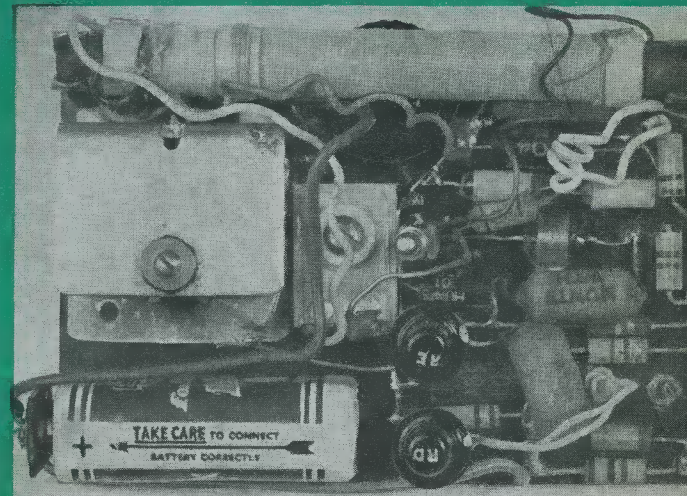
MARCH 1961

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

CONTENTS



"RANGER-3" Transistor Receiver

DATA Publications

1/9

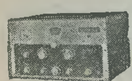
The World-famous Heathkit range of equipment

For the Discerning who require the Best Performance at Minimum Price

HI-FI FM TUNER

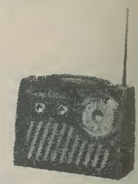
This model is available as two units which, for your convenience, are sold separately. They comprise an R.F. Tuner Unit, Model FMT-4U (£3.2.0 including Purchase Tax) with I.F. output of 10.7 Mc/s, and an Amplifier Unit complete with attractively styled cabinet, also power supply and valves. Model FMA-4U (£10.10.6) making a total cost for the equipment of £13.12.6.

AMATEUR TRANSMITTER Model DX-100U



This is the most popular Amateur transmitter in the world and requires no introduction to "Hams" the world over. Covers all bands from 160–10 metres. Self-contained, including power supply, Modulator and V.F.O. £78.10.0

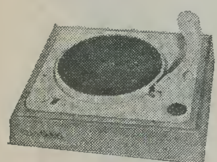
4-WAVE TRANSISTORISED PORTABLE RECEIVER, Model RSW-1



This possesses Medium, Trawler and two Short-wave bands and is mid-way between the domestic broadcasting and professional general communications receiver. Ideal and inexpensive for those who wish to listen to world broadcasts, shipping and aviation communications, etc. It is not the set to buy if you wish only to enjoy domestic broadcasting.

In a handsome solid leather case, it has retractable whip aerial and socket for car radio use. £20.18.6

TRANSCRIPTION RECORD PLAYER



TRANSCRIPTION RECORD PLAYER, Model RP-1U. This new RP594 Collaro Transcription Unit has a Ronette Stereo Pick-up, giving excellent results on stereo or mono (33, 45, or 78 r.p.m.) discs. Complete with furniture-grade wooden plinth. £12.10.0 Heavy Turntable £15.0.0.

THE "COTSWOLD". This is an acoustically designed enclosure 26" x 23" x 15½" housing a 12" bass speaker with 2" speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 32–20,000 c/s. Capable of doing justice to the finest programme source, its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, crossover unit, level control, Tygan grille cloth, etc. All parts pre-cut and drilled for ease of assembly and left "in the white" for finish to personal taste. £19.18.6

THE "COTSWOLD"

HI-FI EQUIPMENT CABINETS

Range now available to suit vastly differing needs and all left in white for finishing to personal taste. Will house Record Player, F.M. Tuner, Amplifier and, in some models, also your Tape Deck. The "GLOUCESTER" cabinet is illustrated below.

Send for details of whole range. Prices from £10.10.0 *to* £17.8.0.

RECENT ADDITIONS TO THE RANGE

TAPE RECORDING/REPLAY AMPLIFIERS. Stereo (TA-IS) £22.4.0. Mono (TA-IM) £16.14.0

R.F. SIGNAL GENERATOR, Model RF-IU. Up to 100 Mc/s fundamental and 200 Mc/s on harmonics and up to 100mV output on all bands. £11.11.0

GRID DIP METER, Model GD-IU. £9.19.6. Transistorised version, Model XGD-1. £9.18.6

★ **In THE FOREFRONT OF GENERAL COVERAGE RECEIVER DESIGN.** The fully transistorised Model GC-IU, with 4 piezo-electric transfilters will be available shortly £38.15.0

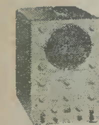
The "GLOUCESTER" (open)

All prices include free delivery U.K. Deferred terms available over £10.

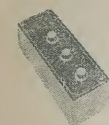
DAYSTROM LTD DEPT. RC3 GLOUCESTER ENGLAND

Easily-built Equipment Heathkit of excellent quality

at much lower cost

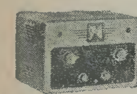


O-12U

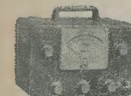


DC-1U

S-33



DX-40U



AG-9U

UJR-1

MA-12

5" OSCILLOSCOPE: O-12U. "Y" sensitivity 10mV/cm, 3 c/s to over 5 Mc/s. Rise time, 0.08 μsecs or less. Sweep, 10 c/s to 500 kc/s. Electronically stabilised. £34.15.0

2¾" PORTABLE SERVICE OSCILLOSCOPE: OS-1. Ideal instrument for service and portable use. Size 5" x 8" x 14". Wt. 10½lb. £18.19.6

DECADE CAPACITANCE BOX: DC 1U. Provides capacity values from 100 mmf to 0.111 mfd in 100 mmf steps. Ideal for experimental, development and design work. £5.18.6

VALVE VOLTMETER: V-7A. The world's largest-selling VVM. Measures volts to 1,500 (DC & RMS) and 4,000 pk. to pk.; resistance 0.1Ω to 1,000MΩ DC. Sensitivity: 7,333,333 ohms per volt. £13.0.0

HI-FI STEREO 6 WATT AMPLIFIER: S-33. Low-priced but high quality; less than 0.3% distn. at 2½ watts per channel. £11.8.0

HI-FI STEREO 16 WATT AMPLIFIER: S-88. Superb reproduction for the man who wants the best in Hi-Fi. Only 0.1% distortion at 6 W/chnl. Many special features. £25.5.6

"HAM" TRANSMITTER: DX-40U. 75W CW; 60W pk. c/c phone; 40W into Aerial. £29.10.0

HI-FI SPEAKER SYSTEM: SSU-1. Ideal twin speaker/ducted-reflex cabinet for stereo/mono in average room (left "in the white"). Legs £1.7.0 extra. £10.5.6

AUDIO GENERATOR: AG-9U. 10 volts, 10 c/s to 100 kc/s pure sine-wave. Switch-selected frequencies attenuation. £19.3.0

JUNIOR TRANSISTOR RADIO: UJR-1. Youngsters are not excluded from our kit programme. This special single transistor set is an excellent introduction to radio and an instructive present. £2.16.6

TRANSISTOR PORTABLE RADIO UXR-1. In elegant solid hide case, with golden relief. Six transistors, dual-wave, fine reproduction, very easy to build. £14.18.6

SINGLE CHANNEL 12 WATT HI-FI AMPLIFIER: MA-12. Ideal for stereo conversions, etc. Generous auxiliary power provided. £9.19.6

COLLARO "STUDIO" TAPE DECK. This extremely attractive and compact 3-speed monaural tape deck features digital counter, pause control and piano-key switches. £17.10.0

(Following models not illustrated)

CAPACITANCE/RESISTANCE BRIDGE: C-3U. Measures capacity, 10pF to 1,000μF. Resistance 100Ω to 5MΩ; Pwr. factor. £7.19.6

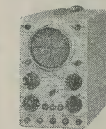
VARIABLE FREQUENCY OSCILLATOR: VF-1U. 10V output; covers 10 to 160 metres. £10.12.0

AUDIO WATTMETER: AW-1U. Up to 25W continuous, 50W intermittent. £13.18.6

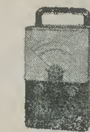
AUDIO VALVE-MILLIVOLTMETER: AV-3U. 1mV to 300V AC. 10 c/s to 400 kc/s. £13.18.6

ELECTRONIC SWITCH: S-3U. This extremely useful device extends your single-beam "scope" for double-beam uses. £9.18.6

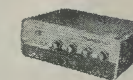
DIRECT READING CAPACITANCE METER: CM-1U. Full-scale ranges of 0–100 mmf, 1,000 mmf, 0.01 mfd and 0.1 mfd. £14.10.0



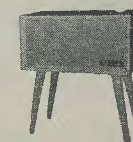
OS-1



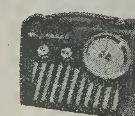
V-7A



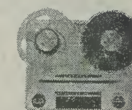
S-88



SSU-1



UXR-1



"STUDIO"

Money Saving "Packaged Deals" of Complete Stereo Equipment from £42.10.0

All prices include free delivery in U.K.
Deferred terms available on orders above £10

★ **SEND THIS COUPON NOW FOR FURTHER INFORMATION**

(Please write in BLOCK CAPITALS)

NAME ______________________

ADDRESS ______________________

____

Without obligation please send me (Tick here)

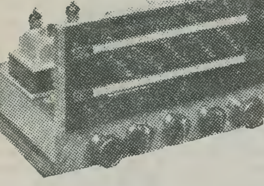
BRITISH HEATHKIT CATALOGUE ....

FULL DETAILS OF MODEL(S) ....

DAYSTROM LTD DEPT. RC3 GLOUCESTER . ENGLAND

A member of the Daystrom Group, manufacturers of the **WORLD'S LARGEST-SELLING ELECTRONIC KITS**

ARMSTRONG AF 208 AM/FM RADIOGRAM CHASSIS



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

PRICE **22 GUINEAS** Carr. Free

LATEST "E.M.I." 4 SPEED SINGLE RECORD PLAYER

Acos 73 Hi-Fi Pick-up for LP, 78 and Stereo, 7", 10" and 12" records. Silent motor heavy turntable, auto stop.

Special offer **£6.19.6** post free

BUILD THIS REPRODUCER BARGAIN

SPECIAL SINGLE PLAYER KIT

COLLARO 4-speed Gram-Pick-up Unit	£3.15.0
Handsome portable case 17½" x 13½" x 7" with room to play 12" records	£2. 5.0
Ready built 3-watt, printed circuit, amplifier with two valves and 7" x 4" elip. speaker	£3.12.6

or **£9.9.0** complete kit post free

I.F. TRANSFORMERS 7/6 pair
465 kc/s slug tuning miniature can 1¾" x ¾" x ¾". High Q and good band width. By Pye Radio. Data sheet supplied.

Weyrad Standard Size 465 kc/s 3½" x 1½" sq. 12/6 pair

New boxed VALVES 90-day Guarantee

1R5	7/6	6K8G	7/6	EA50	1/6	EZ80	7/6
1S5	7/6	6L6G	10/6	EABC80	8/6	E1148	1/6
1T4	6/–	6N7M	6/6	EB91	6/–	HABC80	12/6
2X2	3/6	6Q7G	8/6	EBC33	8/6	HVR2A	6/6
3S4	7/6	6SA7	6/–	EBC41	8/6	MU14	9/–
3V4	7/6	6SJ7M	6/6	EBF80	10/–	P61	3/6
5U4	7/6	6SN7	6/6	ECC84	9/6	PCC84	9/6
5Y3	7/6	6V6G	6/6	ECF80	9/6	PCF80	9/6
5Z4	9/6	6X4	6/6	ECH42	10/6	PCL82	11/6
6AM6	5/–	6X5	6/6	ECL80	10/6	PEN25	6/6
6B8	5/–	12A6	7/6	ECL82	10/6	PL81	12/6
6BE6	7/6	12AT7	8/–	EF39	5/6	PL82	10/6
6BH6	9/6	12AU7	8/–	EF41	9/6	PY80	7/6
6BW6	9/6	12AX7	8/–	EF50	5/6	PY81	9/6
6D6	6/–	12BE6	8/6	EF80	8/–	PY82	7/6
6F6	7/6	12K7	6/6	EF86	12/6	SP61	3/6
6H6	3/6	12Q7	6/6	EF92	5/6	UBC41	9/6
6J5	5/6	35L6	9/6	EL32	5/6	UCH42	9/6
6J6	5/6	35Z4	7/6	EL41	9/6	UF41	9/6
6J7G	6/6	80	9/6	EL84	8/6	UL41	9/6
6K6GT	6/6	807	5/6	EY51	9/6	UY41	8/–
6K7G	5/–	954	1/6	EZ40	7/6	U22	8/–

DK96, DF96, DAF96, DL96, 8/6 each or 30/– set

B.B.C. Pocket 2 Transistor. M.W. and L.W. Radio Kit 32/6. Phones 7/6 or deaf aid earpiece 12/6.

Our written guarantee with every purchase

C.R.T. BOOSTER TRANSFORMERS

For Cathode Ray Tubes having heater cathode short circuit and for C.R. Tubes with falling emission, full instructions supplied. **Type A.** Low leakage windings. **Optional 25% and 50%** boost on secondary: 2V, or 4V, or 6.3V, or 10.3V, or 13.3V, with mains primaries, 12/6. **Our Latest Superior Product. Mains Input Type A2. High quality low capacity 10-15pF. Optional boost 25%, 50%, 75%, 16/6** each. **Type B.** Mains input. Low capacity. Multi output 2, 4, 6.3, 10 and 13V. Boost 25% and 50%. This transformer is suitable for all TV tubes. **21/–** each.

RESISTORS. Preferred values. 20% 10 ohms to 10 meg, ¼W **4d.**, ½W **4d.**, 1W **6d.**, 1½W **8d.**, 2W 1/–. **HIGH STABILITY.** ½W 1%, **2/–**. All preferred values 10Ω–10MΩ. Ditto 5% 100Ω–5MΩ, **9d.** each.

WIRE-WOUND RESISTORS

5 watt	25 ohms–10,000 ohms	1/3
10 watt		1/6
15 watt	12.5 kΩ–50 kΩ 10W, 3/3	2/–

WIRE-WOUND POTS Pre-set min. TV type. Knurled slotted knob. All values 10 ohms to 25k, 3/– each, 30k, 50k, 4/–. Ditto ½W Carbon Track 30k to 2 Meg. 3/–.

3W Lab. Colvern, etc. Standard size Pots, 2¼" Spindle, high grade. All values, 100 ohms to 50k, **6/6**; 100k, **7/6**. W/W EXT. SPEAKER CONTROL 10Ω, 3/–.

MAINS TRANSFORMERS—200/250 AC

STANDARD 250–0–250, 80mA, 6.3V tapped 4V 4A, Rectifier 6.3V 1A, tapped 5V 2A and 4V 2A	22/6
Ditto 350–0–350	22/6
MINIATURE. 200V 20mA, 6.3V 1A	10/6
MIDGET. 220V 45mA, 6.3V 2A	15/6
SMALL. 220–0–220V 50mA, 6.3V 2A	17/6
STANDARD. 250–0–250 65mA, 6.3V 3.5A	17/6
HEATER TRANS. 6.3V 1½A 7/6. 3A	10/6
Ditto 1.4, 2, 3, 4, 5, 6.3V 1½A	8/6
Mullard "510" Osram "912" 300/0/300, 120mA, 6.3V 4A c.t., 6.3V 2A tapped 5V	38/6
General Purpose Low Voltage. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V at 2A	22/6
Auto. Trans. 150W, 0, 10, 120, 200, 230, 250V	22/6

O/P TRANSFORMERS. Heavy duty 50mA, **4/6**. Multi-ratio push-pull, **7/6**. Miniature 3V4, etc., **4/6**. Small pentode, **4/6**. Hygrade push-pull 10 watts, **15/6**. Goodmans heavy duty 10/20W 6k or 8k c.t., **30/–**.
L.F. CHOKES 15/10H 60/65mA, **5/–**; 10H, 85mA, **10/6**; 10H 120mA, **12/6**; 10H 150mA, **14/–**.

CRYSTAL MIKE INSERT by Acos **6/6**
Precision engineered. Size only ⅞" x 3/16"
ACOS CRYSTAL MIKE 39–1 35/–, MIKE 40 25/–

ALADDIN FORMERS and cores. ¼" **8d.**, ⅜" **10d**
0.3" FORMERS 5937 or 8 and cans TV1 or 2, ¾" sq. x 2¼" or ¾" sq x 1¼", **2/–** with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6-1, **2/3.**
REMPLOY INSTRUMENT IRON, 230V 25W, **17/6.**
MAINS DROPPERS. 3" x 1½". With adj. sliders, 0.3A, 1,000 ohms, **4/3**; 0.2A 1,000 ohms, **4/3.**
LINE CORD. 0.3A 60 ohms per foot, 0.2A 100 ohms per foot, 2-way, **6d.** per foot; 3-way **7d.** per foot.
MIKE TRANS. 50:1, 3/9; 100:1, potted, **10/6.**
LOUDSPEAKERS. P.M. 3 ohm. 5" Rola, **17/6**; 6" x 4" **18/–**; 4" Hi-Fi Tweeter, **25/–**; 8" Plessey, **19/6**; 6½" Goodmans, **18/6**; 10" R.A., **30/–**; 12" Plessey, **30/–**; 10" x 6" R.A., **27/6**; 12" Baker 15W 3 ohm or 15 ohm models, **90/–**; Stentorian HF1012 10", **95/–.**
CRYSTAL DIODES. G.E.C., 2/–; GEX34, 4/–.
40 CIRCUITS FOR GERMANIUM DIODES, 3/–.
H.R. HEADPHONES 4,000 ohms, brand new, **15/–** pr.
SWITCH CLEANER FLUID, squirt spout, **4/3** tin.
TWIN GANG CONDENSERS. 365pF, miniature. 1⅜" x 1½" x 1¾", **10/–**; 0.0005 standard with trimmers, **9/–**; less trimmers, **8/–**; midget, **7/6**; 50pF single, **2/6.**
SHORT WAVE Single 75pF, 100pF, 160pF, **5/6** each.
TUNING AND REACTION CONDENSERS. 100pF, 300pF, 500pF, **3/6** each, solid dielectric.

HIGH GAIN TV PRE-AMPLIFIERS
BAND I B.B.C.
Tuneable 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
Tuneable channels 8 to 13. Gain 17dB. ECC84 valve

Volume Controls

Midget size. Long spindles. Guaranteed 1 year. All values 5,000 ohms to 2 Meg.
No switch 3/– D.P. switch 4/6
Linear or Log Tracks

80Ω Coaxial Cable

Semi-air spaced Polythene Ideal Band III **6d.** yd. Losses cut 50%
FRINGE QUALITY Air spaced Coaxial **1/–** yd.
40 yds. **17/6.** 60 yds. **25/–.**

Coaxial Plugs 1/– **Lead Socket** 2/–
Panel Sockets 1/– **Outlet Boxes** 4/6
Balanced Twin Feeder, per yd. **6d.,** 80Ω or 300Ω.
Twin Screened Balanced Feeder, 1/6 yd, 80 ohms.
Trimmers. Ceramic 30, 50, 70pF, **9d.**; 100pF, 150pF, **1/3**; 250pF, **1/6**; 600pF, 750pF, **1/9**; Philips, **1/–** each.
Black Crackle Paint. Air drying, **3/–** tin.
P.V.C. Conn. Wire, 8 colours, single or stranded, **2d.** yd. Sleeving 1, 2mm, **2d.**; 4mm, **3d.**; 6mm, **5d.** yd.
Neon Mains Tester Screwdriver, 5/–.
Solder Radiograde, 4d. yd., ½lb **5/–,** 1lb **9/–.**

Aluminium Chassis. 18 s.w.g. Plain, undrilled, 4 sides, riveted corners, lattice fixing holes, 2½" sides. 7" x 4", **4/6**; 9" x 7", **5/9**; 11" x 7", **6/9**; 13" x 9", **8/6**; 14" x 11", **10/6**; 15" x 14", **12/6**; 18" x 16" x 3", **16/6.**

Miniature Contact Cooled Rectifiers. 250V 50mA, **7/6**; 250V 85mA, **9/6.** **Selenium Rect.** 300V 85mA, **7/6.**
Coils. Wearite "P" type, **3/–** each. Osmor Midget "Q" type, adj. dust core, from **4/–** each. All ranges.
Teletron D.W.R. L. & Med. T.R.F. with reaction, **3/6.**
Ferrite Rod Aerials. M.W., **8/9**; M. & L., **12/6.**
Ferrite Rods 8" x ⅜", **2/6.** **H.F. Chokes, 2/6.**
T.R.F. Coils A/HF, **7/–** pair; HAX **3/–,** DRR2 **4/–.**
Speaker Fret. Gold cloth, 17" x 25", **5/–**; 25" x 35", **10/–.** **Tygan,** 4' 6" wide, **10/–**; 2' 3" wide, **5/–** ft. Samples, S.A.E. Expanded Metal, Gold, 12" x 12", **6/–.**
Condensers. 0.001μF 7kV T.C.C., **5/6**; ditto 20kV, **9/6**; 0.1μF 7kV, **9/6**; **100pF to 500pF Micas, 6d.**; Tubular 500V 0.001 to 0.05, **9d.**; 0.1, **1/–**; 0.25, **1/6**; 0.1/350V, **9d.**; 0.5/500V, **1/9**; 0.01/2,000V, **1/9**; 0.1/2,000V, **3/6.**
Ceramic Condensers. 500V 0.3pF to 0.01μF, **9d.**
Silver Mica. 10% 5pF to 500pF, **1/–**; 600pF to 3,000pF, **1/3**; close tolerance (plus or minus 1pF), 1.5pF to 47pF, **1/6**; ditto 1% 50pF to 815pF, **1/9**; 1,000pF to 5,000pF, **2/–.**

New Mullard Transistors.
Audio OC71 **10/–** R.F. OC44 **15/6**
OC72 **12/6** OC45 **12/6**
Sub-miniature Electrolytics (15V)
1μF, 2μF, 4μF, 5μF, 8μF, 25μF, 50μF, 100μF, 3/–.

