72	7/6
DF91	4/-
DF96	7/6
DK96	7/3
DL92	6/-
DL94	6/-
DL96	7/6
EA50	1/6
EABC80	7/3
EAC91	3/6
EAC91W	7/6
EB34	1/6
EB91	3/9
EBC33	7/-
EBC41	7/9
EBC90	5/-
EC52	8/-
EC70	10/-
EC90	20/-
EC91	3/-
ECC81	5/6
ECC82	6/6
ECC83	7/-
ECC84	7/-
ECC85	8/-
ECC91	4/-
ECF80	10/6
ECF82	8/6
ECH81	7/6
ECL80	7/6
ECL82	8/6
EF36	3/6
EF37A	7/-
EF39	4/-
EF50	1/6
EF54	3/3
EF55	5/-
EF70	4/-
EF73	6/-
EF80	5/6
EF85	6/6
EF86	7/-
EF89	7/-
EF91	3/6
EF92	3/-
EF95	5/-
EL32	3/9
EL33	7/-
EL35	6/-
EL41	8/-
EL42	8/-
EL84	7/-
EL91	4/6
EM80	8/-
EM84	9/-
EN31	10/-
EP71	6/6
EP72	5/-
ESU208	6/-
EY51	8/-
EY86	8/-
EY91	3/-
EZ40	7/-
EZ41	6/9
EZ80	6/-
EZ81	6/9
FW4/500	6/6
G1/236G	9/-
G120/1B	9/-
GL450	10/-
GL464A	10/-
GU20/21	40/-
GZ32	9/-
H63	7/-
HK54	5/-
HL23	6/-
HL23DD	6/-
HVR2	12/6
KRN2A	19/-
KT32	8/-
KT8	22/6
KT33C	4/-
KT44	6/3
KT63	5/-
KT76	10/-
KTW61	6/-
KTW62	6/-
KTW63	6/6
KTZ41	6/-
KTZ63	8/-
MH4	3/6
MH41	5/-
ML4	4/-
ML6	6/-
MS/PEN	6/-
OB3	7/-
OC3	5/6
OD3	6/-
OZ4	4/-
PCC84	7/-
PCC85	8/-
PCF80	7/-
PCF82	8/-
PCL82	8/6
PCL83	10/-
PCL84	9/-
PEN45	4/6
PEN46	5/-
PEN65	6/6
PEN220A	3/-
PL36	10/6
PL81	9/-
PL82	8/-
PL83	8/-
PT15	10/-
PT25H	7/6
PX4	19/-
PX25	9/-
PY32	12/-
PY80	6/9
PY81	7/-
PY82	7/-
PY83	7/3
PZ1-35	9/-
QP21	6/-
QP25	5/-
QS95/10	6/9
QV04/7	7/-
R3	8/-
R3/10	4/-
REL21	25/-
RK34	2/6
RX235	10/-
SP2	3/6
SP13C	4/6
SP41	2/6
SP61	2/-
STV280/40	12/6
STZ280/80	50/-
SU2150A	4/9
T41	7/-
TP25	15/-
TT11	3/-
TT15	25/-
TZ20	16/-
U12/14	8/-
U17	5/-
U18	6/6
U27	8/-
U52	5/-
UCH42	7/6
UBF80	8/6
UL11	5/-
UL12	5/-
UL41	7/-
UL84	7/6
UU9	5/6
UY41	6/-
UY85	6/6
VP23	3/-
VP41	5/6
VR99	8/-
VR105/30	5/6
VR150/30	6/-
VT4C	25/-
VU39	6/-
W31	7/-
X66	8/-
Y63	5/-
Y65	4/-
Y66	8/-
Z31	6/-
1A3	3/-
1A5GT	5/-
1C5GT	7/6
1D8GT	6/-
1E7G	7/6
1G6GT	6/-
1L4	3/-
1LD5	5/-
1R5	6/-
1S4	5/-
1S5	5/6
1T4	4/-
1W4	6/-
2A3	5/-
2A5	6/-
2A6	7/-
2C34	2/6
2C42	25/-
2C46	30/-
2X2	4/-
3A4	5/-
3B7	5/-
3B24	5/-
3E29 (829B)	60/-
3Q4	6/-
3S4	5/-
3V4	6/-
5R4GY	9/-
5T4	9/-
5U4G	5/-
5V4G	8/-
5Y3G	3/-
5Y3GT	6/-
5Z4	8/6
5Z4G	7/-
6AB7	4/-
6AC7	3/-
6AG5	3/-
6AG7	6/-
6AJ7	3/-
6AK5	5/-
6AK7	6/-
6AM5	5/-
6AM6	4/-
6AQ5	7/-
6AT6	5/-
6B7	5/-
6B8G	2/6
6BA6	5/6
6C4	2/6
6C5	6/-
6CFG	4/-
6C6G	3/-
6C8G	5/-
6D6	3/-
6F5G	5/3
6F6G	4/-
6F7	5/-
6F5GT	5/9
6F8G	5/-
6F12	4/6
6F13	5/-
6F33	3/6
6G6G	2/6
6H6M	1/6
6J5	3/6
6J5G	3/-
6J6	3/6
6J7G	5/-
6K6GT	6/-
6K7G	2/-
6K7GT	4/9
6K8G	5/9
6K8GT	8/3
6K8M	8/6
6L5G	6/-
6L6	9/-
6L6G	6/-
6L7G	4/6
6L34	4/6
6N7G	5/9
6N7GT	6/-
6Q7G	6/-
6R7	6/-
6SC7	5/6
6SC7GT	5/-
6SG7	5/-
6SH7	3/-
6SJ7GT	4/9
6SJ7Y	6/6
6SK7	5/-
6SL7GT	6/6
6SN7GT	4/6
6SQ7	6/-
6SS7	3/-
6V6G	4/-
6V6GT	6/-
6X4	5/-
6X5GT	4/6
6Y6G	6/-
6Z4	5/-
7B7	7/6
7C6	7/-
7C7	5/-
7H7	7/3
7Q7	7/-
7V7	5/-
7Y4	5/-
7Z4	4/-
8D2	2/6
9D2	3/-
12A6	2/6
12AH7	5/-
12AT7	5/6
12AU6	9/-
12AU7	6/6
12AX7	7/-
12C8	3/-
12E1	20/-
12H6	2/-
12J5GT	3/6
12J7GT	8/-
12K7GT	4/6
12K8M	7/6
12Q7GT	4/4
12SA7	7/-
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7	3/6
12SL7	5/9
12SN7	5/9
12SR7	5/-
12Y4	2/-
14L7	7/-
1SD2	6/-
20A2	17/6
21B6	9/-
25L6GT	7/9
30	5/-
35L6GT	8/-
35T	17/6
35Z4GT	7/-
37	4/-
38	4/-
42	5/-
58	6/-
59	6/-
75	5/6
76	5/-
77	6/-
78	7/-
80	5/6
81	9/-
82	8/-
84	8/-
85A3	15/-
89	6/-
210VPT 7-pin	2/6
220TH	4/-
250TH	£9
350B	8/-
368A	5/-
393A	15/-
705A	15/-
715B	60/-
717A	8/6
801	6/-
803	22/6
805	30/-
807 (selected)	5/6
807BR	5/-
808	8/-
810	80/-
813	60/-
815	40/-
816	30/-
829A	30/-
832	15/-
832A	35/-
843	7/4
866A	14/-
930	8/-
954	4/-
955	2/6
956	2/-
957	5/-
958A	4/-
1616	3/-
1619	5/-
1625	6/-
1626	4/6
1629	4/6
4043C	13/6
4063	8/-
6064	10/-
6065	8/-
6120	4/-
6516	8/-
7193	1/9
7475	3/-
8013A	25/-
8020	10/-
9001	3/-
9002	5/6
9003	6/-
9004	2/6
9006	2/6
Cathode Ray Tubes	
ACR1	15/-
ACR11	15/-
CV995	15/-
CV1596 (09J)	55/-
E4103/B4	25/-
3FP7	25/-
5BP1	35/-
5CP1	42/6
5FP7	45/-
5FP7A	25/-
7BP7	40/-
12DP7	60/-
VCRX258 (with scanning coil)	45/-
VCR138	30/-
VCR139A	35/-
Photo Tubes	
CMG8	9/-
GS16	12/6
Special Valves	
2J31	45/-
3A/1481	45/-
3J170/E	£3[illegible]
3J192/E	£37.10
4J31	£35
4J50	£35
5D21	£3
723A/B	50/-
725A	30/-
726A	27/6
ACT6	160/-
CV193	30/-
CV238	70/-
CV980	3/-
KR6/3	£4
LS7B	30/-
WL417A	15/-