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/–	100/270V	5/6
8/450V	2/3	500/12V	3/–	2,500/3V	4/–
8/500V	2/9	8+8/450V	3/6	5,000/6V	5/–
16/450V	3/–	8+8/500V	5/–	32+32/350V	5/–
16/500V	4/–	8+16/450V	3/9	32+32/450V	6/–
32/450V	3/9	8+16/500V	5/6	32+32+32/350V	7/
25/25V	1/9	16+16/450V	4/3	50+50/350V	7/–
50/25V	2/–	16+16/500V	6/–	64+120/350V	11/6
50/50V	2/–	32+32/350V	4/6	100+200/275V	12/6

TELEVISION REPLACEMENT
Line Output Transformers
from **70/–** each, from stock
and other timebase components
Most makes available S.A.E. with all enquiries

BRAND NEW AND BOXED with template
Model UA8
£6.15.0
or with Cabinet, Amplifier & Speaker
£12.10.0
CARR. 5/–

★ **COLLARO** ★
HI-FI AUTOCHANGER **£7.19.6**
4 SPEEDS—10 RECORDS
STEREO MODEL £8.10.0

★ **GARRARD 4-SPEED RECORD CHANGERS RC 121 MK II D** ★
With Plug-in Head for Monaural **£8.15.0**
Stereo Heads £2 extra

AUTOCHANGER ACCESSORIES

Suitable player cabinets (uncut boards)	49/6
Amplifier player cabinets with cut boards	63/–
2-valve amplifier and 6½" speaker for above, ready mounted on baffle, 12" x 7", 3" deep	79/6

Wired and tested ready for use

MINIATURE 2-STAGE HI-FI AMPLIFIER. A.C. only, 200-250V. Valves ECL82 and EZ80. 3 watt quality output. Mullard tone circuits, bass boost, treble and volume controls. Separate engraved Perspex front-panel with de luxe finish. Heavy duty output transformer, 3 ohm and shrouded mains transformer. Stove enamelled chassis size 6" x 5" x 3".
Bargain price £4.10.0. Circuit supplied.

Wavechange Switches. 2 p. 2-way, 3 p. 2-way, short spindle, **2/6**; 5 p. 4-way 2 wafer, long spindle, **6/6**; 2 p. 6-way, 4 p. 2-way, 4 p. 3-way, long spindle, **3/6**; 3 p. 4-way, 1 p. 2-way, long spindle, **3/6**; wavechange "MAKITS", 1 wafer, **8/6**; 2 wafer, **12/6**; 3 wafer, **16/–**; 4 wafer, **19/6**; 5 wafer, **23/–**; 6 wafer, **26/6.**
Toggle Switches, s.p., **2/–**; d.p., **3/6**; d.p.d.t., **4/–.**

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 FMT.1 Kit,** Jason chassis with calibrated dial and 4 valves **£6.5.0.**

Valveholders. Pax. int. oct., **4d.** EA50, EF50, **6d.** B12A, CRT, **1/3.** Eng. and Amer. 4, 5, 6, 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. **Valve and TV Tube Equivalents, 9/6.** **TV Fault Finding, 5/–.** **Quality Amplifiers 4/6.** **Radio Valve Guide.** Books 1, 2, or 3, **5/–** each.
Full Wave Bridge Selenium Rectifiers. 2, 6 or 12V 1¼A, **8/9**; 2A, **11/3**; 4A, **17/6.** Free charger circuit.
Charger Transformers. Tapped input 200/250V for charging at 2, 6 or 12V 1½A, **15/6**; 2A, **17/6**; 4A, **22/6.**

AMERICAN BRAND "FIVE"
FERRO-DYNAMICS RECORDING TAPE

Long Play 7" reel, 1,800ft **35/–**	Standard Play—	
5¾" reel, 1,200 ft **23/6**	7" reel, 1,200 ft	**25/–**
5" reel, 900ft **18/6**	5" reel, 600ft	**16/–**

Spare Plastic Reels all sizes **3/–.** Metal Reels 7" only **2/–.** "Instant" Bulk Tape Eraser and Head Defluxer, 200/250V a.c., **27/6.** Leaflet, S.A.E.

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD WEST CROYDON
Telephone **THO 1665**

Buses 133 or 68 pass door. S.R. Stn. Selhurst.

Post and packing charge 1/–, over £2 post free. C.O.D. 1/6 (Export welcome. Send remittance and extra postage)

The
Radio Constructor
Incorporating **THE RADIO AMATEUR**

MARCH 1961

Vol. 14, No. 8

Published Monthly

Annual Subscription 25/– (*including postage*)

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9

Telephone
CUNningham 6141 (2 lines)

Telegrams
Databux, London

CONTRIBUTIONS on constructional matters are invited, especially when they describe the construction of particular items of equipment. Articles should be written on one side of the sheet only and should preferably be typewritten, diagrams being on separate sheets. Whether hand-written or typewritten, lines should be double spaced. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included. Photographs should be clear and sharp. Details of topical ideas and techniques are also welcomed and, if the contributor so wishes, will be re-written by our staff into article form. All contributions must be accompanied by a stamped addressed envelope for reply or return, and should bear the sender's name and address. Payment is made for all material published.

OPINIONS expressed by contributors are not necessarily those of the Editor or the proprietors.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

TECHNICAL QUERIES must be submitted in writing. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

CORRESPONDENCE should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers, as appropriate.

REMITTANCES should be made payable to "DATA PUBLICATIONS LTD."

Suggested Circuits

The Circuits presented in this series have been designed by G. A. FRENCH, specially for the enthusiast who needs only the circuit and essential data

No. 124
A Pre-Amplifier for Radio Luxembourg

Despite the varied sound radio entertainment offered by the B.B.C., a considerable number of people in Great Britain devote much of their evening listening to the programmes transmitted by Radio Luxembourg. Radio Luxembourg broadcasts, on the Medium wave band, on 208 metres, and can be received reasonably well in most parts of this country. In some instances, however, signal strength from Radio Luxembourg tends to be low, this being possibly due to shortcomings in performance of the receiver and/or the aerial and earth system, or to poor reception conditions.

The circuit discussed this month is for a pre-amplifier which may be inserted between the aerial and the receiver, and whose function is to amplify the Radio Luxembourg signal picked up on the aerial. The amplified signal is applied to the aerial and earth terminals of the receiver, whereupon the latter is able to reproduce the programme at greater strength. A further advantage resulting from the use of the pre-amplifier is that the signal it provides is more liable to override self-generated noise at the input stage of the receiver than the unamplified aerial signal, with the result that self-generated background noise may be reduced. Also, since the pre-amplifier causes a signal of higher amplitude to be fed to the a.g.c. detector, the receiver a.g.c. circuits may be able to work more efficiently, with a consequent reduction in fading. The pre-amplifier cannot, of course, discriminate against adjacent channel whistles or impulsive interference picked up on the aerial, and such whistles or interference will be passed to the receiver together with the amplified Radio Luxembourg signal. On the other hand, the pre-amplifier can cause a reduction in second channel interference.

The pre-amplifier employs a single transistor, and it is powered by a 9 volt battery. The gain provided will vary according to the aerial employed and the type of input circuit fitted in the receiver. In a test carried out with the prototype (under conditions which are described later) the pre-amplifier was effective in increasing the strength of the Radio Luxembourg signal by 28dB (25 times).

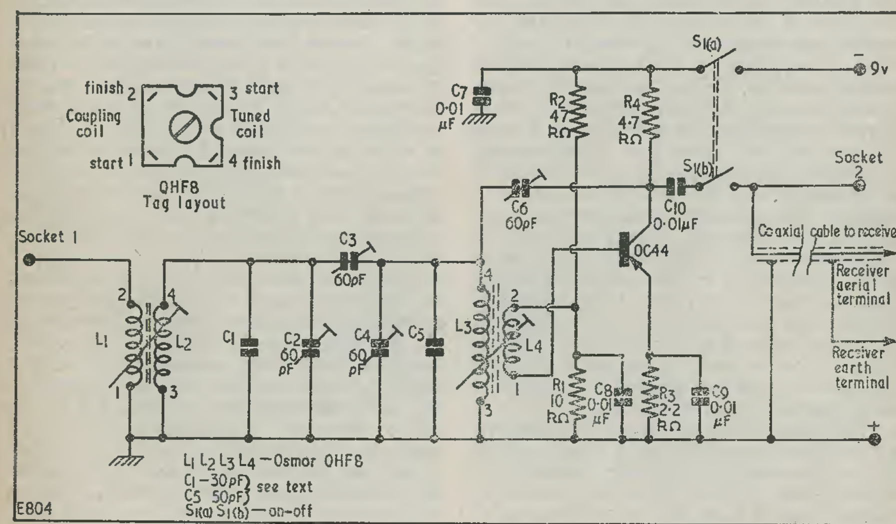
The Circuit

The circuit of the pre-amplifier accompanies this article. When it is required, the unit is switched on by means of $S_{1(a)}$, $S_{1(b)}$, the aerial being connected to Socket 1 and, thence, to the input coil L_1, L_2. L_1 is the coupling winding of the input coil, whilst L_2 is the tuned winding. L_2 is tuned by C_1 and C_2 in parallel, and it is coupled via C_3 to the tuned winding, L_3, of the coil in the transistor circuit. L_3 is tuned by C_4 and C_5 in parallel, and the coupling between L_2 and L_3 is of the same type as is provided in a band-pass pair. Coupling winding L_4 feeds the signal developed across L_3 to the base of the transistor, whereupon an amplified version appears across the collector load, R_4. This amplified signal is then passed, via isolating condenser C_{10} and switch $S_{1(b)}$, to the receiver aerial input terminal via a length of coaxial cable. The outer braiding of this cable provides screening for the pre-amplifier output lead, and also enables the chassis of the pre-amplifier to be bonded to the earth terminal of the receiver.

Regeneration is provided by C_6. The coil in the transistor circuit is connected up in such a manner that the signal applied to the base of the transistor is 180° out of phase with that at the upper end of tuned winding L_3. A further phase reversal takes place in the transistor itself, with the result that the signal on the collector is in correct phase for regenerative feedback to be applied to the upper end of L_3.

The transistor in the pre-amplifier is stabilised by the emitter resistor R_3, the fixed potentiometer R_2, R_1 assisting in ensuring that a relatively stable bias current flows into the base. C_8 and C_9 are bypass condensers.

When the pre-amplifier is not required it is switched off by means of $S_{1(a)}$, $S_{1(b)}$, and the aerial is plugged into socket 2. The aerial now connects directly to the receiver input terminal via the coaxial cable whilst $S_{1(b)}$ disconnects the pre-amplifier r.f. circuits from the aerial, thereby ensuring that no losses result due to the relatively low impedance offered by R_4.



Design Features

When the design of the pre-amplifier was initially considered, the writer had hoped to employ a single coil tuned to 208 metres instead of the two shown in the circuit. In practice, unfortunately, difficulty was experienced in obtaining satisfactory regeneration, this being largely due to variations in coil performance with different aerial loadings. In consequence, it was decided eventually to use two simple coils of the type specified in the diagram. Both coils are of the type usually employed for r.f. coupling, and the coupling windings would normally be connected in the anode circuit of an r.f. amplifying valve. The r.f. coupling coil is used in the L_1, L_2 position instead of a conventional double-wound "aerial" coil for the following reason. A double-wound "aerial" coil normally has considerably more turns on the coupling winding than on the tuned winding, the intention being that this winding, in parallel with the aerial-earth capacity, should then become resonant at a frequency below the band covered and thus boost signal strength at the low frequency end. In this circuit the desired signal is at the high frequency end of the Medium wave band whereupon the use of an "aerial" coil offers no attraction*, and a coil intended for r.f. coupling is used instead. The r.f. coupling coil also fits quite well into the L_3, L_4 position. In this instance the coupling winding provides a low impedance feed for the transistor base.

The combination of the two coils in the circuit ensures that the tuned winding L_3 is not excessively loaded by the aerial. When C_3 is set up correctly the tuning of L_2 is broad whilst that of L_3 is sharp. Since regeneration is then applied to L_3 it becomes possible to achieve a high effective Q in this winding and obtain, thereby, a high degree of overall amplification in the unit.

A considerable difficulty in the design of a pre-amplifier of this type is that it is impossible to predict the type of aerial input circuit which will be employed in the following receiver. The receiver circuit will almost inevitably be reactive and, if it is coupled tightly to the first receiver tuned circuit, the effective load into which the transistor collector feeds will vary as the receiver tuning

* The high inductance of the coupling winding could, indeed, be a disadvantage in the present application.

condenser is adjusted. This is an important point, and differing receiver input circuits may have very marked effects on the manner in which the regeneration circuit in the pre-amplifier operates. It will probably be found that receivers having low impedance bottom-end coupling circuits allow smoothest pre-amplifier regeneration control.

The coil circuit finally evolved employs rather more trimmers than the writer cares to see in a simple design of this nature. Nevertheless, a relatively large number of variables is essential if the circuit is to be reliably set up under the differing aerial and receiver conditions likely to be encountered. If desired, some of the trimmers can be removed after setting up has been completed. The settings of C_2 and C_3 are not critical, and the latter could be replaced by a fixed condenser of the appropriate value after the circuit has been set up. Similarly, C_1 and C_2 could be replaced by a single condenser of the appropriate value, any small tuning adjustments in L_2 required later being carried out with the aid of its iron dust core. It should be pointed out that, at 208 metres, the tuning range offered by the dust core is not great and that it would be inadvisable to attempt the setting up operation itself without the advantage of the considerably wider tuning range offered by C_2. The tuning of L_3 was found, in the prototype, to be extremely sharp, and the writer found it easier to tune this coil with the aid of a parallel trimmer than by adjusting the core. For this reason alone, therefore, C_4 should be retained after setting up. A trimmer in the C_6 position is unavoidable.

There are, again, rather more components around the transistor than a simple circuit of this type might, at first sight, warrant. In this instance, however, the components are essential because of the stabilising action they provide. It would be unwise to operate the transistor at an h.t. potential of 9 volts without a stabilising circuit.

The OC44 specified is designed to function as a mixer in Medium and Long wave receivers. It gave adequate results in the prototype.

Practical Considerations

The layout of the pre-amplifier requires a little thought, as it is necessary to prevent undue inductive coupling between L_1, L_2 and L_3, L_4, and to ensure that the components and wiring in the collector circuit are kept well away from those in the base r.f. circuit.

A simple way of keeping inductive coupling between the two coils at a low level consists of mounting them on either side of a sheet of metal, which may then form the chassis. Alternatively, they may be spaced some 3 to 4 inches apart, with their axes at right angles.

Whilst it is required that the collector components and wiring be kept well away from those in the base r.f. circuit, there should be no necessity to separate these two sections of the pre-amplifier with the aid of a screen. It should be remembered that R_1, R_2, R_3, C_7, C_8 and C_9 are all virtually at chassis potential and that they may be mounted at any convenient points close to the transistor. This fact may assist in the design of a compact layout which meets the requirements just mentioned. Since $S_{1(b)}$ and socket 2 are in the collector circuit these should also, of course, be mounted well away from the base r.f. components. $S_{1(b)}$ is ganged with $S_{1(a)}$ and these two switches can be conveniently combined in a single two-pole one-way switch of the wafer or toggle type.

The coaxial lead to the receiver aerial and earth terminals may be conventional 75Ω cable. Unless the pre-amplifier is mounted in a metal case it should be kept several feet or more away from the receiver to prevent interaction, and the length of the coaxial cable may be adjusted accordingly. A length of cable greater than four feet should be avoided, as it may introduce losses. If the pre-amplifier is fitted in an unscreened case the aerial lead should be kept away from the collector components and wiring when it is plugged into socket 1.

The earth connection at the receiver end of the coaxial cable is essential for correct operation of the pre-amplifier, and this should be at the terminal provided by the receiver manufacturer. *On no account should the pre-amplifier earth connection be made direct to a receiver chassis which is connected to one side of the mains.* If modulation hum occurs when the pre-amplifier is used, the mains supply to the receiver should be reversed. In severe cases, a reliable earth connection may be needed as well.

The 9 volt battery required for operating the pre-amplifier may be of any suitable type, current consumption being of the order of 0.5mA only. A supply potential higher than 9 volts should not be used, as this may cause transistor limiting values to be exceeded.

Setting Up

The process of setting up the pre-amplifier is considerably eased if the associated receiver has a tuning indicator. The latter can be used to monitor input signal strength, whereupon it overcomes the masking effect of the receiver a.g.c. circuits. A temporary tuning indicator may be fitted to the receiver by connecting a voltmeter across the cathode bias resistor of an a.g.c. controlled valve. An increase in signal strength will be be indicated by a decrease in voltage reading. Alternatively, the voltmeter may be connected between chassis and the screen-grid of an a.g.c. controlled valve. Assuming that the screen grid is fed via a dropping resistor, the voltmeter reading will then increase as signal strength increases.

The receiver is initially switched on with the aerial connected to its input terminal, and carefully tuned in to Radio Luxembourg. The pre-amplifier is then switched on and connected up to the receiver, the aerial being plugged into socket 1. At this stage, C_3 and C_6 should be adjusted to insert minimum capacity. Also, the cores in both coils should be adjusted such that their upper ends are level with the upper surfaces of the tuned windings.

C_2 and C_4 are adjusted for maximum signal strength from the Radio Luxembourg signal. C_3 is next increased in capacity, re-adjusting C_2 and C_4 for each change in C_3, until the tuning of C_4 L_3 commences to broaden. The regeneration trimmer, C_6, is then carefully increased in capacity, retuning C_4 for each change in C_6, until C_6 is just below oscillation point. This setting should cause L_3 C_4 to tune very sharply indeed.

From now on the setting up process is as follows. When C_3 is further increased in capacity (accompanied by the necessary readjustments in C_2 and C_4) the tuning of L_3 C_4 commences to broaden again, whereupon it may be made sharp once more by careful readjustment of C_6. Above a certain level of capacity in C_3 the gain remains very nearly constant, and the desired final setting of C_3 is the *minimum* value which allows this degree of gain to be achieved. After the desired setting of C_3 has been found, C_2 and C_5 should be finally adjusted with C_6 just below oscillation point.

Since the degree of regeneration obtained varies with h.t. voltage, initial setting up should be carried out using a new battery. This will then obviate the possibility of the pre-amplifier oscillating if a battery with a higher potential is later fitted to it.

In the diagram C_1 and C_5 are specified as 30pF and 50pF respectively. These were the values which gave a comfortable trimming range with the prototype. The fact that they are different may be due to discrepancies between the two coils, or to discrepancies in coil operation because of the circuit. If coil discrepancies are high, the values of C_1 and C_5 may need to be altered accordingly in pre-amplifiers built in conformity to the circuit.

It must be pointed out that the pre-amplifier should not be left in an oscillating condition for long periods during setting up, because of the risk of interference with neighbouring receivers.

Results with the Prototype

The prototype pre-amplifier was coupled to a standard superhet receiver having a tightly-coupled inductive input circuit, and was aligned to the Radio Luxembourg signal in the manner just described. An aerial approximately 20 feet long was employed. It was found that the final settings of C_3 and C_6 were near to the minimum capacity end of their range.

The effective gain provided by the pre-amplifier was then checked. The pre-amplifier was switched off and disconnected from the receiver, and the aerial was connected direct to the receiver aerial terminal. The receiver a.g.c. line was next short-circuited to chassis and a voltmeter connected across the signal diode load. The Radio Luxembourg signal then caused approximately 2 volts to appear across this diode load. After this reading was taken, the pre-amplifier was reinserted, whereupon the voltage across the diode load became approximately 50. Thus, the pre-amplifier was effective in causing a gain increase of some 25 times, or 28dB.

It must be pointed out that this figure is applicable only to the case examined by the writer. Different aerials and different receiver input impedances may cause variations in the effective gain obtainable.

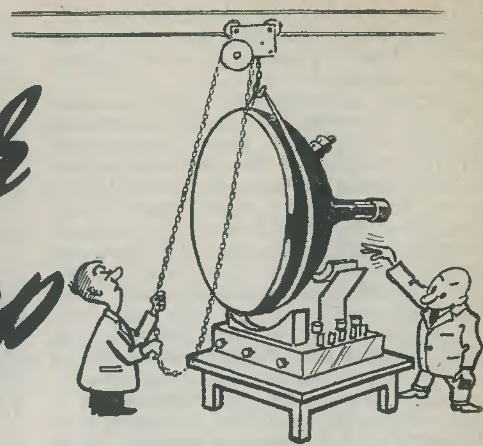
When regeneration was just below oscillation point it was found that the pre-amplifier went into oscillation when the associated receiver was tuned between 215 and 220 metres, this effect being doubtless caused by the tightly coupled input circuit. The effect was not considered a serious disadvantage as the conditions causing oscillation would not occur in normal usage.

The current consumption of the prototype was 0.5mA at 9 volts.

NEXT MONTH . . .

- ***A Printed Circuit Pre-Amplifier***
- ***Stereo/Mono Microphone Mixer Unit***
- ***High Impedance Transistorised Voltmeter***

In your Workshop



In this month's episode Smithy the Serviceman and his able assistant Dick discuss matters of polarity which will be of special interest to beginners

DICK SHOOK THE SURPLUS DROPS OF solder from his iron and glanced contentedly at the brightly tinned surface of its bit. He applied it, together with a length of resin-cored solder, to the tags of the replacement half-wave selenium h.t. rectifier he had just fitted into the television set on his bench.

The rectifier tags were of relatively heavy gauge and Dick had to apply the iron for a second or so to each, first tinning at the point of contact to allow good thermal conduction, before the solder flowed evenly over the metal and its connecting wire. As soon as solder flow had taken place Dick removed the iron. He replaced the soldering iron on its rest and gazed, with supreme satisfaction, at the two perfect solder joints he had just made.

Rousing himself, he re-plugged the television receiver into the mains supply and, with a nonchalant gesture, switched it on.

The Workshop lights dimmed.

Almost immediately afterwards there was a loud crack as a cartridge fuse-link at the rear of the television chassis shattered. The Workshop lights returned to their full intensity.

Shaken, Dick gazed at the receiver. A wisp of smoke rose up from the rectifier he had just fitted. He suddenly became aware of a nauseating smell which emanated from the chassis, and which quickly gained in strength and filled the room.

Rectifier Polarity

A cry of distress rose from Smithy's bench.

"For goodness' sake" coughed the Serviceman, "open a window."

Hastily, Dick opened the window behind his bench, whilst the Serviceman rushed to open the door. A current of fresh March air passed through the Workshop, taking with it the intolerable stench which originated from Dick's bench. It was a full minute before Smithy decided that the atmosphere in the workshop was sufficiently cleansed for the door and window to be closed again. He stood and regarded his embarrassed assistant with the utmost severity.

"It's bad enough," Smithy remarked eventually, "your trying to blow up the Workshop. But *that* was ridiculous!"

"It was something which broke down in that chassis," protested Dick weakly.

"I know it was," replied Smithy with dignity. "I should think I've been in the business long enough now to be able to recognise the charnel-house fetor which arises from a broken-down selenium rectifier in a t.v. set. What did you do, connect the rectifier direct across the mains?"

A light of understanding gleamed in Dick's eye, and he ignored Smithy's sarcasm.

"Do you mean," he said, "that that awful pong came from the rectifier?"

"Nowhere else."

"Then," said Dick with conviction, "the replacement unit I fitted in that receiver was faulty."

Smithy walked over and examined the chassis.

"May I offer a tentative opinion," he remarked drily, after a moment's inspection,

"to the effect that you connected up the rectifier the wrong way round."

"How can you tell?"

"Because, you silly muggins," retorted Smithy wrathfully, "you connected the positive end to the mains side instead of to the reservoir condenser!"

"Now, let's just recap on events up to now," he said heavily. "With great care and ability you solder the h.t. rectifier for this television receiver into circuit the wrong way round. (Fig. 1 (a)). Having completed this job you then plug the receiver into the mains and switch on. Right?"

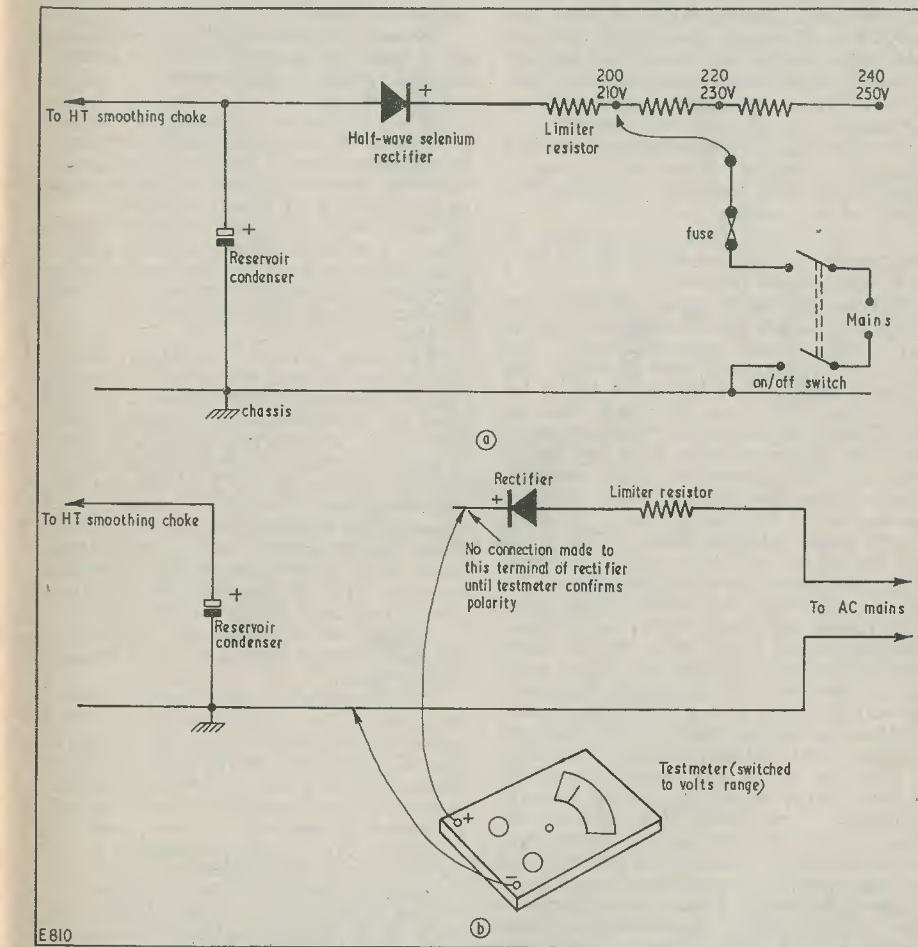


Fig. 1. (a). The h.t. rectifier circuit in the receiver "repaired" by Dick. (b) If any doubt exists concerning rectifier polarity it is advisable to check this in the manner shown here before connecting up the reservoir condenser

Dick reflected unhappily on the care with which he had soldered in the rectifier.

"I suppose," he remarked grudgingly, "you might be right at that. Still, I wouldn't have thought it could have caused all that much trouble."

Smithy sighed.

"Yes," confessed Dick.

"Right! Now the rectifier at once commences to carry out the job it was designed to do, with the result that the positive terminal of the reservoir electrolytic condenser goes negative of chassis. At once the electrolytic breaks down. Being a heavy job of the type you get in t.v. sets, you can be pretty certain that it will provide a really *dead* short-circuit. With the result that the full whack of the mains is passed, via the on-off switch, and the fuse, to the rectifier and the limiter resistor in series. For the mains tap you've chosen the limiter resistor is of the order of 20Ω only, which means that, for an applied voltage of some 200 it will pass 10 amps. So, during alternate half-cycles you'll be thumping currents around 10 amps through that poor rectifier."

"What about the fuse," protested Dick. "Shouldn't that protect the circuit?"

"A fuse takes a finite time to blow," pronounced Smithy. "And in this case it blew just a little too late to prevent the demise of the rectifier."

"Oh, well," said Dick with a shrug of his shoulders. "It looks as though I'll have to fit another new rectifier."

"I'll say you will," agreed Smithy, "*and* a new fuse, *and* a new reservoir electrolytic, *and* a new limiter resistor! Even if the latter two components *look* all right, they will now be too unreliable to be left in the set. Also, you'll have to check that the on-off switch contacts aren't welded together, and that the mains input plug and socket and the voltage selector panel contacts have stood the heavy current without burning up. You've got a job on, my lad!"

"Oh gosh," groaned Dick. "This looks like one of my bad days. But, you know, if it's possible to do so much damage to a set by connecting the rectifier the wrong way round, shouldn't there be a clearer identification of which tag is which? Some rectifiers just have a little spot of red paint on the positive tag, and even *that* could get scraped off if it was stored carelessly."

"What you say is true enough," admitted Smithy. "The best way to avoid connecting the rectifier wrong way round is to check polarity before connecting up the reservoir condenser. The policy I've followed for many years when wiring up replacement metal half-wave rectifiers is to start off by making all the connections except those to the positive tag. I leave this tag entirely free. (Fig. 1 (b)). I then quickly connect up the mains and check the polarity of the voltage between chassis and the positive tag with a voltmeter. If the positive tag carries a positive voltage with respect to chassis then I switch off the mains and connect up the reservoir electrolytic, with the comforting knowledge that the rectifier polarity can't help but be right."

"What sort of voltmeter do you use?"

"Just an ordinary testmeter switched to read 150 volts or so. I put the positive test lead on the positive tag of the rectifier, and the negative test lead on the chassis. If the needle goes in the right direction then rectifier polarity *must* be right. If the needle goes backwards you've obviously got a negative voltage coming out of the rectifier and the latter is connected wrong way round."

"Why do you use a meter voltage of 150 when the a.c. going into the rectifier is 200 to 250 volts?"

"Because," replied Smithy, "you haven't got a reservoir condenser, and the average rectified voltage is much lower."

Dick reflected.

"Why don't you check for rectifier polarity with a simple ohmmeter test," he remarked after a moment, "checking it first one way round and then the other to see which gives lowest resistance?"

"Apart from the fact," replied Smithy, "that I can never remember what polarity is carried by the leads of a testmeter switched to ohms, you wouldn't be able to check the rectifier with this test anyway."

"Hey?"

"I'm quite serious," chuckled Smithy. "At the low voltages employed in ohmmeter circuits a selenium half-wave h.t. rectifier gives just about the same resistance reading either way. Its rectifying action only begins to show up when you've got a fair number of volts applied to it. Don't forget that, with the system of checking I've just described, it's well-nigh impossible to make a mistake. After you've carried out your voltmeter check there is only one further connection to make: that to the reservoir electrolytic itself. You can't go far wrong there."

"Do you do this check with all selenium rectifiers, even if their tags are marked up really reliably?"

"I do nowadays," said Smithy, "because the check is so quick to carry out and it saves so much possible damage. After all, the rectifier *could* have been incorrectly marked at the factory. Besides, I had an unnerving experience rather similar to yours a number of years ago."

"Don't say *you've* connected an h.t. rectifier wrong way round!"

Smithy maintained a discreet silence.

"I'm beginning to see now," continued Dick as a thought suddenly struck him, "why you recognised that smell so readily!"

Rectifier Symbols

Smithy ignored his assistant and proceeded along another track.

"I was talking just now," he remarked, "about the 'positive tag' of the rectifier. Actually, I find it much easier to visualise the rectifier action if I refer to that tag as the 'cathode tag'."

"You mean, as though it represented the cathode of a valve diode?"

"That's right. Rectifier markings tend, sometimes, to be a little confusing, and I find it helps considerably if I think in terms of valve diodes. If I draw a couple of rectifiers and the rectifier symbol alongside that for a diode (Fig. 2 (a)), perhaps you'll see what I mean. You look upon the straight line of the rectifier symbol as though it were a cathode."

"It's a pity it looks more like an anode," commented Dick dispassionately.

"It is, rather," agreed Smithy. "The rectifier symbol is really intended to represent an arrow (Fig. 2 (b)) which represents the flow of conventional current."

"By conventional current," said Dick, "I suppose you mean that old fashioned idea where it's assumed that current flows from positive to negative."

"That's right."

"I sometimes wonder," complained Dick, "if we'll ever get shot of this conventional current business. All it does is muddle people!"

"I couldn't agree more," said Smithy. "Anyway, the best thing to do is to get it firmly entrenched in your noddle that the straight line in the rectifier symbol is equivalent to a cathode. That's all you've got to remember."

"What about crystal diodes?"

"The same applies. Only in this case the cathode tag, or lead-out wire rather, of the physical component may not be marked red, or with a 'plus' sign, as are h.t. rectifiers. You may for instance have it marked by a white line on a black body, or something like that. At any event, whatever the marking, the lead that's marked is the cathode lead."

"I notice", offered Dick, "that a number of the more recent sound receivers are going in for metal h.t. rectifiers in a bridge circuit."

"That's correct," agreed Smithy. "These are usually complete units of the contact-cooled variety containing four rectifiers, and they are connected up like this."

Smithy scribbled in the note pad lying on Dick's bench. (Fig. 3).

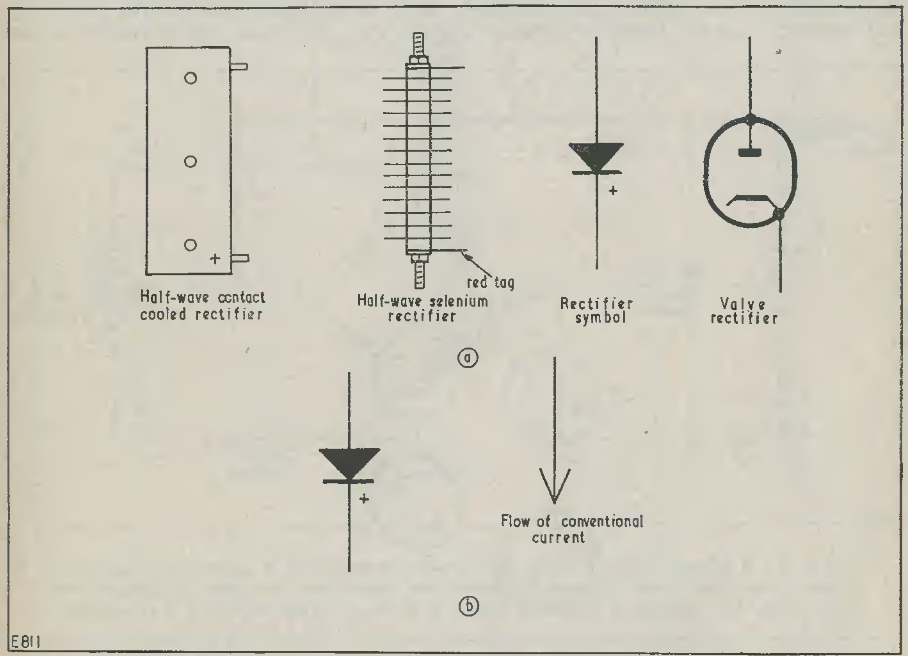


Fig. 2 (*a*). *Illustrating two rectifiers, and the rectifier symbol, against a valve diode. Rectifier action in a circuit may frequently be more quickly grasped if the tag marked red, or with a + sign, is looked upon as the cathode of a valve diode.* (*b*) *The "arrow" part of the rectifier symbol is intended to indicate the direction of conventional current flow; that is, from positive to negative*

"Just a moment," said Dick suspiciously. "What's this 'load' you've sneaked in across the reservoir condenser?"

"It's just an imaginary resistor," soothed Smithy, "which draws the same h.t. current as would be drawn in practice by the valves in the receiver. Having a load in the circuit makes it easier to describe the rectifier action.

"Now, if you change the rectifiers to valve diodes," continued Smithy, "it's very easy to see how the bridge rectifier works. Look, I'll re-draw the rectifiers as valve diodes, with the cathodes taking the place of the straight lines of the rectifier symbols. (Fig. 4 (a).) I'll also assume that the top end of the mains transformer secondary supplying the bridge is positive and the bottom end negative. Can you see what happens?"

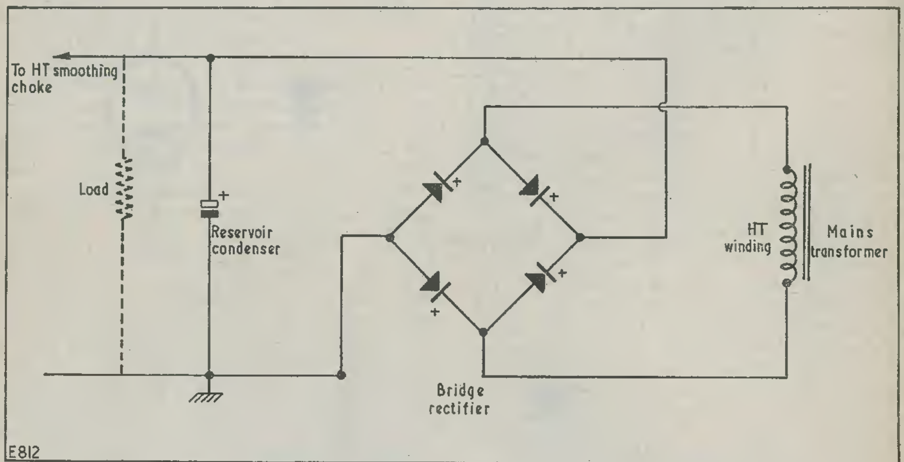


Fig. 3. A typical bridge rectifier h.t. circuit, as employed in some current sound receivers. The "load", shown in dotted line, represents a resistor which draws the same h.t. current as would be drawn in practice by the valves in the receiver

"It's dead easy," said Dick. "The positive from the top end of the transformer winding goes through diode number 2, whereupon it meets the positive terminal of the reservoir condenser. At the same time the negative from the bottom of the winding goes through diode number 3 after which it hits the deck. Diodes 1 and 4 don't conduct because they're wrong way round."

Smithy had assumed an expression of agony during this recital.

"I appreciate your clear and elegantly-phrased explanation," he commented, when his assistant had finished.

Dick beamed

"I shall now," continued Smithy, "reverse the polarity from the mains transformer winding." (Fig. 4 (*b*).)

"In this case," said Dick, "you've got negative at the top of the winding and this goes to chassis via diode number 1. The positive on the bottom goes through diode number 4 to the positive terminal of the reservoir. This time, diodes 2 and 3 don't conduct, as they're wrong way round."

"Well, you've got the idea, anyway," remarked Smithy grudgingly, "but I'm not very happy about the way you described the routing of these currents. To be more precise you should say that, in the first instance, current flows from the lower, negative, end of the winding, through diode number 3 to the chassis. It then flows through the load, across which the reservoir condenser is connected, and through diode number 2 to the upper, positive, end of the winding. In the second case, you should start from the negative, upper, end of the winding and trace through to the positive, lower, end."

"Nevertheless, I had the diodes right," said Dick, impatient of these finer points of detail. "What's the advantage of the bridge circuit?"

"You get full-wave rectification, with all its attendant advantages," replied Smithy, "with a single h.t. winding on the mains transformer. If you used a conventional two-rectifier full-wave circuit (Fig. 5) you'd need approximately twice as many turns on the transformer h.t. winding to get the same rectified voltage. You save quite a bit of money in the mains transformer with the bridge circuit, and this saving may well be greater than the extra cost of the bridge rectifier unit over a conventional two-rectifier job."