AND MANY OTHERS IN STOCK, INCLUDING CATHODE RAY TUBES AND SPECIAL VALVES. All U.K. Orders below 10/-, 1/- P. & P. 2/6 over 10/-. Orders over £3, P. & P. free. C.O.D. 2/6 extra. Overseas Postage extra at costs.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS. Please write your requirements.

MARCONI RECEIVER TYPE CR 100/2 tested and aligned £32.10.0 Carr. £1.

TELEPHONE HANDSET. Standard G.P.O. type. New 12/-. P. & P. 2/-.

CONNECTORS FOR TCS RECEIVER, TRANSMITTER AND REMOTE CONTROL, with original plugs on both ends. New £1.17.6 each. P. & P. 2/6.

SPECIALLY BUILT POWER PACK for TCS receivers, 230 volts A.C. mains, including 6X5GT valve, £3.10.0. Carr. 5/-.

R.109 RECEIVER. Covering 2-8 Mc/s. 6 v. D.C. with set of spare valves and carrier. Brand new in original packing case. £6.18.0 including delivery in U.K.

R.109A RECEIVER. Covering 2-12 Mc/s., £7.18.0.

"CONNECT AND FORGET—CANNOT OVERCHARGE" "ESSTRON" MARK I AUTOMATIC BATTERY CHARGER. Initial charging rate 6-7 amps. The charging rate automatically adjusts itself to the charge in the battery. Automatic current and voltage control. Patented application of magnetic amplification to battery charging. Indicator lights show battery fully charged, receiving charge, incorrectly connected or faulty cells. Mains voltage 200/250 v. Built for 6 or 12 v. batteries. Measurements 7 x 5 x 5½in. Weight 8½ lb. Price £7.19.6. P. & P. 3/6.

53 TRANSMITTER SPARES. Full range. Price list on application.

H.R.O. Senior. Table Model. In excellent, fully checked, and tested condition (without coils and power pack), **£15.10.0.** As above but rack mounted model, **£14.10.0.**

Individual frequency coils for above **£1** each or set of 9 **£8.** Either model carriage £1.10.0.

Power pack for above. British made, A.C. 110/200/250 v., **59/6.** Postage 4/-.

COMPLETE V.F.O. UNIT from TX53. Freq. range in 4 switched bands from 1.2-17.5 Mc/s. Two V.T. 501s as oscillator and buffer, 807 as driver, two S130s as voltage stabilizers. Output sufficient to drive two 813s in parallel. Slow motion drive directly calibrated in Mc/s. Provision for crystal control, metering of buffer and driver stage. Power requirements 400 v. and 6.3 v. D.C. Can also be used as low power transmitter. In excellent condition with valves and circuit diagram. **£5.** P. & P. 15/-.

RE-ENTRANT LOUD HAILERS. 500 ohms, approx. 20w. **£6.10.0.** Carr. 10/-

AERIALS 11ft. long. 2ft. long when folded, **15/-.** P. & P. 2/-.

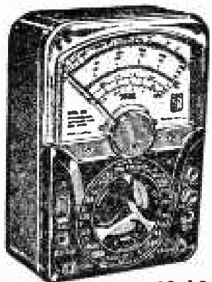
P. C. RADIO LTD.
170 GOLDHAWK ROAD, W. 12
Shepherd's Bush 4946

AMERICAN WIRE RECORDER/REPRODUCER UNIT. Facilities for recording from Dynamic or Carbon microphone and radio. 1 knob operation for recording, rewinding and erasing. Neon recording lever indicator. Internal speaker. Mains 110 v. Supplied with outer transformer, carbon mike and wire magazine for 1 hour's operation and headphones. Price £18.0.0. P. & P. £1. **Spare Wire Magazine 50/-. Dynamic mike and stand £4.**

R.209 RECEPTION SET. A 10-valve high-grade Superhet Receiver with facilities for receiving R/T (A.M. or F.M.) and C.W. frequency 1 Mc-20 Mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Dimensions: Length 12in., width 8in., depth 9in. Weight 23lb. In as new, tested and guaranteed condition, **£23.10.0,** including special headphone and supply leads. Carr. £1.

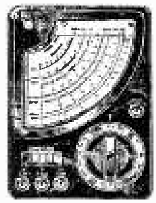
RECEIVER TYPE R.206. Frequency 0.55 Mc to 30 Mc/s in 6 bands. 100-250 v. A.C. or 12 v. D.C. Loudspeaker in power supply unit. High performance super heterodyne, eleven valves including a separate local oscillator valve, beat oscillator valve and two valves (Amplifier and Detector) in the A.B.C. system. In very good condition **£20.10.0,** including power pack. Carriage and Packing 15/-.

BRAND NEW TEST METERS - BEST VALUE - FOR ALL PURPOSES



£8.19.6

30,000 ohms per Volt Model 500
8 Ranges D.C. volts to 1 kV.
7 Ranges A.C. volts to 1 kV.
5 Ranges D.C. current to 12 amps.
3 Range resistance to 60 meg.
Short circuit buzz test. Output meter dB, etc., etc. Size 6¼ x 4¼ x 2¼in. With Leads, Batteries and Instructions.



5 GNS.

20,000 ohms per Volt Model ITI-2
6 Ranges D.C. voltage to 2½ kV.
5 Ranges A.C. voltage to 1 kV.
3 Ranges D.C. current to 250 mA.

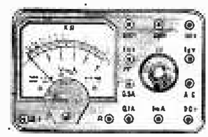
Resistance to 6 meg.

Capacity and dB ranges.

Size 4½ x 3½ x 1⅝in. with leads, batteries and instructions.

75/-

2,000 ohms per Volt Model THL33
0/10/50/250/500/1,000 volts D.C.
0/10/50/250/500/1,000 volts A.C.
0/500µA/10/250mA., D.C.
Resistance 0/10K/100K/1 Meg.
Capacity and dB ranges, etc. Size 5 x 3½ x 1½in. with batteries, test leads and instructions.