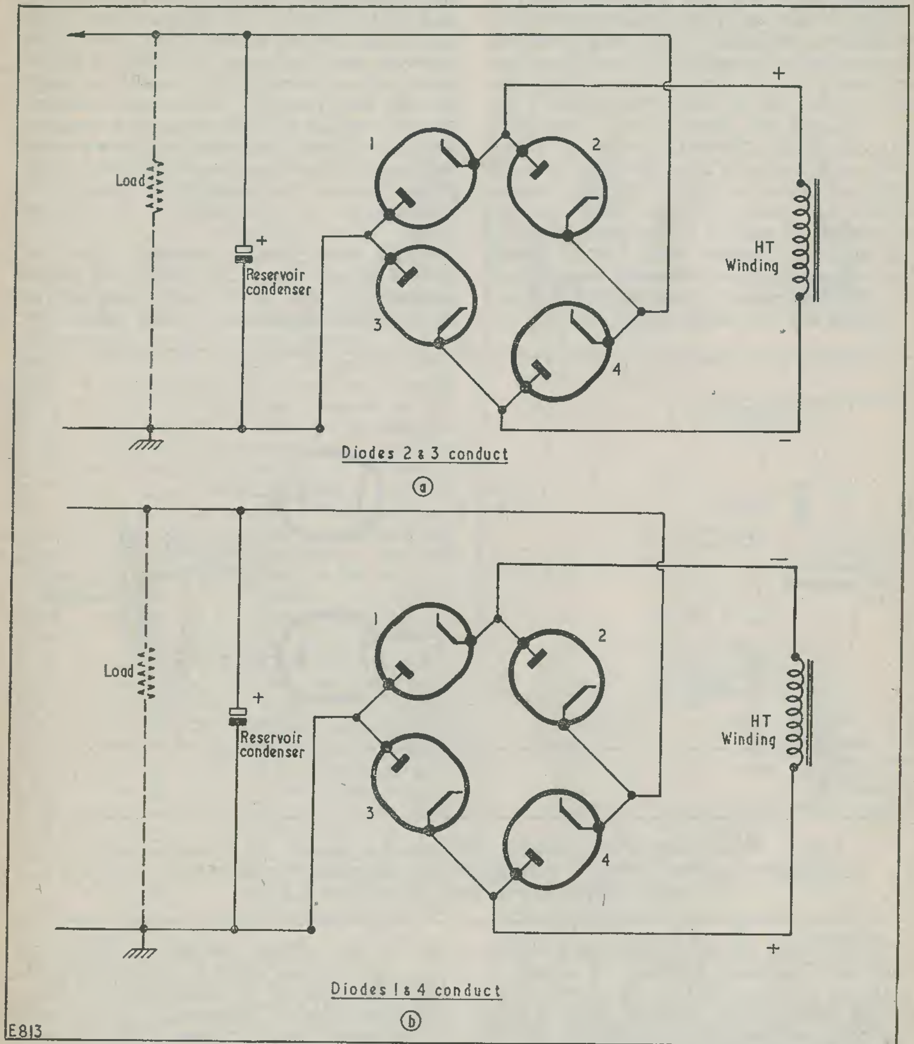


Fig. 4. These two diagrams illustrate the bridge circuit of Fig. 3 with the rectifiers changed to valve diodes. In (a) the potential at the top of the h.t. winding is positive. In (b) the potential at the top of the winding is negative

Transistor Polarity

"Whilst we're on the subject of polarity," said Dick, offhandedly, glancing out of the corner of his eye at the Workshop clock, "I often find myself getting into similar difficulties with transistors. I mean to say, which way round they should be connected and all that sort of thing."

"I experienced something like that myself," remarked Smithy, his interest in the subject causing him to forget the passage of time, "especially when transistors first appeared in this country."

"What did you do?"

"I'd read," replied Smithy, "about transistors in books and publications before I'd even seen one; but what I wanted to do was to get the 'feel' of them when they worked as amplifiers. I was very fortunate, at that time, in being able to wangle several very early p.n.p. junction transistors, and so I carried out a little experiment. I got a 9-volt grid bias battery, and I connected up one of my transistors with a 0-5mA meter and a resistor around 2.2kΩ in series with the collector, and a resistor around 100kΩ in series with the base. I then connected the emitter to the positive end of my grid bias battery and played around by connecting the collector and base circuits into various taps in the battery." (Fig. 6 (*a*).)

"What did that teach you?"

"Only what the gen books had already told me!" grinned Smithy. "I ended up with the collector lead in the 6-volt socket of the battery and I plugged the lead from the base into its various tappings. As the lead in the base circuit tapped into a higher voltage, collector current increased. At zero volts on the base, collector current was negligible and, if I tapped the lead from the base into a point positive of the emitter, it stayed that way."

"It sounds a simple experiment."

"It was," replied Smithy. "But, funnily enough, it caused the basic requirements of transistor polarities to stick in my mind more firmly than all the swotting-up I did. What I taught myself was this: when a p.n.p. transistor is operated in an earthed emitter amplifier circuit (Fig. 6 (*b*)), the emitter goes to the positive end of the supply and the collector, via its load, to the negative end of the supply. To bring the transistor 'on', you have to cause a current to flow from a negative source of supply into the base. This, incidentally, would normally be the bias current. If you increase that current—which I did in my case by tapping higher up the battery—then collector current increases. Provided you remember those basic points, the question of polarity of connections to a transistor is a piece of cake.

"This very simple concept, which of course ignores things like input and output impedances and so on, also enables you to sort out the phase reversal which you get in an earthed emitter transistor. If you increase the current flowing into the base, by making it more negative, then collector current increases. An increase in collector current causes a greater volts drop across the collector load. So the collector goes positive; that is, further away from the negative supply line. The final result is that, if the base goes negative the collector goes positive. In other words an earthed emitted transistor gives you 180° phase reversal."

"Well, I'm dashed," said Dick. "I must remember that in future! I always have to look up the text book when I want to check whether or not there's phase reversal in an earthed emitter transistor."

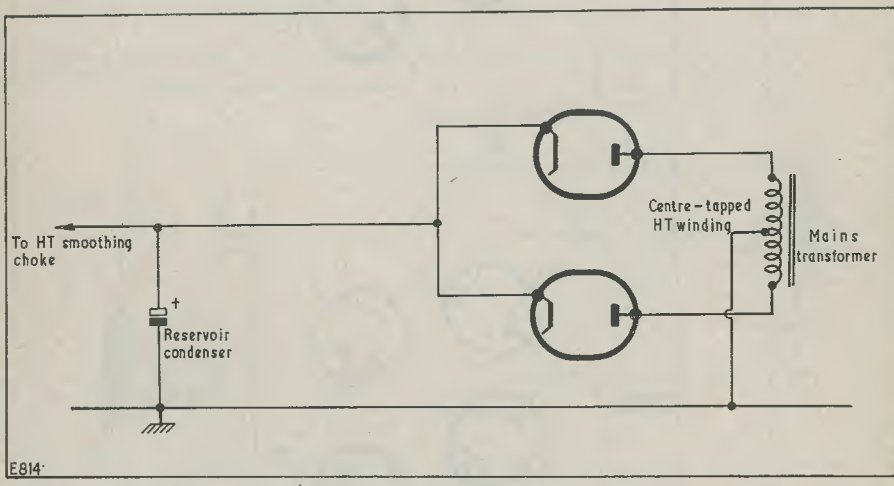


Fig. 5. A conventional two-rectifier full-wave h.t. circuit. To obtain the same rectified voltage as is given by a bridge circuit, the mains transformer h.t. winding needs approximately twice the number of turns

"Earthed base transistors are just as easy," remarked Smithy, "if you remember the original earthed emitter experiment. The earthed base goes to the positive end of the h.t. supply line and the collector, via its load, to the negative line. (Fig. 6 (*c*).) To bring the transistor 'on' you have to apply a bias current between base and emitter. Previously, the base was biased negative of the emitter. This time you do the same thing, speaking purely in terms of polarity, by biasing the emitter positive of the base. Via a resistor of suitable value, of course."

"Dead easy," remarked Dick. "Let's see what happens when you put a signal into the transistor."

"Go ahead."

"In this case," pronounced Dick, "you apply your signal to the emitter. If the signal causes the emitter to go positive, that is presumably the same as causing the base in the previous instance to go negative." Smithy nodded in agreement. "So the collector current increases, and the collector goes positive also."

"That's it," confirmed Smithy. "With the earthed base connection a positive-going signal on the emitter causes a positive-going signal to appear at the collector. So the output has the same phase as the input."

"It all seems very simple," remarked Dick. "I think I'll try out that little experiment of yours some time, Smithy."

"I should," replied the serviceman. "It's so easy to do that you can set it up in a few minutes and finish it in a few more. But it will fix the essential requirements of transistor connection polarities more firmly in your mind than anything else I can think of. I must repeat that I have only been discussing *polarities* up to now and that what I've said concerns the very elementary basics of p.n.p. transistors when they are used as amplifiers. I've completely ignored input and output impedances, stabilising circuits, and things like that."

"You keep referring to p.n.p. transistors. What about n.p.n. transistors?"

"With n.p.n. transistors," said Smithy, "you just reverse the polarity of the supply and the polarity of the source of bias current."

Rectified Replacement

Smithy glanced at the Workshop clock and started.

"Ye gods," he said irately. "Have I been talking for all *that* time? Come on, Dick, we've got work to do! You'd better start work on that wreck on your bench. By the way, what *was* wrong with the h.t. rectifier you took out of that set?"

"It was giving low h.t. voltage," replied Dick. "The set came in with insufficient width. The first thing I checked was h.t. and this was down to 160 volts or so."

"Fair enough," said Smithy, satisfied.

Left to himself, Dick set about repairing the ravages he had wrought in his receiver. He removed the rectifier, the reservoir electrolytic condenser, and the series limiter resistor. He was relieved to find that the voltage selector panel and the input plug and socket had apparently withstood the heavy overload without any serious damage. Dick's momentary relief changed to a frown when he found that the tumbler action on the on-off switch was not working.

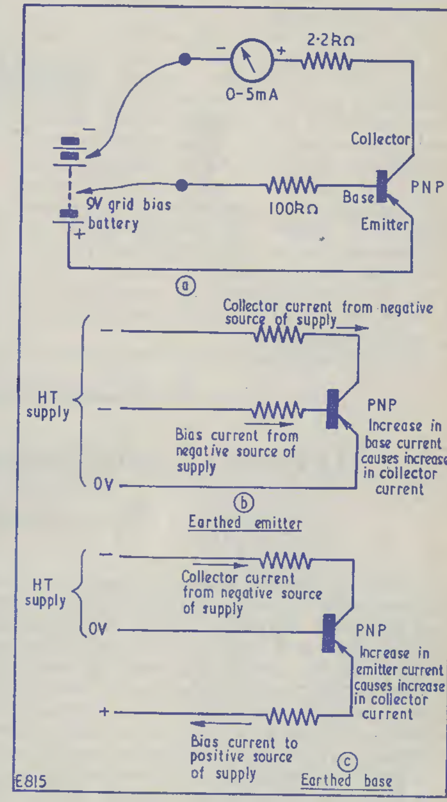


Fig. 6 (a). Getting to grips with the polarity requirements of a transistor. This simple set-up is discussed in the text

(b). Polarity requirements of a p.n.p. transistor employed as an earthed emitter amplifier

(c). Polarity requirements of a p.n.p. transistor employed as an earthed base amplifier

He disconnected the switch. As this was ganged to the volume control, the latter had to be disconnected also.

Dick next fitted, and connected up, a new limiter resistor, a new reservoir electrolytic condenser, and a new switch and volume control. Thoughtfully, he inserted a new cartridge fuse-link into the socket at the rear of the chassis.

The routine work of replacing these components cheered him up, and, when it was time to fit the new rectifier, he had completely recovered his usual high spirits. Very carefully, he refrained from making any connection to the red tag of the rectifier, completing the wiring to its remaining tag only. He next connected up to the mains and checked, with a testmeter, that a voltage positive of chassis did, indeed, appear on the red tag. Just to make absolutely certain, he checked with another testmeter. There was no doubt about it whatsoever—a voltage positive of chassis was definitely given at the red tag.

Dick disconnected the receiver from the mains and connected the lead from the reservoir to the red tag. As this was the last connection to be made he soldered it as carefully and skilfully as he possibly could. When he had taken his soldering iron away, the joint at the red tag was immaculate. Gazing fondly at his handiwork, Dick re-connected the receiver to the mains and switched on.

The Workshop lights dimmed.

Almost immediately afterwards the new cartridge fuse-link shattered. A little puff of smoke rose from the new rectifier to be followed by the sickening stench with which Dick was already familiar.

Smithy had already rushed to the door, at which he now stood, seething. The unhappy Dick fought his way to his window and opened it. His eyes dropped to the chassis and he gave a gasp of horror.

"Don't say," exploded Smithy, "that you've connected up the *new* rectifier wrong way round as well!"

"I haven't," wailed Dick. "This time it's the reservoir electrolytic!"

Marconi Installations for New Ocean Weather Ships

Marconi's Wireless Telegraph Co. Ltd. are currently engaged on an extensive Air Ministry contract which involves the supply and installation of new radio communication equipment and automatic direction finders, and the modernising and installation of Admiralty ranging and height-finding radar for high altitude windfinding aboard two new ocean weather ships. The installation planning for these has also been a Marconi responsibility.

The first of these, O.W.S. *Weather Adviser*, has now been completed and has run her acceptance trials. She was formerly the frigate H.M.S. *Amberley Castle* and as such has undergone an extensive conversion refit at the yards of the Blyth Dry Docks & Shipbuilding Co. at Blyth, Northumberland, before going into commission as an ocean weather ship under her new name.

The second frigate, H.M.S. *Pevensey Castle*, is at present undergoing a similar refit at the same yards. Marconi's are carrying out identical work on this also.

The Marconi radio equipments for these two ships include the following, divided equally between each:

Eight 1kW independent sideband transmitters Type NT201. These are medium-power transmitters designed for single sideband and independent sideband operation, but with facilities for double sideband and continuous wave working. Each is complete with a fully remotely controlled aerial matching unit for use with a whip aerial. The frequency range is 1.8–23 Mc/s covered in five bands.

Sixteen receivers Type NS702. These are marine equipments designed to comply with the latest international regulations, and conform to the G.P.O. performance specification for a general purpose receiver. They provide continuous coverage from 15 kc/s to 28 Mc/s, in ten ranges.

Two MF automatic direction finders Type ND103. These cover the frequency range 250–550 kc/s. They employ a Bellini-Tosi fixed loop system with an automatically adjustable goniometer as the rotating element. They conform fully to G.P.O. specifications for maritime direction finders.

Two VHF automatic direction finders Type AD210C and displays. These are single channel equipments with provision for five crystal-controlled frequencies in the frequency range of 100–156 Mc/s. The associated displays have been modified to provide both true and relative bearings.

UNDERSTANDING TELEVISION

PART 38

By **W. G. MORLEY**

The thirty-eighth in a series of articles which, starting from first principles, describes the basic theory and practice of television

In last month's issue we introduced the subject of television receiver power supplies and discussed three general basic types. These were: circuits employing an isolating mains transformer for both heater and h.t. supplies (the latter having a full-wave rectifier), circuits employing an autotransformer supplying heaters and a half-wave h.t. rectifier, and a.c./d.c. supplies employing half-wave h.t. rectification together with series heater circuits.

We shall now carry on to consider power supply requirements in more detail.

Operation from Non-synchronous Mains

It is possible for the power supply circuits of a television receiver operated from a.c. mains to cause discrepancies in the size and shape of the reproduced picture. Such discrepancies vary at the supply frequency.[1] A typical instance of picture discrepancies is given if the magnetic field around a mains transformer enters the cathode ray tube at sufficient strength to cause deflection of the electron beam. Should this occur the picture, or part of the picture, will change in shape at the mains frequency. Change in picture shape may also result if, due to inadequate h.t. smoothing, a ripple appears on the h.t. positive rail. This ripple may cause a varying h.t. potential to be applied to the frame sawtooth generator and frame output valves, with the result that picture height varies at the ripple frequency. If a half-wave h.t. rectifier is employed, the ripple frequency will be that of the mains supply.

It is usual practice, in Britain, to synchronise the frame frequency of the transmitted signal with the 50 c/s power supply frequency employed in the National Grid electricity supply system. This practice considerably eased power supply design problems in earlier British receivers since, even if the power supply stage caused small deviations in picture shape and size, these were not obviously noticeable when the receiver operated from a "synchronous" a.c. supply, i.e. a supply derived from the Grid. To take an example, if the field around a mains transformer fed from a "synchronous" supply caused the bottom part of the reproduced picture to be deflected horizontally, the amount of deflection would be equal in each successive frame because the passage downwards of the electron beam scanning the frame would be synchronised with the magnetic field causing the deflection. In consequence, the distortion in picture shape would remain constant from frame to frame. Provided it was not too great such distortion would not then be noticed by the viewer.

The distortion in picture shape given in the example just quoted would, however, become very noticeable to the viewer if the receiver were operated from an a.c. supply which was not derived from the Grid system. In this instance, the received frame frequency

[1] If they are caused by ripple from a full-wave rectifier h.t. circuit, at twice the supply frequency.

would be out of synchronism with that of the supply, and the magnetic field from the mains transformer would cause the bottom of the reproduced picture to be distorted from its correct shape at a frequency equal to the difference between frame and supply frequencies. The resultant, continually changing, distortion of picture shape would be much more obvious than the constant distortion.

Whilst the practice of synchronising transmitted frame frequency with that of the National Grid eased power supply design problems in earlier British receivers, most sets manufactured since around 1955 have been provided with power supply circuits which can operate from "non-synchronous" mains supplies without noticeable picture distortion. Two contributions towards this state of affairs are the use of a.c./d.c. power supply circuits, together with the availability of relatively low-cost h.t. smoothing condensers having large values of capacity. Employing an a.c./d.c. power supply circuit obviously assists in overcoming difficulties with "non-synchronous" mains supplies because the mains transformer is eliminated. So far as h.t. smoothing condensers are concerned, components having capacities of 100µF (reservoir) and 200µF (smoothing) at 275 working volts are readily available. Such condensers, together with a low resistance smoothing choke, offer adequate smoothing in a half-wave rectifier circuit for most applications where connection to "non-synchronous" mains is intended.

Interference with picture shape by causes other than the magnetic field around the mains transformer (if used) and ripple on the h.t. positive rail may also occur. Feasible instances would be given by stray couplings between mains wiring and time base circuits and by the magnetic fields around smoothing chokes. Elementary design procedure can, however, obviate such possibilities.

Receivers manufactured outside Britain frequently employ mains transformers. In such receivers, the magnetic field from the transformer is prevented from interfering with the shape of the reproduced picture by the use of several precautions. The most obvious precaution consists of mounting the transformer some distance away from the cathode ray tube. Also, the transformer may be wound on special cores or laminations which keep external fields to a minimum.

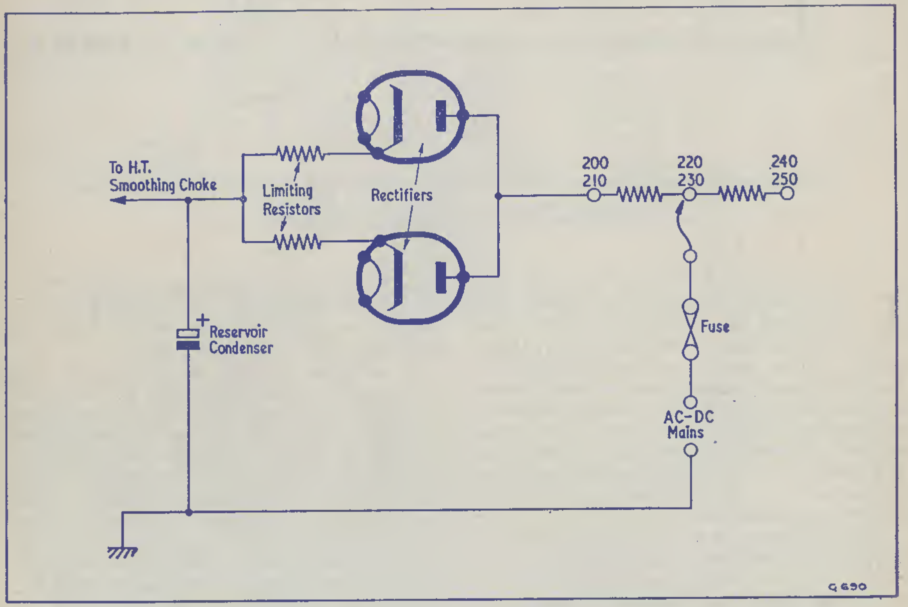


Fig. 228. Some British receivers employ two valve rectifiers in parallel when the required h.t. current is in excess of the limiting rectified output current of either. If desired, the limiting resistors may be connected in series with the rectifier anodes instead of the cathodes as is shown here

A further precaution which may be used consists of shielding the transformer from the cathode ray tube by metal sheet having a high permeability.[2] The sheet provides a path through which the lines of magnetic force in the field from the transformer travel much more readily than they would through the air beyond.

H.T. Rectifiers

Two types of rectifier have been commonly employed in the past in television h.t. circuits. These are the thermionic valve rectifier and the selenium "metal" rectifier. Over recent years, silicon h.t. rectifiers have been introduced.

Full-wave thermionic rectifiers employed in television receivers are normally types which are familiar to the amplifying or amateur transmitting enthusiast. A frequently encountered full-wave television rectifier is the 5U4.

Several special valves have been developed for half-wave rectification in British television receivers (and Continental receivers operating

[2] Permeability in electrical theory is the equivalent of conductivity (the reciprocal of resistance) in electrical theory.

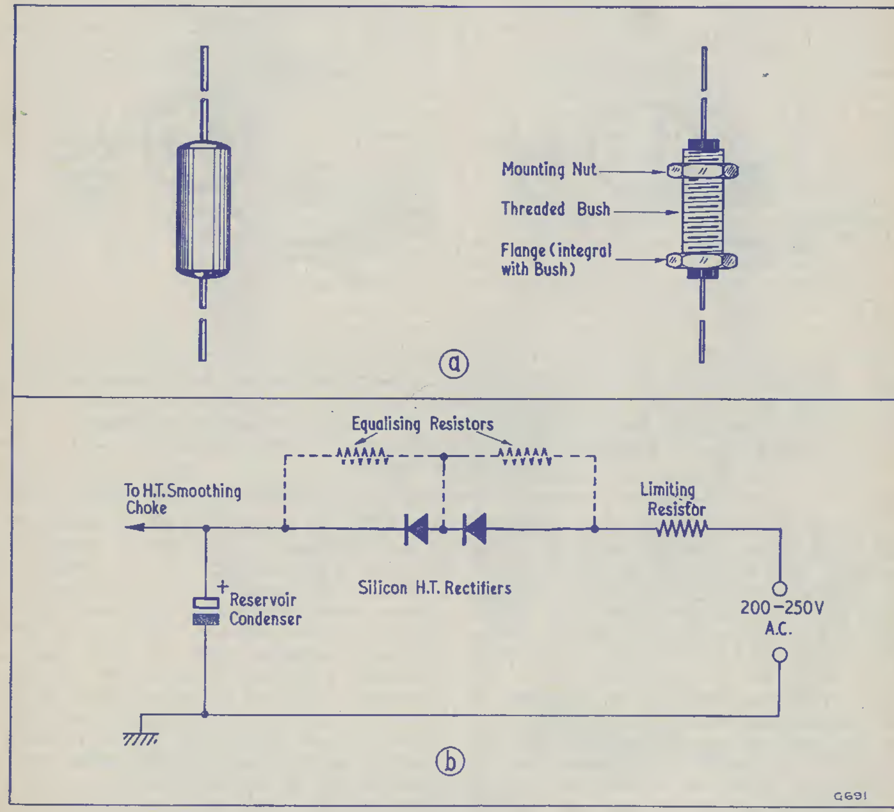


Fig. 229 (a). Illustrating the physical appearance of two typical silicon h.t. rectifiers. The rectifier on the left is housed in a plastic case which may have dimensions of the order of ¾in long by ¼in diameter. The rectifier on the right is smaller and is intended to be mounted on a metal plate which then conducts heat away

(b). The peak inverse voltage rating of silicon h.t. rectifiers is too low to allow a single rectifier to be employed in half-wave circuits running from British mains supplies. Two silicon rectifiers can, however, be employed in series, as shown here. In practice the circuit would also include a fuse and series resistors for mains voltage selection

from mains voltages similar to those used in Britain), examples of these being given by the PY82 and PY32. The h.t. current requirements of conventional British television receivers can be met by a single PY32, whose limiting rectified output current is 300mA. PY82's, with a limiting rectified output current of 180mA, may be connected in parallel, as shown in Fig. 228, in receivers where a single rectifier cannot provide the h.t. current required.[3] In Fig. 228 each rectifier has its individual limiter resistor.[4]

An important feature of rectifier design is the *peak inverse voltage* applied to the rectifier. This is the peak voltage applied to the rectifier with *reverse* (i.e. non-conducting) polarity. In a rectifier circuit employing a reservoir condenser the peak inverse voltage is 2.8 times the r.m.s. voltage of the applied a.c.[5] Thus, for an applied voltage of 250 r.m.s. (the maximum to be expected in Britain) the peak inverse voltage is 700. The limiting peak inverse voltage rating for both the PY82 and the PY32 is 700 volts.

Selenium half-wave rectifiers are usually manufactured with the conventional "finned" construction. The function of the fins is to provide a large cooling area for the selenium rectifying junctions, the *forward* (i.e. conducting) resistance of which increases with temperature. A variant of the "finned" selenium rectifier, and one which is sometimes encountered in television receivers, is the contact-cooled rectifier. The contact-cooled rectifier has the selenium rectifier junctions enclosed in a shallow metal case which is secured to the receiver chassis such that a good thermal contact exists between the two. The chassis then allows heat to be conducted away from the rectifier and provides a large surface area for cooling.

Silicon h.t. rectifiers for television receivers have recently been introduced. The silicon rectifier junction has a very low forward resistance, with the result that it dissipates little heat in operation. In consequence, half-wave silicon h.t. rectifiers for television applications can be made with very small physical dimensions. Silicon rectifiers may be manufactured as wire ended components, or as components fitted with a threaded metal bush, both types being shown in Fig. 229 (*a*). Types having the threaded bush construction are intended to be mounted to a metal plate, which then conducts heat away from the rectifier. The peak inverse voltage rating of silicon h.t. rectifiers intended for television receivers is too low, at around 400 volts, for a single component to be employed in a half-wave rectifier circuit working from British mains supplies. However, two such components may be used in series, as illustrated in Fig. 229 (*b*). Fig. 229

[3] The figures quoted for the PY32 and PY82 are taken from Mullard literature.

[4] The limiter resistor circuit limits the heavy charging current which flows during conducting half-cycles into the reservoir condenser.

[5] Assuming no load, the rectified voltage across the reservoir condenser rises to very nearly the peak voltage of the a.c., that is, to 1.4 times its r.m.s. voltage. This voltage is then applied to the rectifier, in series with the peak voltage of the a.c., during the non-conducting half-cycle; giving a total peak inverse voltage equal to 2.8 times the r.m.s. voltage of the a.c.

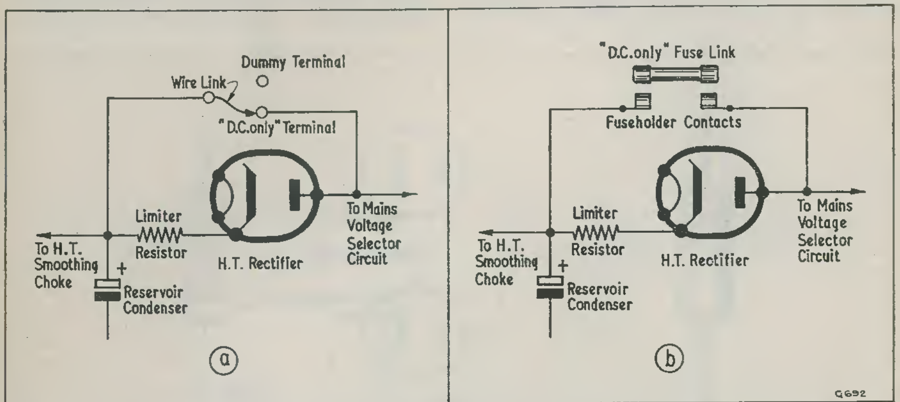


Fig. 230. *In order to overcome voltage drop in the rectifier and limiting resistor when operating from low voltage d.c. mains, some receivers incorporate a means of short-circuiting these two components. In (a) this is achieved by moving a wire link from the dummy anchoring terminal to the "d.c. only" terminal. In (b) a fuse-link is inserted*

(*b*) shows, in dotted line, equalising resistors connected across the rectifiers. The function of these resistors is to ensure that approximately half the peak inverse voltage appears across each rectifier even if the *backward resistances* (i.e. the non-conducting resistances) of the latter are different. In some instances it is possible to dispense with the equalising resistors.[6]

Low Voltage D.C. Mains

When British television receivers having a.c./d.c. power supplies are operated from low voltage (200 volt) d.c. mains, the voltage dropped in the rectifier and limiter resistor tends to be sufficiently high to prevent the appearance of an adequate h.t. voltage. Some receivers incorporate a means of short-circuiting the rectifier and limiter resistor (or the rectifier alone) for operation from low voltage d.c. mains, two typical methods being illustrated in Fig. 230. In Fig. 230 (*a*) the rectifier and limiter resistor are short-circuited by means of a wire link, whilst in Fig. 230 (*b*) they are short-circuited by inserting a cartridge fuse-link. When a receiver of this type has been modified by short-circuiting the rectifier and limiter resistor, it is essential that it be connected to the d.c. mains with correct polarity as, otherwise, a reverse voltage will be applied to the reservoir electrolytic condenser.

Voltage Doubling Circuits

Voltage doubling rectifier circuits are frequently employed in American television receivers, because they enable an h.t. voltage which is approximately twice that available from a half-wave rectifier to be obtained without the use of a transformer. Voltage doubling circuits are especially attractive for American applications since they provide an adequate h.t. voltage despite the relatively low mains supply voltage.

A commonly used voltage doubling circuit is given in Fig. 231 (*a*). Fig. 231 (*b*) illustrates the action of the circuit for half-cycles which cause the upper input terminal to be negative and the lower input terminal positive. Under these conditions rectifier W_1 conducts, causing C_1 to charge (after a number of half-cycles) such that its right hand plate is positive and its left hand plate negative.

Fig. 231 (*c*) shows the circuit on the alternate half-cycles, when the upper input terminal is positive and the lower input terminal negative. In this instance the voltage applied to rectifier W_2 consists of the supply voltage *plus* the voltage across the charged condenser C_1. In Fig. 231 (*c*) rectifier W_2 conducts, causing C_2 to become charged (after a number of half-cycles) to the supply voltage plus that across C_1. The rectified voltage across C_2 is approximately twice that which would be given in a half-wave circuit, and a voltage-doubling action can be said to have taken place.

If there were no load across C_2, C_1 would charge initially to very nearly the peak voltage of the applied a.c. In its turn, C_2 would charge to very nearly twice the peak voltage of the applied a.c. In practical applications, current would be drawn from C_2 by the h.t. circuits of the associated receiver. At the same time C_1 would lose

[6] SenTerCel FST1/4 silicon rectifiers (manufactured by Standard Telephones and Cables Ltd.) may be employed in the circuit of Fig. 229 (*b*) without equalising resistors.

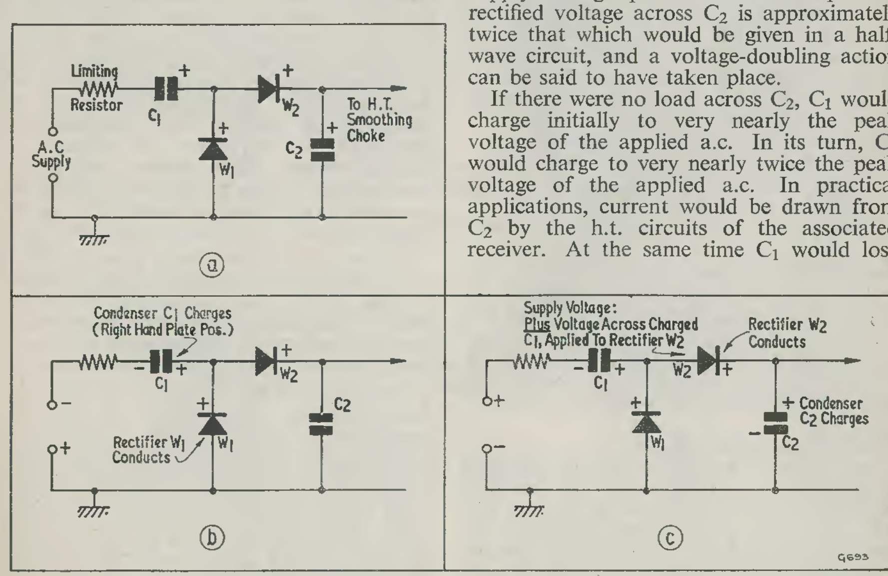


Fig. 231 (*a*). *A commonly employed voltage doubling h.t. rectifier circuit, as used in American receivers.* (*b*) *and* (*c*). *Illustrating circuit operation during alternate half-cycles* part of its charge to C_2 during the half-cycles when rectifier W_2 conducted. Both C_1 and C_2 act, therefore, as reservoir condensers.

The voltage on the right hand plate of C_1 is always positive of that on its left hand plate. C_1 may, in consequence, be an electrolytic component.

"Stacked" H.T. Systems

Many American receiving valves are designed for operation with applied h.t. voltages of the order of 120 volts. Such valves are sometimes employed in American television receivers in "stacked B supply" circuits, a typical example being illustrated in Fig. 232. In this diagram an h.t. potential of some 250 volts is applied to two i.f. amplifying valves connected in series, the anode of the lower valve obtaining its h.t. voltage from the cathode of the upper. The junction of anode and cathode is suitably decoupled and each valve functions with approximately half the available h.t. voltage.

Other pairs of valves in a receiver may be similarly connected, and it is possible for the upper and lower sections of a single "stacked" circuit to include several stages each. Alternatively, a single valve may be used in the upper section and several valves in the lower section.

It is stated that "stacked" circuits offer the advantage of reduced h.t. current consumption since the total current drawn is equal to the operating current of either valve (or set of valves). When two i.f. amplifiers valves are "stacked", and the grid voltage of the upper valve is fixed by a potentiometer (as it is in Fig. 232) the voltage available for the anode of the lower valve remains relatively constant. If a.g.c. is applied to the lower valve, the current flowing through the upper valve reduces when a.g.c. voltage increases. The gain of both valves becomes, as a result, controllable by the a.g.c. voltage.

"Stacked B supply" systems are normally used only with i.f. or a.f. amplifying stages. Stages such as those which include the line output valve, the frame output valve, and the video output valve, operate from the full h.t. voltage.

Two-valve "stacked" i.f. circuits, such as that shown in Fig. 232, are sometimes incorrectly described as "cascode" circuits.

Series Heater Supplies

In current British television receivers employing a.c./d.c. heater circuits the individual valve heaters, together with the cathode ray tube heater, are connected in series to from a *heater chain* or *heater string*. The chain is then connected to the supply mains via a resistor and a thermistor as shown in Fig. 227 (*c*).[7] The mains voltage selector circuit for the receiver varies the amount of series resistance to suit differing mains voltages. Conventional British (and Continental) practice consists of using a standard television heater chain current of 300mA.

Valve heaters, when cold, offer a markedly lower resistance than when they reach operating temperature. In consequence the total resistance of a heater chain is much lower when it is cold than after warm-up. If a cold heater chain were connected, via a series resistor having a value applicable to the operating resistance of the heaters, direct to the mains supply, a heavy current surge would flow. Such a surge may be prevented by inserting a thermistor in series with the chain. A thermistor exhibits high resistance when cold and low resistance when warm, its high cold resistance limiting the initial heavy surge of current when switching on the mains supply to the chain. After switching on, the thermistor warms up and its resistance reduces. Eventually a state of equilibrium is reached in which the thermistor achieves a temperature which allows the correct current to flow through the warmed-up heater chain. A typical thermistor for use in series with a television heater chain is the Brimistor type CZ1.[8] This has an initial resistance of 3,800Ω at 20°C, the resistance dropping to 44Ω when the thermistor has warmed up and is passing its maximum operating current of 300mA. It is normal to specify a maximum surge current for a thermistor, a relatively heavy surge current on switching on being possible in some valve circuits despite the high initial resistance of the thermistor. If the surge current on switching on exceeds that specified, the thermistor may be shunted by a resistor of suitable value. This resistor carries the appropriate fraction of the initial switching-on surge current, after which its effect in the circuit reduces as thermistor resistance drops.

Occasionally, a pilot lamp is employed in a television receiver and this may consist of a small bulb wired in series with the heater chain. The bulb is normally shunted by a low value resistor which maintains continuity in the heater chain if the bulb burns out.

All valves have a small self-capacity between heater and cathode, and this self-capacity may cause a voltage, at a.c. supply frequency, to appear on the cathode. The a.c. voltage, with respect to chassis, applied to the heaters is at its minimum for the heater at the chassis end of the chain, and is at its maximum for the heater at the other end of the chain. Because of this, valves whose performance would especially suffer because of the appearance of a.c. voltages on their cathodes are connected into the heater chain at, or near, the chassis end. Such valves include those employed in the tuner unit, those in the early i.f. stages, and those whose cathodes are coupled to high impedance circuits. In some receivers, the heater of the frame sawtooth generator is also inserted near the chassis end of the heater chain in order to prevent the frame sawtooth being affected, in amplitude or phase, at the frequency of the a.c. supply. It is possible to reduce the effects of the stray capacity between cathode and heater by connecting large value bypass condensers between the cathode and chassis. In practice, however, this course is not normally adopted, r.f. and i.f. valve cathodes being bypassed to chassis via condensers of the order of 1,000pF only. A.F. amplifying valves and frame output

[7] Published in last month's issue.

[8] Manufactured by Standard Telephones & Cables Ltd.

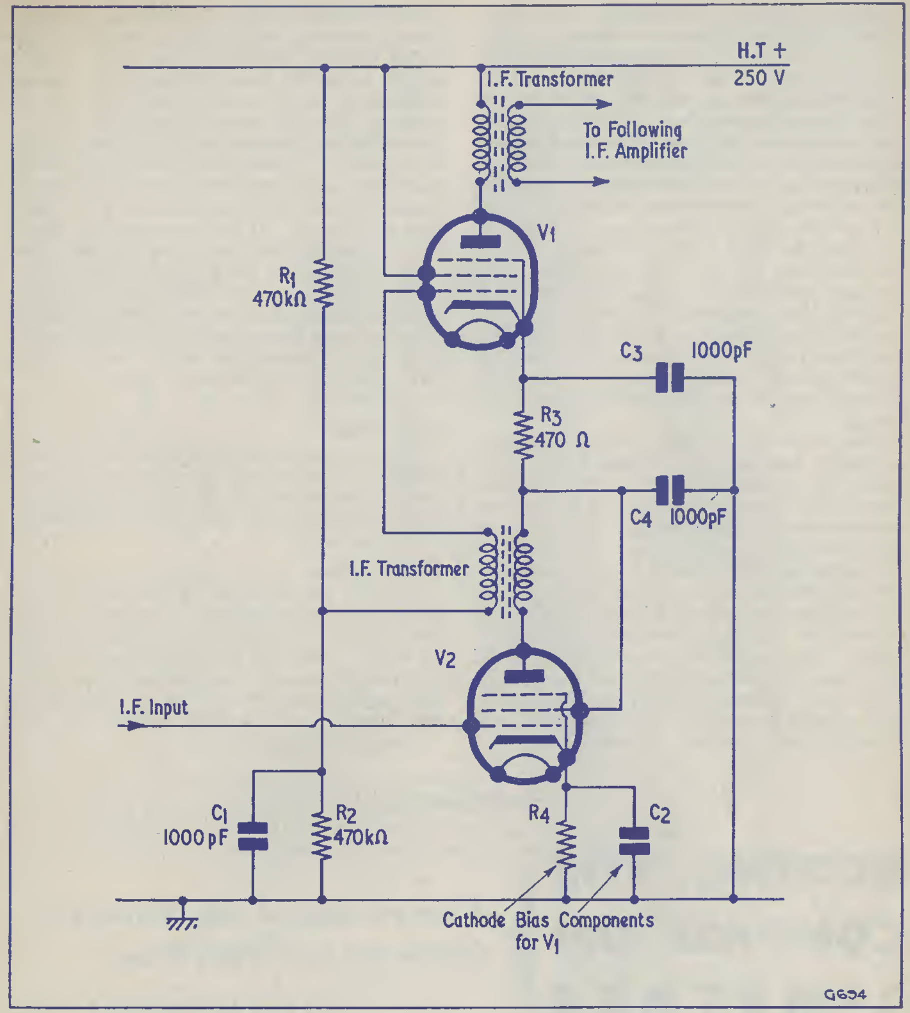


Fig. 232. "Stacked B supply" circuits are frequently encountered in American receivers. This diagram illustrates two i.f. amplifier valves in a "stacked" circuit with typical component values. Resistors R_1 and R_2 maintain the grid of V_2 at a fixed potential. C_1, C_3 and C_4 are bypass condensers

valves may have their cathodes bypassed to chassis via electrolytic condensers of the order of 20 to 50μF, but condensers with values of this order are necessary for the cathode bias circuits of such valves in any case. Some valves, such as the line output valve, normally have their cathodes connected direct to chassis, whereupon the possibility of a.c. voltages being passed to the cathodes by stray capacities does not arise.

Another factor which may affect the position of a valve in a series heater chain is the limiting voltage between heater and cathode specified by the manufacturer. If limiting heater-cathode voltages are exceeded, breakdown may occur between these two electrodes. Valves having low limiting heater-cathode voltage ratings are normally inserted close to the chassis end of the heater chain.