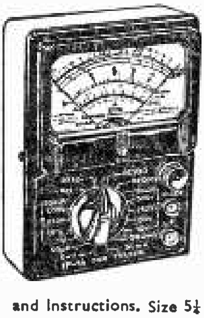
49/6

1,000 ohms per volt Model PT34
0/10/50/250/500/1,000 volts A.C./D.C. 0/1/100/500 mA D.C. Resistance 0/100k ohm.

Ideal pocket sized multi-tester for all radio and domestic work.

Size 3¾ x 2¾ x 1¼in. with battery, leads and instructions.

All Meters Fully Guaranteed for 6 months. Full Service Facilities.



MODEL TP55

A.C./D.C. voltage up to 1,000 in 5 ranges. D.C. current 4 ranges up to 500mA. 4 range resistance to 10 megs. Capacity dB scales, etc.
20,000 ohms/volt
Fully Guaranteed

£5.19.6

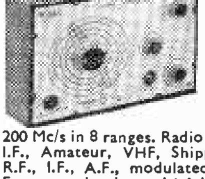
With Test Leads, Battery and Instructions. Size 5¼ x 3½ x 1¾in.

CRYSTAL MIC. INSERTS	ACOS 2in.	10/6
	ACOS 1½in.	7/6
	¾in. sq.	3/6
	ACOS 39-1 Insert	15/-

METER BARGAINS

2½in. Moving Coil double range Voltmeter centre zero. 30-0-30 and 3-0-3 volts. Ideal for transistor tester or voltage measurements. 12/6. Post free.
0/500 microamp, 2½in., flush-mounting. D.C. 20/-
2½-0-2½mA, 2½in. flush. D.C. ... 12/6

TRANSISTOR PORTABLE SIGNAL GENERATOR



PRICE **£7.10.0**
P.P. 2/6

A 1st class Signal Generator covering 220 Kc/s to 200 Mc/s in 8 ranges. Radio broadcasts and I.F., Amateur, VHF, Shipping, TV, etc. R.F., I.F., A.F., modulated R.F outputs. Easy to read and use with full details. Within 2% accuracy. Size 6⅝ x 4⅝ x 2in.
12 MONTHS' GUARANTEE
Leaflet on request.

TRANSISTORS

100% 1st Grade Fully Guaranteed
A selection from our complete list.

XA101	5/-	XB102	4/-	XC121	
XA111	5/-	XB112	4/-	Pairs	10/-
XA102	6/-	XB121	8/6	XC131	
XA112	6/-	XB103	4/6	Pairs	10/-
XA103	4/-	XB113	4/6	XC171	
XA104	4/-	XB133	5/6	Pairs	10/-
XA125	7/6	XC101	6/-	XA701	9/-
XA141	9/6	XC101A	6/-	XA702	17/6
XA142	9/6	XC121	6/-	XA703	25/-
XA143	10/6	XC161	6/-	XC141	10/-
XA151	5/-	XC163	7/-	XC142	15/-
XA152	5/-	XC181	7/-	XC155	20/-
XA161	9/6	XC101A		XC156	22/6
XA162	10/6	Pairs	10/-		

XC141 Pairs 22/6. XC142 Pairs 32/6
XC155 Pairs 42/6. XC156 Pairs 50/-

New Transistor Catalogue with Connection Diagrams, Equivalents and Details included in New 44 Page Catalogue, 1/-.

AF102	27/6	OC23	20/-	OC78D	7/-
AF114	11/-	OC29	20/-	OC82	10/-
AF115	10/6	OC35	18/-	OC83	6/-
AF116	10/-	OC41	9/-	OC84	8/6
AF117	9/6	OC42	9/6	OC170	9/6
AC107	14/6	OC44	7/6	OC171	10/6
ACY21	6/-	OC45	6/6	OCP71	29/-
AFZ12	35/-	OC71	5/-	ORP12	12/6
OC16	20/-	OC72	7/-	MAT100	7/9
OC22	23/-	OC75	7/-	MAT101	8/6
OC23	33/6	OC76	7/-	MAT120	7/9
OC24	29/-	OC78	7/-	MAT121	8/6
OC25	12/-	OC81	7/-	SB305	8/6
OC26	25/-	OC81D	7/-	SB231	12/6

Special Very Low Price for Matched Sets—Let us Quote.

SILICON RECTIFIERS 500mA

XU611	3/-	XU614	5/-
XU612	3/6	XU604	5/-
XU613	4/6	5E10	10/-

REMEMBER—All our transistors and devices are 100% 1st Grade and Fully Guaranteed. We can advise as to the correct type to use.

SOLDERING IRON

Antex miniature 15 watt 220/250 volt Iron. Easily removed $\frac{1}{16}$in. bit. Ideal for all miniature work, 29/6.

DEKATRON

ERICSSON GS12C (CV-1740) Bi-directional 12-way Selector Tube. 25/-.

PHOTO MULTIPLIER

931A (CV2696). Brand new, 60/- each. Base 2/-. Special purpose version 931A-CV337, 80/- each. Base 2/-.

TYPE 38, TRANSMITTER RECEIVER

Complete with 5 valves. In new condition. These sets are sold without guarantee but are serviceable. 7.4 to 9 Mc/s. **22/6** P.P. 2/6
Headphones 7/6 pair. Junction Box 2/6. Throat Mike 4/6. Aerial Rod 2/6.

MARCONI 19 SET CRYSTAL CONTROLLED CALIBRATOR

Crystal controlled oscillators giving either 10 kc/s, 100 kc/s or 1 Mc/s pips. Features neon modulator, supplied with spare valves and full handbook. **79/6** P.P. 2/-
Ideal standard frequency check.

CV2886 (M2H) LIQUID SAMPLING GEIGER TUBE. 370 volts. 22/6. P.P. 1/-.

AMPLIVOX Medium Impedance Lightweight **HEADPHONES**—Special Offer. 45/-. P.P. 1/6.

TAPE RECORDER MOTOR

Miniature Motor designed for Battery Recorders, 4½ to 9 volts. Built in governor, 12/6. P.P. 1/-.

STEREO AMPLIFIER

4-Valve Amplifier with 2 watts output per channel to 3 ohms. Ready built, complete with Dials, Sockets and Knobs. Full tone, volume and balance controls. Crystal input. 220/250 volt mains input.
Fully Guaranteed **79/6** P.P. 2/-
Suitable 8 x 5 inch Speakers 49/6 Pair.

VALVES AND CRYSTALS

New Catalogue Now Ready
More Types—Lower Prices

Henry's Radio Ltd.

PADdington 1008/9

5 HARROW ROAD, LONDON W.2
Open Monday to Sat. 9-6, Thurs. 1 o'clock

PLEASE TURN TO BACK PAGE

Tubes

HIGHEST QUALITY—
COMPARE OUR PRICES

Carr. & Ins. 12/6

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMI-SCOPE, BRIMAR, FERRANTI TYPES, PROCESSED IN OUR OWN FACTORY

GUARANTEED	6 Months	12 Months
12in.	£2. 0.0	£3. 5.0
14in.	£2.10.0	£3.15.0
15-17in.	£3. 5.0	£4.10.0
21in.	£3.15.0	£5.15.0

NEW TYPES
MW 31/74 £4-0-0
MW 36/24 £5-0-0
CRM 172 MW 43/64 £6-0-0

RECTIFIERS, CHARGING. 1½A, 3A.

40 WATT FLUORESCENTS. With lamps, white batten, choke starter. Fantastic value. **49/-**

12 POTS. Popular values. 5K. to 2 Meg. Unused, mixed, pre-set, long sp., switched, etc. **4/6**

CO-AX, standard and low loss, 25 yds., 11/6, 50 yds., 22/-, 100 yds., 42/6. Co-ax Plugs 1/3. Wall outlet boxes 3/6

4-SPEED RECORD PLAYERS. Latest Turntable, together with lightweight Staar Galaxy dual sapphire crystal turnover pick-up head. Amazing value (pick-up only 19/-). £3.10.0. Carr. 3/-.

NEW SPEAKER CABINETS, covered in attractive Rexine, Gold Metal front 11/-. Or complete with 7 x 4 Speaker, 19/-. P.P. 1/6.

3 VALVE AMPLIFIERS. Kit of new parts, consisting chassis mains and output transformers, valves (P61, 696G, 6X5G) and all components. With full instructions for making high gain amplifier with separate base and treble controls, negative feedback, etc. Truly unusual value at 29/-.

P.V.C. CONNECTING WIRE. 100 yds. 30 mil: Special Price 7/6. 200 yds. 30 mil: special price, 12/6. 25ft. Coil, 1/-, 5 Coils different colours, 4/-. Connecting flex. Prices as above.

100 RESISTORS 6/6
Excellent. Sizes ½-3 watt.

100 CONDENSERS 10/-
Miniature Ceramic and Silver Mica Condensers. 3 pF to 5,000 pF. LIST VALUE OVER £5.

CONDENSERS. 25 Mixed, Electrolytic. Many popular sizes. List Value £5, Our Price 10/-.

TUBE SNIPS

Due to huge Bulk Special Purchase we are offering MW31/74 Tubes at the unrepeatable price of 29/-. MW 36/24 ditto, 39/-. P.P. 12/6. The above are guaranteed for 6 months.

IVORY GOLD KNOBS 1" Diameter, half price 1/2, 5 for 4/6; ½" 1/-, 5 for 4/-; top quality ½" sp. grub screws.