The cathode ray tube raises particular problems because its cathode is normally held at a positive potential with respect to chassis, this potential approching the limiting heater-cathode voltage rating. As it is in any case desirable to keep the a.c. component of the heater-cathode voltage to a low value in order to prevent a.c. voltages appearing on the cathode, the cathode ray tube is normally inserted at, or near, the chassis end of the chain. For a further reason, now to be discussed, it is desirable to insert the cathode ray tube at, instead of near, the chassis end.

If a valve in a heater chain burns out, the chain becomes broken. All the heaters on the chassis side of the burnt out valve assume chassis potential whilst all the heaters on the other side of the burnt out valve assume supply potential. The heater-cathode limiting voltages of some of the valves in the second category may be exceeded, with the risk of cathode-heater breakdown. Since the cathode ray rube is a considerably more expensive item than any of the valves in the receiver it is desirable to insert its heater at the chassis end of the chain. It then becomes impossible for its limiting heater-cathode voltage rating to be exceeded if a valve burns out elsewhere.

The fact that some valves may have their limiting heater-cathode potentials exceeded when a series heater chain is broken emphasises the undesirability of removing valves from an a.c./d.c. television receiver whilst it is switched on.

Next Month

This completes our discussion on the power supply circuits of the television receiver. In next month's issue we shall start to consider the last subject to be dealt with in this series: television aerials.

Editor's Note

As may be gathered from the last paragraph, the current very popular series of articles by W. G. Morley is now approaching its end. After the last article on "Understanding Television" appears, our contributor will commence, in the issue immediately following, a new series under the title "Understanding Radio".

BOXING THE COMPASS ON 2-METRES

A Simple Control and Indicating System for a 2-Metre Beam

by H. J. LONG, B.E.M. G5LO

IN MY EARLY YOUTH, WHICH IS SOME TIME ago now, I had often read in adventure stories how the hero would run away to sea. One of the first things he would be taught in his apprenticeship as a seaman would be to "box" the compass. To me, in those days, this "boxing" the compass was always a bit of a mystery. Never having had the call of the sea, it was not until later in life that this same problem was to crop up with myself. Only, in this case it was not so much learning to "box" the compass as to know exactly in what direction my two-metre beam, unseen away up in the attic, was pointing!

Rotating by Selsyn Motors

Rotating the beam had been fairly simple by means of a pair of selsyns, but reliable calibration had been found almost impossible, owing to the tendency of the selsyns to "hunt" or "wander". True, a two-metre signal could be tuned in by slowly rotating the motors, although it was quite easy to miss a weaker signal altogether. Even on schedule with a station in a known direction it was quite impossible to be sure the beam could be pointed in the right direction.

Accordingly, it was decided that some kind of indicating device visible from the operating position was desirable, this giving visual

evidence of direction. With this end in view, it was decided, first of all, to scrap the selsyns and in their place use a small a.c. electric motor, rated at 115 volts, 0.5 Amps, and fitted with a 900 to 1 reduction gear. The motor being series wound, it was possible to make it reversible by means of a d.p.d.t. switch. This latter facility was necessary to avoid winding up the coaxial feeder.

ammeter or voltmeter as indicator, seemed to fill the bill, so experiments using such a system were carried out.

Fig. 1 shows three circuits tried out. All three circuits require a suitable potentiometer, preferably wire-wound, with the moving arm being rotatable at the same speed as the beam. Also, the moving arm must be capable of passing the usual stop, in case the beam is rotated past the full circle of 360

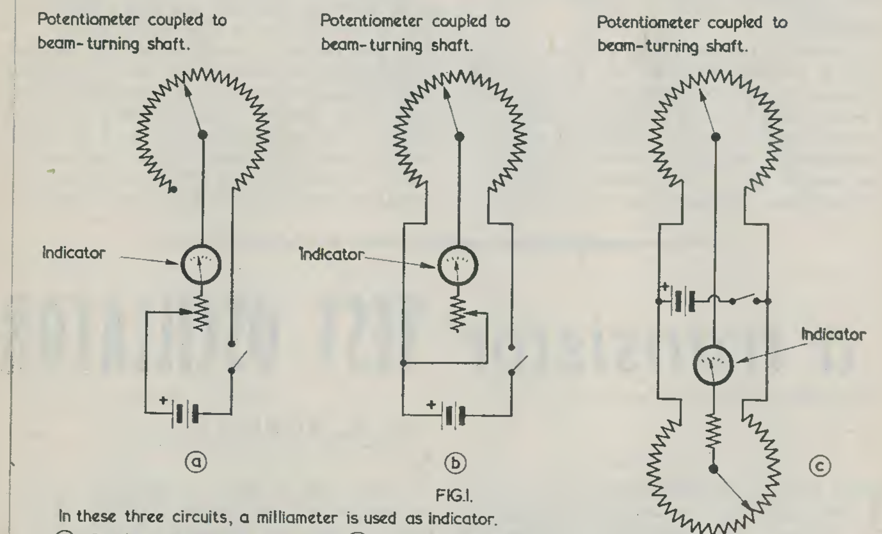


FIG.I.

In these three circuits, a milliameter is used as indicator.
ⓐ - Simple series resistance circuit. ⓑ - Potentiometer method.
ⓒ - Bridge method. With this method the lower potentiometer is set for minimum indicator reading. Beam direction is then indicated by potentiometer setting.

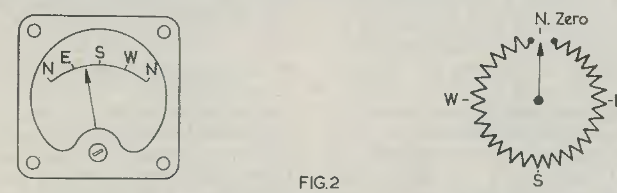


FIG.2

How the meter is marked out in points of the compass corresponding to the setting of the potentiometer coupled to the beam-turning shaft. M936

A suitable transformer was wound to supply power for the motor, and on testing out it was found possible to rotate the beam slowly in either direction by means of the control switch. A much simpler operation when searching for a signal than with the selsyn motors.

Indicating Systems

Consideration was then given to the visual indicating device at the operating position. A simple electrical system, using a milli-

degrees. A wire-wound potentiometer with a total resistance of 250 ohms was found in the spares box and, by filing off the stop at the end of the travel, it was made continuously rotatable. The potentiometer was mounted on to a bracket adjacent to the motor shaft, and with the aid of two small Meccano sprockets and a suitable length of chain, the moving arm of the potentiometer was driven round at the same speed as the beam-turning shaft.

Indicator

Using the circuit shown in Fig. 1 (*b*), which, after experiments, seemed to be the most suitable, a 0 to 5 milliammeter was employed as the indicator. For energising purposes, a small transformer and selenium half-wave rectifier, giving about 6 volts d.c. well smoothed, was used in place of the recommended battery. This was in order to make the unit self-contained, and also to obviate the possibility of recalibration as the internal resistance of the battery increased.

Calibration

Calibration of the beam relative to the meter is simple. First of all, the variable resistance in series with the meter, which can be about 5kΩ, requires adjusting so that the meter will give full scale deflection when *no* potentiometer resistance is in circuit. In other words, meter f.s.d. should correspond to maximum voltage from the potentiometer. Once this setting has been obtained, the variable resistance should require no further adjustment.

There is a "blind" spot for a few degrees when the potentiometer reaches the space between the ends of the wire resistance, and in this position the meter will give a zero reading.

The beam is set up by compass to point due north, and the moving arm of the potentiometer adjusted so as to be in the zero position. Once this has been done, no other calibration is required, and the meter scale can be marked out as shown in Fig. 2.

In conclusion it should be pointed out that no originality is claimed for this system, and that quite a few amateurs are no doubt using something similar. Nevertheless, it is put forward as an inexpensive and practical method, and one which has been particularly useful to the writer, a confirmed invalid, in assisting operating activity on Two Metres.

a transistor TEST OSCILLATOR

By M. ROBERTS

THE OSCILLATOR ABOUT TO BE DESCRIBED was designed to test domestic radio receivers and radiograms. Transistors were used because of their compactness and low power consumption. The unit built by the writer was designed to fit into a tool case which occupied a space of 4 x 2 x 3in only. The test oscillator should be of great use to amateurs as it is capable of testing the audio section of a receiver, of aligning the 470 kc/s i.f. stages, and of aligning the r.f. section.

The transistors used are Newmarket types consisting of two V10/30A audio transistors and one V6/8R standard i.f. transistor. If any equivalent transistors of alternative manufacture are available they will do just as well. For compactness, all components are miniature types, and the unit will run for several months on two 1.5V dry cells.

Circuit

The circuit is illustrated in Fig. 1. The two audio transistors TR_1 and TR_2 constitute a phase-shift a.f. oscillator. The phase-shift oscillator is similar to a valve phase-shift oscillator in some respects and works on the same principle. This is, of course, that a voltage from the collector of one transistor is fed back to the base of the other transistor, producing the necessary 180° phase inversion.

When TR_1 is in a conducting state, a voltage is built up across R_4 which is 180° out of phase with the voltage on the base of TR_1. The voltage across R_4 is applied to the base of TR_2 and is inverted a further 180° before appearing across R_7. The voltage across R_7 has therefore been swung through 360° from its starting point on the base of TR_1. It is therefore in phase with the base of TR_1 and as applied to this base, gives the correct positive feedback necessary to maintain oscillations.

The frequency selective network in the oscillator consists of R_1, C_1 and R_2, C_2. These components control the frequency of oscillation. Different oscillation frequencies may be obtained, if desired, by switching different values of capacity into the C_1 position.

The output from the audio oscillator is taken off R_7 via C_4, and is fed to a suitable socket, R_9 controlling the amplitude of the audio output. R_9 also controls the amount of modulation on the r.f. oscillation, since C_5 feeds audio from R_9 to the emitter of TR_3.

The r.f. oscillator consists of TR_3 and its associated components, and is emitter modulated by the audio fed via C_5. The circuit can be compared to the conventional

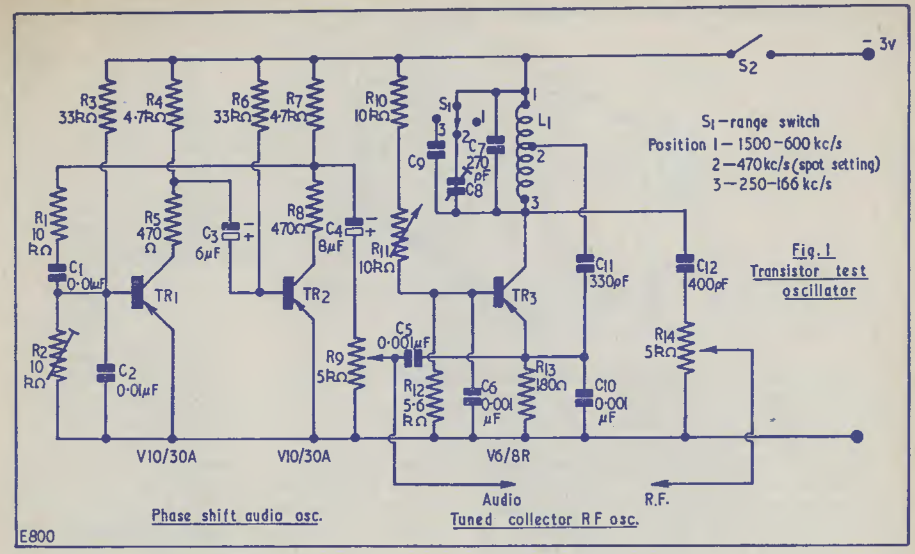


Fig. 1 Transistor test oscillator

Components List

Resistors

(All resistors are ½ watt)

- R_1 10kΩ
- R_2 10kΩ miniature potentiometer
- R_3 33kΩ
- R_4 4.7kΩ
- R_5 470Ω
- R_6 33kΩ
- R_7 4.7kΩ
- R_8 470Ω
- R_9 5kΩ miniature potentiometer
- R_{10} 10kΩ
- R_{11} 10kΩ miniature potentiometer
- R_{12} 5.6kΩ
- R_{13} 180Ω
- R_{14} 5kΩ miniature potentiometer
- L_1 100 turns 32 s.w.g. enamelled wire tapped at 30 turns. Former fitted with dust iron core

Condensers

(All condensers are 6V wkg. minimum)

- C_1 0.01μF
- C_2 0.01μF
- C_3 6μF electrolytic
- C_4 8μF electrolytic
- C_5 0.001μF
- C_6 0.001μF
- C_7 270pF
- C_8 100pF trimmer
- C_9 200pF (see text)
- C_{10} 0.001μF
- C_{11} 330pF
- C_{12} 400pF

Transistors

- TR_1 V10/30A Newmarket
- TR_2 V10/30A Newmarket
- TR_3 V6/8R Newmarket

valve oscillator where a tuned circuit is connected to the cathode. In this instance the tuned circuit is placed in the collector circuit and the positive feedback necessary to maintain oscillation is applied to the emitter via C_{11}. Frequency adjustments are made by R_{11} and R_{10}, their total resistance determining the frequency of oscillation. The modulated radio frequency output is taken off the collector via C_{12} to R_{14}, the r.f. output amplitude control. Different frequency ranges are available by switching additional capacity across C_7 by means of S_1.

Construction

The construction of the writer's oscillator is shown in Figs. 2 and 3. Dimensions are not specified as these depend entirely upon the components available. If the constructor wishes to build a similar unit at minimum cost ordinary potentiometers and large resistors and condensers can be used, the unit being mounted in a suitable box. It must be remembered that some form of cursor must

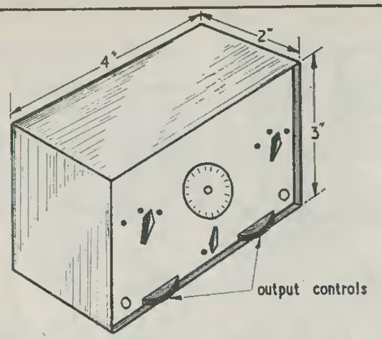


Fig. 2
The complete oscillator

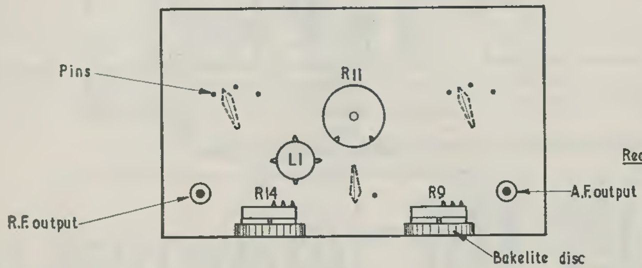


Fig. 3
Rear of front panel

E801

be fitted to R_{11} so that the unit can be calibrated.

If a small compact unit is required miniature components should be used, together with two small 1.5V cells. The output controls R_{14} and R_9 were miniatures in the prototype, and were fitted with Bakelite discs protruding through slots in the front panel, as shown in Figs. 2 and 3. The Bakelite discs had holes drilled in the centre and were push fits on the potentiometer spindles, to which they were finally secured with Araldite.* R_2 was not made a panel control on the prototype.

* "Araldite" is an epoxy-resin adhesive and is available at most hardware stores.—*Editor.*

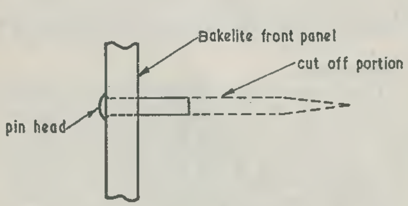


Fig. 4
Enlarged view of one pin & front panel

E802

In the prototype three switches were fitted, two of these being S_1 and S_2. The third caused different values of capacity to be switched into the C_1 position, thereby providing an adjustment of a.f. oscillator frequency. In order to provide the necessary miniaturisation these switches were home-constructed, the fixed contacts consisting of ordinary needlework pins fitted to the Bakelite front panel with the aid of Araldite. Wipers, made of springy metal, then made contact to the pin heads on the front side of the panel. The rear ends of the pins were snipped off, as shown in Fig. 4, components being soldered to the remaining parts of the pins.

The coil, L_1, is also home-constructed and consists of 100 turns of 32 s.w.g. enamelled wire wound on a ¼in former, as shown in Fig. 5. The coil length is ¾in and it may have to be wound in two layers, one on top of the other. The former is fitted with a dust iron core.

Operating Instructions

After the unit has been completed, check the wiring and then connect the battery, ensuring correct polarity. Connect the audio output to an audio amplifier or to an oscilloscope if one is available. See that the audio generator is working and that R_9 gives variable output. Also see that R_2 gives variable frequency coverage. If an audio

amplifier is used there should be enough output to fully load the speaker. If an oscilloscope is used there should be at least one volt of output.

Proceed to the r.f. generator and correct the r.f. output either to a sensitive oscilloscope or to a conventional a.m. receiver. With S_1 in position, reception of the modulated r.f. output should be obtainable in one position on the Medium wave band. Once this spot has been found check to see if the signal is being correctly modulated by adjusting R_9.

The unit is now ready for alignment and calibration.

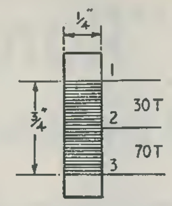


Fig. 5 Coil L_1
100 turns of 32 swg enamelled wire tapped at 30 turns. Former fitted with dust-iron core

E803

Alignment Instructions

If the audio oscillator is required to have a wide frequency coverage, the value of C_1 can be altered by switching in alternative values of capacity.

To obtain frequencies within the range 20 c/s to 3 kc/s, a selection of some of the following values can be used for C_1—0.1μF, 0.05μF, 0.02μF, 0.01μF, 3,000pF, 2,000pF, 800pF and 500pF.

Should feedback be too high and the transistors driven into the wrong operating point, distortion of the sine wave will result. This effect can be cured by trying different values for R_3 and R_6, i.e. 47kΩ, 56kΩ or 68kΩ.

The r.f. oscillator is best aligned against another reliable oscillator with the aid of a domestic radio receiver. The frequency band is determined by the condenser switched in by S_1, and frequency coverage within the band by R_{10} and R_{11}. The 270pF condenser C_7 should cause oscillation in the middle of the Medium wave band and R_{10} must be adjusted until R_{11} causes the oscillator to sweep the whole of the Medium wave band. S_1 should then be set to position 2 and C_8 adjusted until, with R_{11} in the centre of its travel, oscillator output is at 470 kc/s. S_1 should next be set to position 3, whereupon it should be possible to cover the range 250 to 166 kc/s by adjustment of R_{11}. Should accurate coverage of this band not occur, C_9 may require a slight adjustment in value.

The final operation consists of calibrating R_{11} in terms of frequency against the signal generator with the aid of the receiver.

CAN ANYONE HELP?

Requests for information are inserted in this feature free of charge, subject to space being available. Users of this service undertake to acknowledge all letters, etc., received and to reimburse all reasonable expenses incurred by correspondents. Circuits, manuals, service sheets, etc., lent by readers must be returned in good condition within a reasonable period of time

R1273 Receiver.—G3NSU, 27 Oldfield Street, Leeds 12, urgently requires the circuit diagram for this receiver.

* * *

Reax Radio Receiver, type E52AC.—C. Blackburn, 15 Lowton Road, Golborne, Warrington, Lancs, would like to obtain the manual or circuit of this receiver which was made by Essential Electrical Equipment Ltd., 21 Victoria Road, Surbiton, Surrey, about 20 years ago.

* * *

Eddystone 358 Receiver.—R. W. Jones, 24 Forest Avenue, Forresthall, Newcastle on Tyne, requires information on where the trimmers fitted to the coils (15 to 45pF) may be obtained.

* * *

R107 Receiver.—E. Binnion, 9 Sunny Road, Lodge, Wrexham, N. Wales, wishes to purchase the manual for this receiver.

* * *

HRO 60, BC221, 465 kc/s "Q-Multiplier".—C. Clarke, 9 Clarinda Park East, Dun Laoghaire, Co. Dublin, would like to obtain circuits and any data available.

* * *

Electronic Metronome.—R. Goodsell, Flat 1, 212A Northdown Road, Margate, Kent, is interested in constructing such a unit, using one or two transistors, and requests a circuit or any information from readers. All letters answered.

* * *

Cossor 701K FM Receiver.—P. J. Plater, 1 Deerhurst Road, Streatham, London, S.W.16, would like to hear from any reader who has constructed this receiver and who has found a method of reducing hum.