HEADPHONES. Ex-Govt. quality with Jack-plugs, 7/6 pair. P.P. 1/6.

MIRROR GALVANOMETERS. Evershed and Vignoles, 45 second swing, high sensitivity, heavy gunmetal cases, with spares, in transit case, unused. £3.10.0.

PORTABLE RECORD PLAYERS. Takes all sizes Records, all speeds, amplifier, auto-changer, Garrard new "Slimline" Gram. In two-tone Case. All absolutely new. **14 gns.**

VALVE HOLDERS. B76, 6d. ea., with Screen 8d. ea., B9A 6d. ea. with Screen 8d. ea. Int. Octal 6d., Mazda Octal 4d., B8A 6d. (less 15% in dozens).

SILICON RECTS.

250V 500mA standard TV replacement. Top quality 8/6 (3 for 24/-).

MINIATURE EARPHONES. Latest personal portable or deaf aid types. 3ft. cord and standard jacks. Magnetic or xtal. 5/9. Jack socket to match, 1/9.

PORTABLE RECORD PLAYERS. E.M.I. turntable, complete with amplifier, in excellent modern carrying case with amplifier and 7 x 4 speaker. Amazing value. Carr. 6/-. **£7.10s**

GARRARD TA MK. II PLAYERS. Latest quality deck at a most competitive price. **£7.19s**

TRANSISTORS

Huge reductions. Red Spot standard L.F. type now only 1/6; White Spot R.F. 2/-. Mullard Matched Output Kits (OC81O and 2—OC81's), 14/-. Receiver Kits, OC44, OC45(2), OC81D, OC81(2), six transistors. 26/-.

TRANSISTOR CONDENSERS. Latest single-ended sub-miniature 5μF 3V, 1/-; 5μF 6V, 1/3; 10μF 3V, 1/3; 30μF 3V, 1/3; 30μF 6V 1/6; 100μF 6V 1/8; 120μF 9V, 2/-.

COSSOR D.B. SCOPE TUBES. Type 09D Split Beam, ideal for building your own quality oscilloscope whilst stocks last. **55/-**

TAPE AMPLIFIERS. Professional quality, famous make (listed approx. £35) very compact, two inputs, mixing, record/playback, erase. Requiring only deck, speaker, mike, grey case. **£9.10.0**

P.M. SPEAKERS. 3Ω Top Makes.
6½in. 8in. **7/6** 5in. 7 x 4in. **8/6**

VALUE!
4 watt AMPLIFIERS

excellent amplifier with high gain preamp stage, (1013) driving 20P3 output stage, complete with 8in. speaker. In attractive 2-tone case. Tone control, negative feed-back, ready for immediate use, individually tested. Amazing volume and clarity, ideal for guitars, record players, p.a. in small halls, baby alarms etc. Easily worth £5. Our price whilst stocks last. Carr. Packing etc. 7/6. **45/-**

★ VALVES ★

By return of post

THE MOST COMPREHENSIVE COMPETITIVE VALVE LIST IN THE COUNTRY

10% DISCOUNT SPECIAL OFFER TO PURCHASERS of any SIX VALVES marked in black type (15% in dozen). Post: 1 valve, 6d., 2-11, 1/-.

NEW LOW PRICES GUARANTEED 3 MONTHS

FREE TRANSIT INSURANCE. All valves are new or of fully guaranteed ex-Government or ex-equipment origin. Satisfaction or Money back Guarantee on Goods if returned unused within 14 days.