The "Ranger-3"

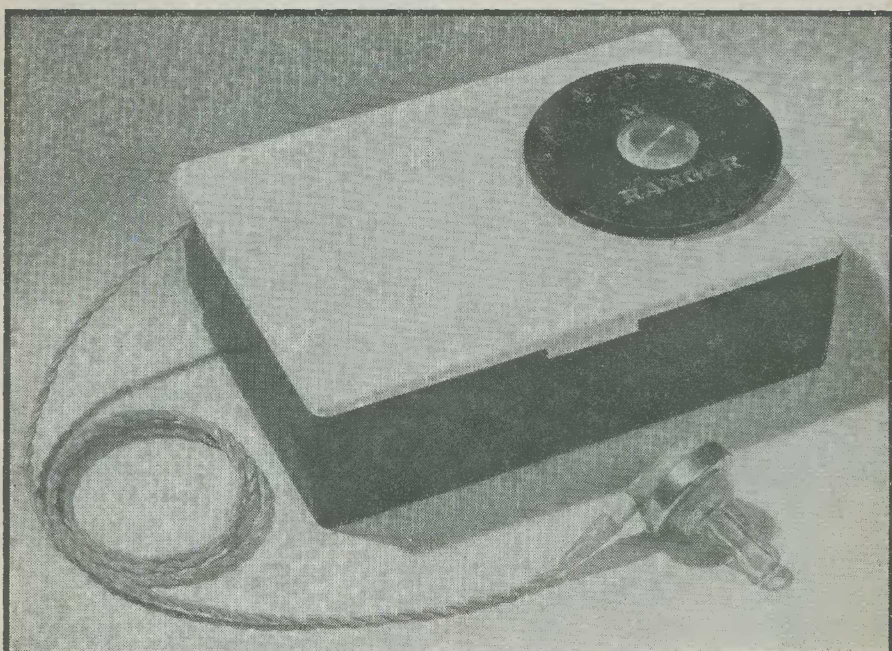
Personal Transistor Receiver

Designed by
D. J. FRENCH
Grad.I.E.E.

PERSONAL TRANSISTOR RECEIVERS HAVE FOR some years been very popular with the home constructor fraternity, and the design now offered not only follows in the wake of other successful designs featured in this magazine but also supersedes them with regard to efficiency. With the present design, three transistors of the latest types have been included, the circuit being that of a five stage reflex receiver.

The "Ranger-3" is fully tunable over the Medium wave range and, in addition, effectively covers the amateur "Top Band" (160 metres) and part of the shipping band—a most useful coverage for any enthusiast interested in both the amateur and broadcast frequencies. The total coverage is, in fact, from 600 kc/s (500 metres) to 2.5 Mc/s (120 metres). From this it will be noted that Radio Luxembourg on 208 metres is not, as is usually the case, at the extreme end of the tuning range where the average receiver performance is not at its best. In fact, with this receiver, adequate reception of Radio Luxembourg is guaranteed in localities where this station is normally receivable. Portability is ensured by the inclusion of a ferrite rod aerial assembly and the usual battery h.t. supply. No external aerial or earth is required. With normal usage, battery life should be for a period of some six months.

From the illustrations shown herewith it will be seen that the receiver is fitted with a calibrated dial which slightly protrudes over one side of the case, thus permitting easy "finger-tip" adjustment of the variable condenser. A miniature volume control and combined on/off switch fitted with a milled edge knob is also fitted in such a manner that it protrudes slightly from the case. The whole assembly is contained within a black and white moulded plastic case measuring some $4\frac{3}{8}$ x 3 x $1\frac{1}{4}$in.



The "Ranger-3" Transistor Receiver

Circuit

The circuit is shown in Fig. 1, from which it will be seen that it consists of a three transistor five stage reflex design. Transistor TR_1 functions primarily as an r.f. amplifier, the resultant r.f. signal being fed, via C_3, to

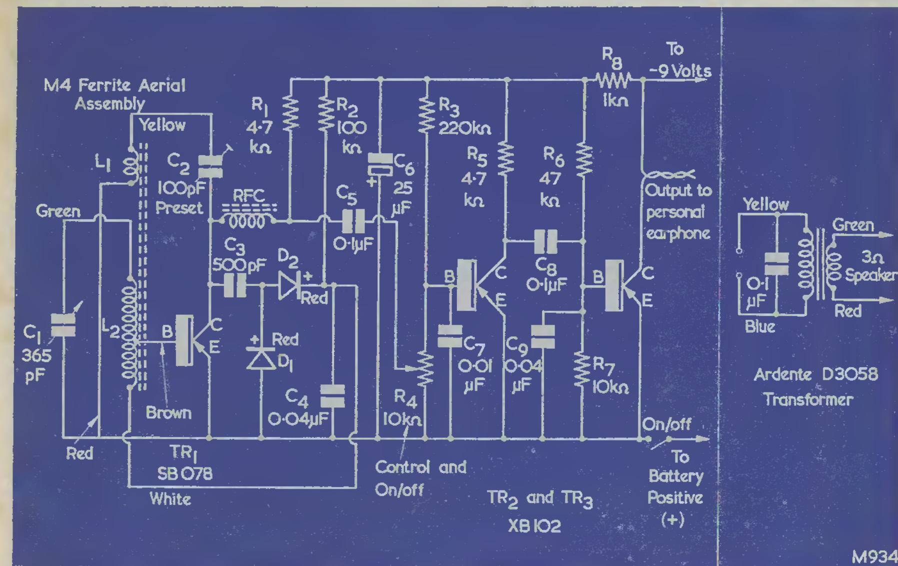


Fig. 1. Circuit of the "Ranger-3" personal transistor receiver and (right) details of additional components required to operate a speaker

Components List

Resistors (all $\frac{1}{8}$ watt)
- R_1 4.7kΩ
- R_2 100kΩ
- R_3 220kΩ
- R_4 10kΩ miniature potentiometer
- R_5 4.7kΩ
- R_6 47kΩ
- R_7 10kΩ
- R_8 1kΩ

Condensers
- C_1 365pF variable (Henry's Radio Ltd.)
- C_2 100pF preset
- C_3 500pF
- C_4 0.04μF
- C_5 0.1μF
- C_6 25μF electrolytic, 25 w.v.
- C_7 0.01μF
- C_8 0.1μF
- C_9 0.04μF

Transistors
- TR_1 SB078
- TR_2 XB102
- TR_3 XB102

Miscellaneous
- Transistor holders (3)
- Germanium diodes (2)
- Battery, Ever-Ready PP3 (9V)
- Battery clips (Henry's Radio Ltd.)
- Ferrite rod assembly (Henry's Radio Ltd.)
- Paxolin chassis (Henry's Radio Ltd.)
- RF choke (Henry's Radio Ltd.)
- Drilled cabinet (Henry's Radio Ltd.)
- Engraved dial, etc. (Henry's Radio Ltd.)
- Deaf aid insert (Henry's Radio Ltd.)

the voltage doubler detector formed by the diodes D_1 and D_2. The signal is rectified here and fed back to the ferrite secondary winding and, from there, to the base of TR_1. The detected audio signal applied to the base of TR_1 is now amplified by the transistor and fed, via the r.f. choke and C_5, to the slider (centre tap) of the variable resistor R_4. The a.f. signal on the upper end of R_4 is then fed into the base of TR_2. Regeneration is obtained by feedback from the collector of TR_1, via pre-set condenser C_2, to winding L_1 on the ferrite of rod. The amplified a.f. signal appearing across R_5 is applied, via C_8, to the base of TR_3, from the collector of which the final audio output is fed into a deaf aid insert. All three transistors operate in the earthed emitter mode.

The modification necessary for operating a speaker for low level listening is shown in the inset of Fig. 1. Here an Ardente D3058 transformer is required, connected as shown. Any size 3Ω speaker may be used.

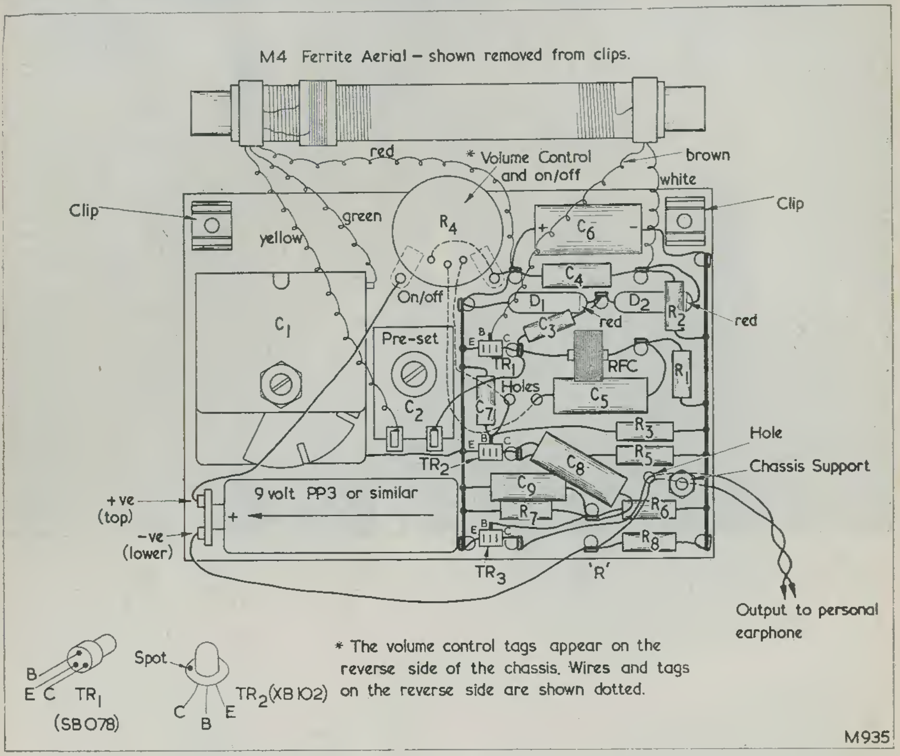


Fig. 2. Point-to-point layout diagram of the receiver (rear chassis view). Compare with illustration

Construction

The actual construction of this receiver is considerably simplified by the use of a Paxolin chassis which is supplied complete with all the necessary holes, clips and fitted solder tags. All components should be mounted as shown on the layout diagram of Fig. 2. Frequent reference both to this and the layout photograph will considerably assist in the trouble-free construction of the receiver.

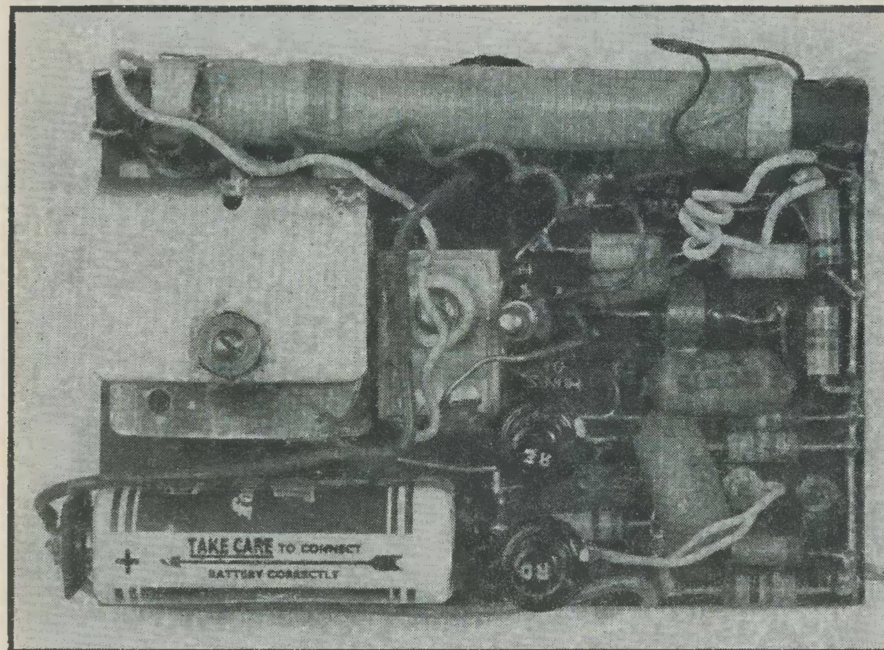
First, secure the volume control to the Paxolin chassis and follow this by mounting into position the variable tuning condenser, the 100pF preset condenser C_2 and the two clips which will eventually hold the ferrite rod aerial assembly. Mount and secure the chassis support nut and bolt (see Fig. 2). Wiring the "Ranger-3" may now commence.

Solder into position the positive and negative bus-bars and follow this operation by mounting the three transistor holders.

The next step consists of wiring into circuit the two crystal diodes and the r.f. choke. Follow on by soldering into position all the resistors.

Dealing next with the condensers, solder all the fixed components into circuit and then complete the wiring to the tuning and the preset condenser.

It now remains for the ferrite rod aerial assembly and the battery to be inserted into circuit. From the circuit of Fig. 1 it will be noted that the lead-outs of the aerial assembly are colour coded, and particular care should be taken to ensure that these are correctly wired into circuit. The battery connection Paxolin panel should next be soldered up, each clip connecting to its respective p.v.c covered wire. Ensure that the battery is connected with correct polarity. The illustration shows that the battery, when mounted into position, should be so placed that the positive connection is further away from the Paxolin chassis (underside). In this manner, when a new battery is to be connected, the printed warning on the battery case will be toward the operator. Check that the battery positive is connected to the on/off switch and the negative to negative point "A". (See Fig. 2.)



Showing the layout of the completed receiver

The three transistors should now have their lead-out wires cut at approximately ⅜in from the actual transistor body. They should next be inserted into their respective holders taking particular care to ensure that the correct lead out wires are inserted in the individual sockets.

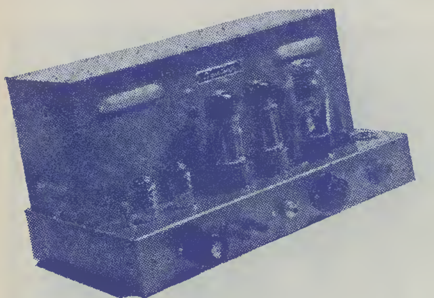
The deaf aid insert should now be wired into circuit and all wiring and connections finally checked before switching on the receiver.

Setting up the "Ranger-3"

The pre-set condenser C_2 should be adjusted so that best results are obtained on the 200 metre end of the Medium wave band, Radio Luxembourg itself being an ideal station on which to perform this task. If possible, setting up should be carried out during the late evening, when this station is normally at its best with respect to reception in this country. C_2 should be finally set in such a position that it is just below the point of oscillation at this wavelength and that operating the receiver over the remainder of its range does not produce oscillations. With reference to the foregoing, it should be remembered that the receiver, being fitted with a ferrite rod aerial, is somewhat directive, and that the chassis should therefore be rotated until the Radio Luxembourg signal is at its greatest signal strength.

Having set up the receiver satisfactorily, the chassis should now be placed into the moulded plastic case, ensuring that the on/off switch with combined volume control protrudes through the aperture in the side of the case. With the lid closed, the dial should now be secured to the variable condenser spindle by means of the special screw provided. Before finally securing the dial, ensure that calibration is correct.

The "Ranger-3" has been found an ideal receiver in a very bad reception area, Continental stations being received at very good signal strengths especially in the evenings. Sensitivity and selectivity are extremely good and these factors, together with the low average consumption—only some 2mA—make the "Ranger-3" an ideal personal transistor receiver.



The Cooper-Smith MAGNUM 20 Watt Power Amplifier

Part 2

Described by W. HOLMES

Construction

The construction of the Cooper-Smith 20 watt amplifier is fully described in the step-by-step instructions which follow. These instructions may be followed with the aid of the wiring diagrams given in Figs. 4 and 6. In both these diagrams the front apron of the chassis is shown laid flat in order that connections to the sockets and panels mounted on it may be indicated more clearly.

Mounting the Main Components

1. Fit the three long 2BA bolts (supplied) to the chassis (heads above chassis). Make certain that the bolts are securely tightened, as the heads and nuts are covered in later stages of assembly. The bolts take up the positions circled in Fig. 4.

2. Fit the voltage selection panel, tuner outlet panel and matching socket to the front chassis apron. All these are fitted from the inside of the chassis. Fit the mains input socket, from the outside. Fit the loudspeaker sockets with a Paxolin washer on each side, taking care not to over-tighten the nuts.

3. Fit the valveholders and pre-amplifier outlet socket to the chassis, from the inside, ensuring correct orientation and fitting chassis solder tags as shown in Fig. 4. Ensure that good contact is made to chassis by the tags by scraping, or cleaning, the chassis immediately underneath the appropriate valveholder or socket metalwork. Next fit the input socket, ensuring correct orientation, as in Fig. 4, and scraping the chassis to provide good connection. Fit fuseholder FS_1 and the motor socket. The long pin on the latter is towards the centre of the chassis.

4. Mount output transformer T_1, mains transformer T_2, and the smoothing choke CH_1, ensuring correct orientation. Whilst mounting, pass the coloured lead-out wires of the mains transformer, T_2, through the holes indicated in Fig. 4. Similarly pass the two blue leads of the smoothing choke through the chassis hole indicated. A solder tag is fitted under one securing bolt of T_2 and the chassis underneath must be scraped to ensure good contact.

5. Fit the smoothing condensers C_{16} and C_{17}. These may be fitted either way round as they are not electrolytic components. Whilst clamping down ensure that the tag which takes up position 1 in each case (see Fig. 4) is well clear of chassis.

6. Fit the cover over the transformers, choke and condensers just mounted. This will enable the chassis to stand upside-down squarely whilst wiring proceeds.

Wiring Up—First Stage

Wiring up now commences. In order that all connections may be made to each individual tag before they are soldered to that tag, soldering should only be carried out

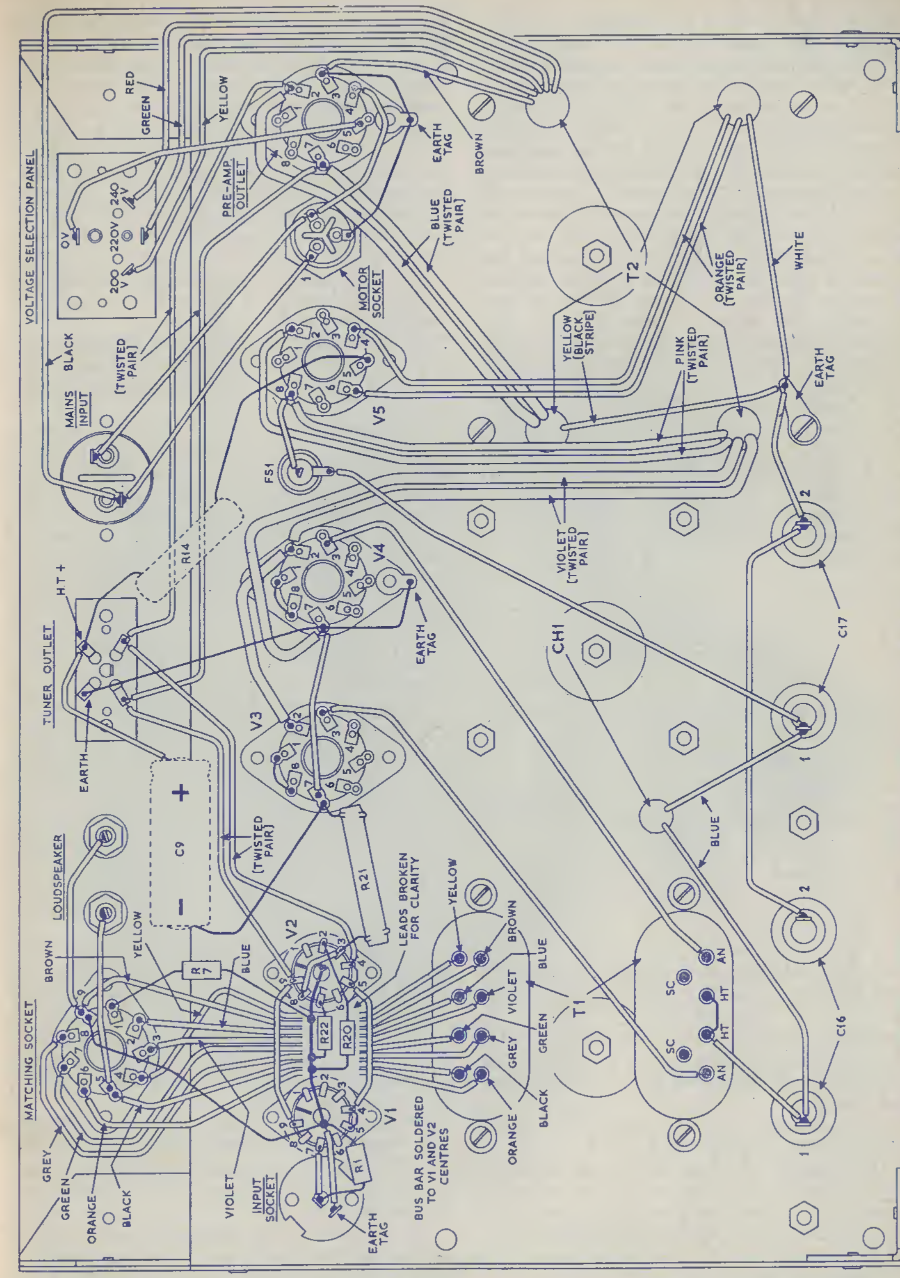


Fig. 4. The layout of the components and wiring fitted in the first wiring stage

where stated. Unless otherwise specified all resistors referred to are ½ watt 10%, and all connecting wires are covered with sleeving. Resistor and condenser lead-out wires are not sleeved unless otherwise stated.