OZ4	5/-	6J5GT	4/-	12Q7GT	5/-	DF33	9/9	EM81	8/6	SU25	16/-
1A5GT	5/-	6J6	4/-	12SA7	7/-	DF91	3/6	EM84	9/-	SU2150	4/6
1A7GT	11/-	6J7	8/6	12SG7	5/-	DF96	7/3	EM85	10/-	T41	7/6
1C5GT	9/-	6J7G	4/9	12SH7	3/6	DF97	8/6	EN31	16/-	TDD4	7/6
1D5	8/-	6J7GT	7/6	12SJ7	5/6	DH63	6/-	EY51	7/9	U14	8/-
1D6	9/9	6J8	9/6	12SK7	4/9	DH76	5/-	EY86	7/6	U18	8/-
1H5GT	9/9	6K6GT	6/6	12SN7GT	7/9	DK32	11/-	EZ35	6/6	U22	6/9
1L4	3/3	6K7	5/9	13D3	9/-	DK91	5/6	EZ36	6/6	U24	16/-
1LD5	3/6	6K7G	2/3	14S7	14/9	DK92	7/-	EZ40	6/6	U25	11/6
1LN5	4/9	6K7GT	4/6	19AQ5	7/6	DK96	7/3	EZ41	7/-	U26	9/9
1N5GT	9/9	6K8GT	8/9	19BG6	19/-	DL33	8/-	EZ80	6/-	U31	7/-
1R5	5/6	6K25	7/6	20D1	9/6	DL35	9/-	EZ81	6/6	U33	14/-
1S4	8/-	6L1	12/6	20F2	9/6	DL63	6/-	FW4/500	8/-	U35	12/6
1S5	4/6	6L6G	6/6	20L1	16/-	DL75	6/-	FW4/800	8/-	U37	26/-
1T4	3/6	6L18	9/-	20P1	8/9	DL82	9/-	GT1C	7/-	U50	5/9
2A3	6/6	6L19	11/-	20P3	12/6	DL91	8/-	GZ32	8/9	U52	4/9
2A7	9/6	6LD3	8/-	20P4	18/-	DL92	6/-	GZ34	12/6	U76	5/6
2D21	5/-	6LD12	6/9	20P5	15/-	DL94	6/9	HL41DD	8/6	U78	5/-
3A4	4/9	6LD20	7/9	25A6G	8/-	DL96	7/3	HN309	19/-	U191	12/6
3A5	9/-	6N7	7/6	25L6G	6/9	EABC80	6/9	HVR2	10/6	U281	9/6
3D6	4/6	6P1	7/6	25L6GT	7/9	EAC91	8/6	1W4/350	7/6	U282	15/-
3Q4	7/-	6P25	8/6	25Y5G	8/-	EAF42	8/-	1W4/500	7/6	U301	15/-
3Q5GT	8/-	6P28	12/6	25Z4G	7/-	EB41	7/-	KLL32	8/6	U309	6/9
3S4	6/-	6Q7G	6/-	25Z5	8/-	EB91	3/-	KT32	6/9	U329	6/9
3V4	6/9	6Q7GT	8/6	25Z6G	8/-	EBC33	4/9	KT33C	4/6	U339	11/-
5R4GY	12/6	6R7G	8/6	30C1	7/-	EBC41	8/-	KT36	12/6	U801	19/-
5T4	8/-	6SA7	5/6	30C15	11/6	EBC81	7/9	KT44	7/6	UABC80	8/-
5U4G	4/9	6SG7	4/9	30F5	6/-	EBF80	7/9	KT45	8/6	UAF42	7/9
5V4G	7/9	6SH7	3/-	30FL1	9/6	EBF83	9/6	KT61	8/6	UB41	7/9
5Y3G	5/9	6SK7	5/-	30L1	6/9	EBF89	8/6	KT63	5/9	UBC41	7/9
5Y3GT	5/9	6SL7GT	5/9	30L15	9/6	EBL21	12/6	KT76	8/6	UBC81	9/6
5Y4G	11/-	6SN7GT	4/6	30P4	9/6	EBL31	17/6	KTW61	5/9	UBF80	8/-
5Z4	11/-	6SQ7	5/9	30P12	7/6	EC91	4/6	KTW62	5/9	UBF89	7/6
5Z4G	7/6	6SS7	3/6	30P16	6/6	ECC31	7/6	KTW63	5/9	UBL21	14/6
5Z4GT	11/-	6U4GT	10/6	30P19	17/6	ECC32	4/-	KTZ63	5/6	UCC84	14/6
6/30L2	9/-	6V6G	5/-	30PL1	9/6	ECC33	4/6	L63	2/9	UCC85	7/-
6A6	4/9	6V6GT	6/-	30PL13	13/-	ECC34	9/-	LN152	7/-	UCF80	15/-
6A7	10/-	6X2	7/9	35L6GT	8/6	ECC35	6/-	MU14	7/6	UCH21	12/-
6A8G	8/6	6X4	5/-	35T	25/-	ECC40	14/-	N37	11/-		
6A8GT	13/6	6X5G	5/-	35W4	6/9	ECC81	5/6	N78	13/-	UCH42	7/3
6AB8	7/-	6X5GT	5/6	35Z4GT	5/6	ECC82	6/-	N108	16/-	UCH81	8/-
6AC7	3/3	6Y6G	7/6	35Z5GT	8/-	ECC83	6/6	N152	8/6	UCL82	9/9
6AG5	3/-	7A7	8/6	41	7/6	ECC84	8/-	P41	4/6	UCL83	13/6
6AG7	7/6	7B7	9/-	42	7/6	ECC85	7/9	P61	2/9	UF41	7/6
6AK5	5/-	7B7	7/9	50C5	9/-	ECC89	16/-	PABC80		UF42	5/6
6AL5	3/-	7C5	7/3	50CD6	19/-	ECC91	4/-		11/6	UF80	7/-
6AM6	3/-	7C6	7/6	50L6GT	8/6	ECF80	8/6	PCC84	6/9	UF85	7/6
6AQ5	6/-	7H7	7/3	52KU	10/6	ECF82	8/6	PCC85	8/9	UF86	14/6
6AT6	5/9	7K7	9/6	53KU	10/6	ECH21	12/6	PCC88	14/-	UF89	7/-
6AU6	7/6	7Q7	8/6	61SPT	11/-	ECH35	7/6	PCC89	9/-	UL41	7/-
6B7	8/6	7S7	9/-	62BT	13/6	ECH42	8/6	PCC189	13/6	UL44	11/-
6B8G	3/-	7V7	7/9	75	6/6	ECH81	7/9	PCF80	7/-	UL46	9/9
6BA6	5/9	7Y4	6/9	78	6/6	ECH83	8/3	PCF82	7/3	UL84	7/-
6BE6	5/9	7Z4	7/-	80	5/9	ECL80	7/-	PCF84	16/-	UM80	9/6
6BG6G	15/-	8D3	3/-	83	9/6	ECL82	9/6	PCF86	12/6	UR1C	8/-
6BH6	6/-	10C1	11/6	185BT	19/6	ECL83	11/7	PCL82	7/3	UU6	12/6
6BJ6	6/-	10C2	14/6	803	19/-	ECL86	10/6	PCL83	10/6	UU7	9/6
6BR7	9/6	10C14	8/-	807(A)	5/6	EF22	7/-	PCL84	7/6	UU8	17/-
6BW6	7/6	10F1	5/9	808	7/6	EF36	3/3	PCL85	11/6	UY1N	11/-
6BW7	5/6	10F9	10/6	813	55/-	EF39	4/6	PCL86	12/6	UY21	11/-
6BX6	4/9	10F18	10/-	832	14/-	EF40	12/-	PEN45	8/6	UY41	6/-
6C4	2/3	10L14	7/-	866A	11/6	EF41	8/-	PEN46	5/-	UY85	6/6
6C5	5/6	10LD3	7/9	954	2/-	EF42	7/6	PL33	8/3	VP41	5/6
6C6	3/9	10LD11	14/6	956	2/6	EF50-BR	2/-	PL36	9/6	VR105	5/6
6C9	11/-	10LD12	8/-	5763	9/6	USA	3/-	PL38	16/6	VR150	5/-
6CD6G	19/6	10P13	11/-	9001	4/-	EF54	3/3	PL81	8/6	W61M	11/-
6CH6	7/6	10P14	9/-	9002	4/9	EF80	4/9	PL82	6/6		
6D2	3/-	10P18	7/-			EF85	6/6	PL83	6/6	W76	4/9
6D3	9/6	12A6	1/9	ATP4	2/9	EF86	9/-	PL84	8/-	W81	7/3
6D6	4/3	12AH8	9/-	AZ31	8/-	EF89	6/9	PL820	8/6	X61M	11/-
6F1	4/9	12AT6	7/6	AZ41	11/-	EF91	3/-	PX4	12/6	X63	8/6
6F6G	5/9	12AT7	5/6	B36	7/9	EF92	4/6	PX25	9/6	X65	11/-
6F12	3/-	12AU6	9/6	C1C	9/6	EF96	3/-	PY31	9/-	X66	11/-
6F13	6/9	12AU7	6/-	CBL1	26/6	EF183	14/-	PY32	10/-		
6F14	9/6	12AX7	6/6	CBL31	21/-	EF184	12/-	PY80	6/9	X76M	11/-
6F15	9/6	12BA6	7/6	CCH35	14/-	EL32	4/6	PY81	6/6	X78	21/-
6F16	8/-	12BE6	7/6	CL33	9/6	EL33	7/9	PY82	6/-	X79	16/6
6F19	6/6	12BH7	9/9	CY31	9/-	EL35	7/-	PY83	7/-	X81M	9/-
6F23	6/6			D77	3/6	EL41	8/-	PY88	9/9		
6F24	12/-	12C8	6/6	D152	5/9	EL42	8/9	PZ30	9/6	Y63	6/3
6F25	13/-	12E1	17/6	DA30	12/6	EL81	11/-	R18	11/-	Z63	4/9
6F32	6/6	12J7GT	9/-	DAC32	9/9	EL83	11/-	R19	11/-	Z66	9/6
6F33	6/6	12K7GT	4/9	DAF91	4/6	EL84	7/-	RL18	9/-	Z152	4/9
6J5	4/3	12K8	11/-	DAF96	7/3	EL91	4/-	SP41	2/6	Z719	4/9
6J5G	3/-	12K8GT	9/6	DET19	2/9	EM80	7/9	SP61	2/6	ZD152	7/9

Post: 2 lbs. 2/-, 4 lbs. 2/6, 7 lbs. 3/6, 15 lbs. 4/-. etc. No C.O.D. ALL ITEMS LESS 5% AND POST FREE IN DOZENS. LIST OF 1000 SNIPS, 6d.

TECHNICAL TRADING CO.

RETAIL SHOP
350-352 FRATTON ROAD, PORTSMOUTH
MAIL ORDER ONLY **DEVONIAN COURT, PARK CRESCENT PLACE, BRIGHTON 7, SUSSEX**

← TURN PAGE →