7. Connect together, without sleeving,

pins 4 and 5 of V_1. Similarly connect together pins 4 and 5 of V_2. Using twisted wiring and sleeving, connect together pin 9 of V_1, pin 9 of V_2, the lower left hand tag of the tuner outlet panel (see Fig. 4) and pin 7 of the pre-amplifier outlet socket; connect together pin 4 of V_1 and pin 5 of V_2; connect together pin 4 of V_2, the lower right hand tag of the tuner outlet panel (see Fig. 4) and pin 2 of the pre-amplifier outlet socket. In common with other heater leads, the pairs of wires between the points just connected are shown as separate leads in Fig. 4 for reasons of clarity; in practice they should be twisted, including the pair between V_1 and V_2. Solder all the connections just made except for those at pins 2 and 7 of the pre-amplifier outlet socket.

8. Connect the two blue lead-out wires from mains transformer T_2 to pins 2 and 7 of the pre-amplifier outlet socket, twisting these two wires before connecting. Solder at pins 2 and 7.

9. Connect, and twist, the two orange leads from T_2 to pins 4 and 6 of V_5, soldering at these pins.

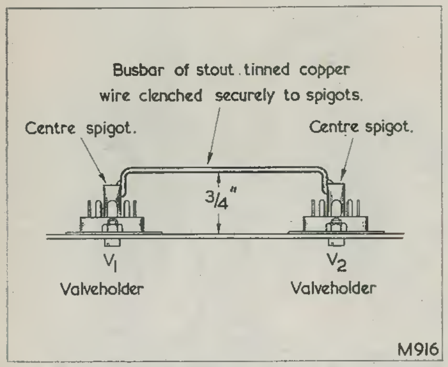


Fig. 5. Side view, showing how the busbar is fitted between the centre spigots of V_1 and V_2

10. Connect, and twist, the two pink leads from T_2 to pins 2 and 8 of V_5, soldering at pin 2 only.

11. Connect, and twist, the two violet leads from T_2 to pins 2 and 7 of V_4.

12. Connect pin 2 of V_3 to pin 2 of V_4. Connect pin 7 of V_3 to pin 7 of V_4. Solder at pin 2 of V_3 and pin 2 of V_4.

13. Connect the yellow (black stripe) and white leads from T_2 to the chassis tag indicated in Fig. 4.

14. Connect the brown lead from T_2 to pin 3 of the pre-amplifier outlet socket. Without sleeving, connect pin 3 of the pre-amplifier outlet socket to the adjacent chassis tag (indicated in Fig. 4). Solder at pin 3.

15. Connect the black lead from T_2 to the left hand tag (see Fig. 4) of the mains input socket. Connect the left hand tag of the mains input socket to tag 1 of the motor socket. Solder all connections.

16. Connect the red lead from T_2 to the 240V tag on the voltage selection panel. Connect the green lead from T_2 to the 220V tag on the voltage selection panel. Connect the yellow lead from T_2 to the 200V tag on the voltage selection panel. Solder all connections.

17. Connect one blue wire from smoothing choke CH_1 to tag 1 of C_{16}, and the other blue wire to tag 1 of C_{17}.

18. Connect tag 2 of C_{16} to tag 2 of C_{17}, and tag 2 of C_{17} to the adjacent chassis tag. (See Fig. 4.) Solder all connections except tag 2 of C_{16}.

19. Identify the "H.T." tags on output transformer T_1. Some transformers have only one "H.T." tag. If the transformer employed has two tags connect these together without sleeving. Connect the "H.T." tags (or tag) to tag 1 of C_{16}, using sleeving. Solder all connections, except tag 1 of C_{16}.

20. Connect together tag 1 of C_{17} and the "outer" tag (see Fig. 4) of fuseholder FS_1. Solder both connections.

21. Connect the OV tag on the voltage selection panel to pin 5 of the pre-amplifier outlet socket. Solder both connections.

22. Connect the right hand tag (see Fig. 4) of the mains input socket to the upper right hand tag (see Fig. 4) of the motor socket, continuing to pin 4 of the pre-amplifier outlet socket. Solder all connections.

23. Connect the lower (earth) tag of the motor socket to the adjacent chassis tag as indicated in Fig. 4. Solder both connections.

24. Connect the "centre" tag (see Fig. 4) of fuseholder FS_1 to pin 8 of V_5. Solder both connections.

25. Using unsleeved wire connect pin 7 of V_4 to the upper left hand tag of the tuner outlet panel and to the adjacent chassis tag, as indicated in Fig. 4. Solder all connections.

26. Using unsleeved wire connect together pins 1 and 8 of V_3. Similarly connect together pins 1 and 8 of V_4. Solder at pin 8 of V_3 and pin 1 of V_4.

27. Reverting to sleeved wire, connect pin 3 of V_4 to the right hand (see Fig. 4) "AN" tag of T_1. Connect pin 3 of V_3 to the left hand "AN" tag of T_1. Solder all connections.

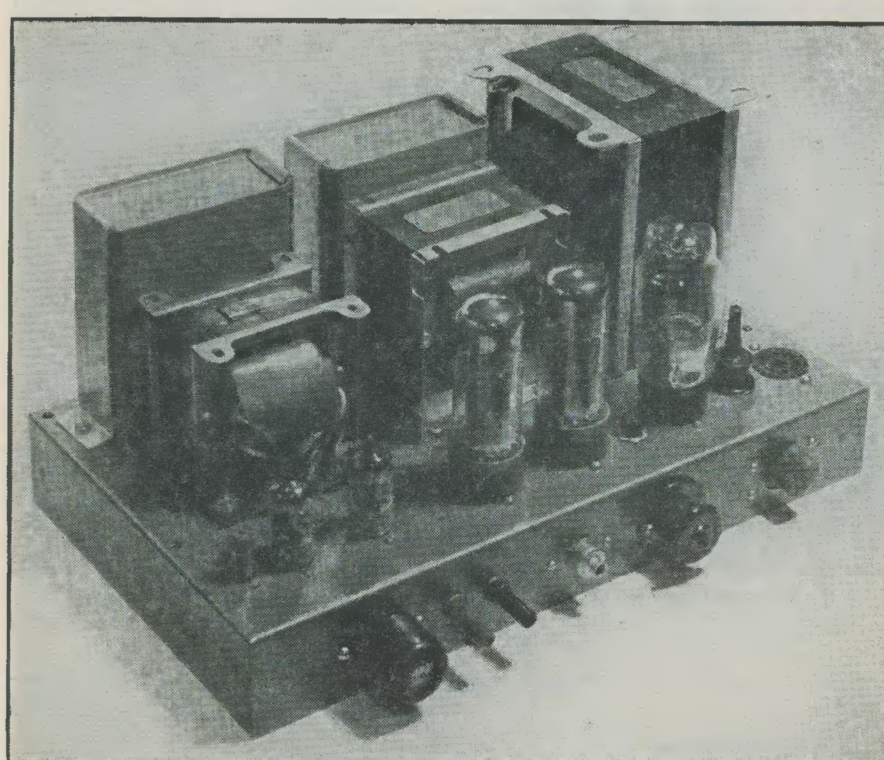
28. Connect the coloured leads from output transformer T_1 to the matching socket tags in the following manner. Blue lead to tag 2, violet lead to tag 3, yellow lead to tag 4, black lead to tag 5, orange lead to tag 6, green lead to tag 7, grey lead to tag 8, brown lead to tag 9. All these leads travel between V_1 and V_2 valveholders and should

be kept close to the chassis. They may pass under the twisted heater pair between these two valveholders. This twisted pair should also be pressed down towards the chassis after the output transformer wires have been fitted. Solder all connections just made except for those at tags 5 and 9.

29. Connect tag 5 of the matching socket to the left hand (see Fig. 4) loudspeaker terminal. Connect tag 9 of the matching socket to the right hand loudspeaker terminal. Solder all connections except that at tag 9.

33. Using sleeving, connect the earthy, outer, tag (see Fig. 4) of the input socket to V_1 spigot, or to the busbar wire adjacent to the spigot, if the latter is crowded. Solder at the earth tag.

34. Connect the centre tag (see Fig. 4) of the input socket to pin 7 of V_1. Connect R_1 (1MΩ) between the centre tag of the input socket and V_1 spigot, or to the busbar wire adjacent to the spigot, if the latter is crowded. Solder at pin 7 of V_1 and at the centre tag, and solder all connections, including the busbar, at V_1 spigot.



Top-chassis view of the amplifier with the cover removed

30. With stout, unsleeved, tinned copper wire, form a busbar between the centre spigots of V_1 and V_2 valveholders in the manner shown in Fig. 5. Clench the wire securely to the centre spigots and solder at the V_2 spigot only.

31. With sleeved wire join pins 3 and 8 of V_1. Solder at pin 8.

32. Without sleeving, connect tag 9 of the matching socket to V_1 spigot. Solder at tag 9.

35. Connect R_7 (100Ω) between tag 1 of the matching socket and the busbar. Solder at the busbar.

36. Connect R_{22} (470kΩ) between pin 7 of V_2 and the busbar. Solder at the busbar.

37. Connect R_{20} (470kΩ) between pin 2 of V_2 and the busbar. Solder at the busbar.

38. Connect R_{21} (680Ω, 1W) between pin 3 of V_2 and pin 7 of V_3. Solder at pin 3.

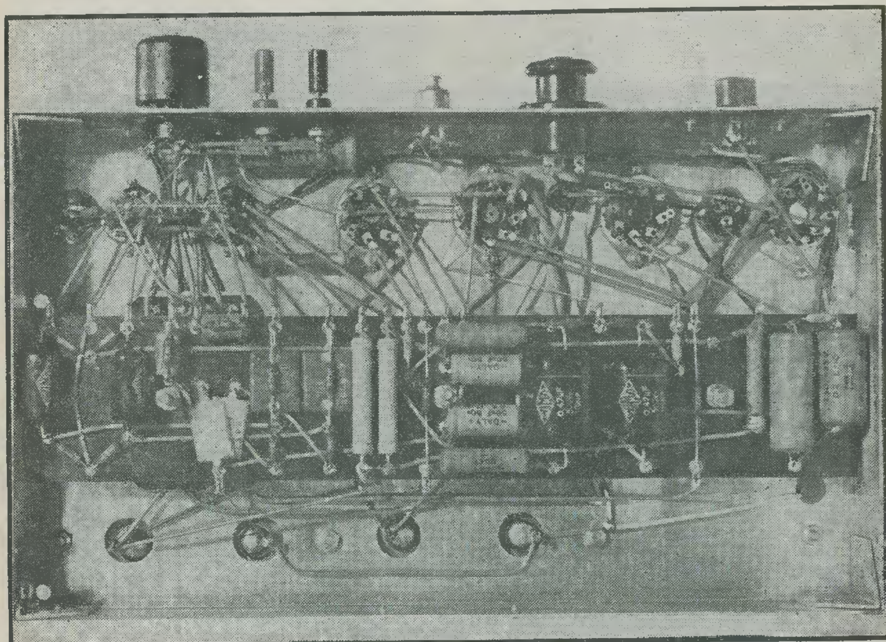
39. If a tuner unit h.t. outlet is required,

connect C_9 (8μF, 450V) between pin 7 of V_3 and the upper right hand tag of the tuner outlet panel. Ensure correct polarity in C_9 and sleeve its positive lead-out wire. Also connect R_{14} (value according to tuner unit h.t. requirements) between the upper right hand tag of the tuner outlet panel and pin 5 of V_5. Solder at the tuner outlet panel tag. Whether C_9 and R_{14} are fitted or not, solder also at pin 7 of V_3.

wiring stage are to the *holes* in the appropriate tags and eyelets. It is only in the third stage that connections are made to the tags projecting over the sides of the group board.

The tags and eyelets on the group board are numbered in Fig. 6. The instructions which follow refer to these numbers, and, also, to the eyelets as "tags". There is no wiring under the group board.

40. Using sleeving, connect together the



Under-chassis view of the amplifier, illustrating the clean and neat component layout

The first stage of the wiring is now complete.

Wiring Up—Second Stage

The second stage of wiring is concerned with the fitting of components to the group board, and should be carried out before the board is fitted to the chassis. The connections made are shown in Fig. 6, which illustrates both the second and third wiring stages. When it is wired, the group board will be mounted over the three long 2BA bolts fitted in step 1. Sufficient clearance should be left between components and wiring adjacent to the three corresponding holes in the group board to enable the securing 2BA nuts and washers to be eventually fitted and tightened up.

All the connections made in the second

following tags, ensuring that no wire passes over other tag holes where they might hinder later soldering operations. 4 and 44; 3 and 5; 2 and 16; 7 and 19; 9, 14, 34, 33, 50 and 48; 11 and 17; 13 and 20; 21 and 36; 23 and 39; 26 and 35; 29 and 30; 31 and 32; 38 and 41. Omitting sleeving between 22 and 24, connect together 22, 24 and 46. Without sleeving connect together 45 and 47.

41. Connect C_6 (0.25μF, 500V) between tags 1 and 2.

42. Connect R_5 (220kΩ) between tags 1 and 4, soldering at 1.

43. Connect R_6 (220kΩ) between tags 4 and 6, soldering at 4.

44. Connect R_{10} (1MΩ, matched 2%) between tags 2 and 5, soldering at 2.

45. Connect R_9 (1.2MΩ) between tags 5 and 7, soldering at 5.

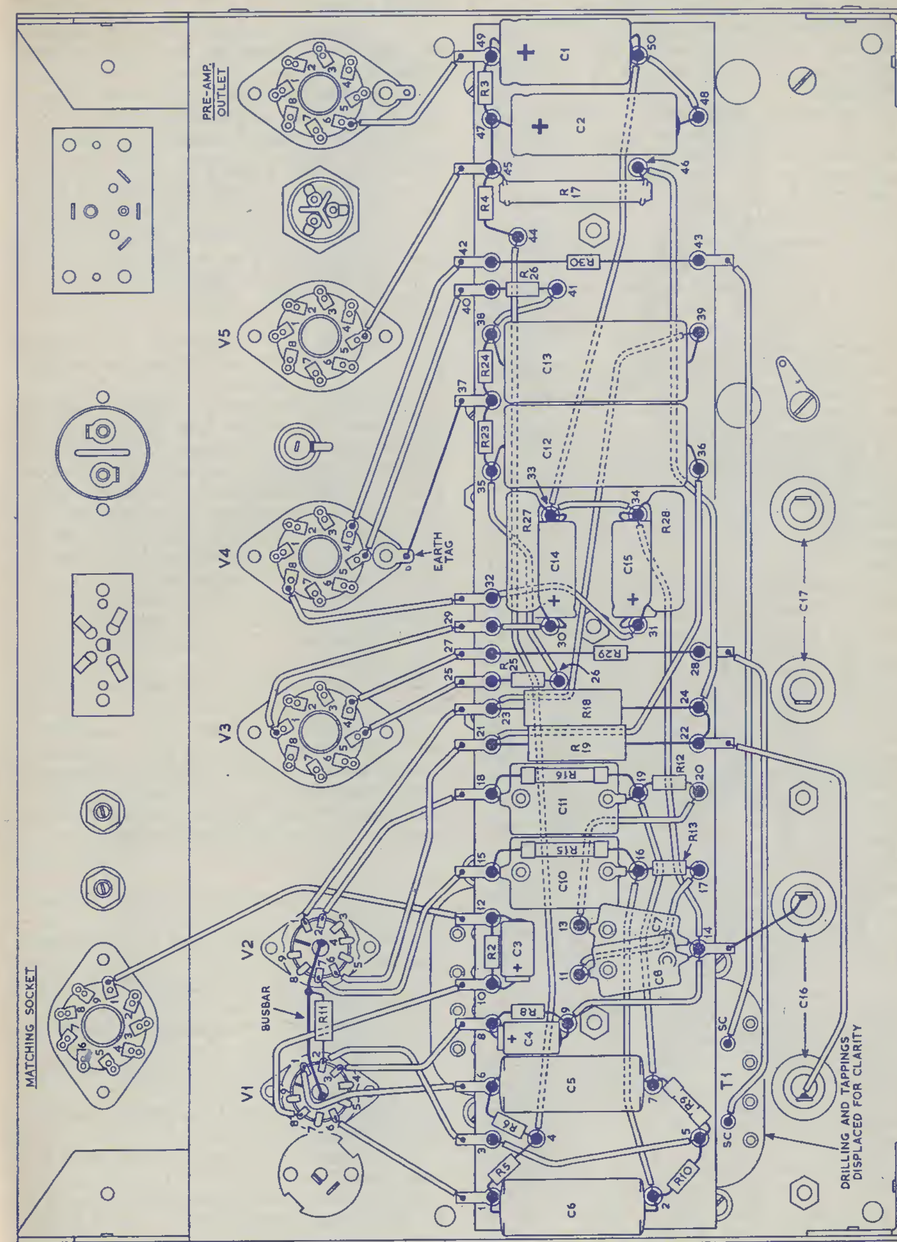


Fig. 6. The components and wiring fitted in the second wiring stage

46. Connect C_5 (0.25µF, 500V) between tags 6 and 7, soldering at both tags.

47. Connect, in parallel, C_4 (50µF, 12V) and R_8 (3.3kΩ) between tags 8 and 9, observing correct polarity on C_4. Solder at both tags.

48. Connect, in parallel, C_3 (50µF, 12V) and R_2 (3.9kΩ) between tags 10 and 12, observing correct polarity in C_3. Solder at both tags.

49. Connect C_7 (470pF) between tags 13 and 14, soldering at 13.

50. Connect C_8 (470pF) between tags 11 and 14, soldering at both tags. As shown in Fig. 6, C_8 is positioned so that it overlaps C_7.

51. Connect, in parallel, C_{10} (5,000pF) and R_{15} (4.7MΩ, matched 2%) between tags 15 and 16, soldering at tag 15.

52. Connect, in parallel, C_{11} (5,000pF) and R_{16} (4.7MΩ, matched 2%) between tags 18 and 19, soldering at 18.

53. Connect R_{13} (10kΩ) between tags 16 and 17, soldering at both tags.

54. Connect R_{12} (10kΩ) between tags 19 and 20, soldering at both tags.

55. Connect R_{19} (47kΩ, matched 2%) between tags 21 and 22, soldering at both tags.

56. Connect R_{18} (47kΩ, matched 2%) between tags 23 and 24, soldering at both tags.

57. Connect R_{25} (10kΩ) between tags 25 and 26, soldering at both tags.

58. Connect R_{29} (1.2kΩ) between tags 27 and 28, soldering at both tags.

59. Connect, in parallel, C_{14} (50µF, 50V) and R_{27} (470Ω 3W, matched 3%) between tags 30 and 33, observing correct polarity in C_{14}. Solder at both tags. R_{27} dissipates heat and must be kept clear of adjacent components.

60. Connect, in parallel, C_{15} (50µF, 50V) and R_{28} (470Ω, 3W, matched 3%) between tags 31 and 34, observing correct polarity in C_{15}. Solder at both tags. R_{28} dissipates heat and must be kept clear of other components.

61. Connect C_{12} (0.47µF, 500V) between tags 35 and 36, soldering at 36.

62. Connect C_{13} (0.47µF, 500V) between tags 38 and 39, soldering at 39.

63. Connect R_{23} (220kΩ, matched 2%) between tags 35 and 37, soldering at 35.

64. Connect R_{24} (220kΩ, matched 2%) between tags 37 and 38, soldering at both tags.

65. Connect R_{26} (10kΩ) between tags 40 and 41, soldering at both tags.

66. Connect R_{30} (1.2kΩ) between tags 42 and 43, soldering at both tags.

67. Connect R_4 (22kΩ) between tags 44 and 45, soldering at 44.

68. Connect R_{17} (68kΩ, 1W) between tags 45 and 46, soldering at both tags.

69. Connect C_2 (8µF, 450V) between tags 47 and 48, observing correct polarity. Solder at 48.

70. Connect C_1 (16µF, 450V) between tags 49 and 50, observing correct polarity. Solder at 50.

71. Connect R_3 (68kΩ) between tags 47 and 49, soldering at both tags.

The second stage of wiring is now complete.

Wiring Up—Third Stage

In this stage all connections made to group board tags are soldered to the tag projections on either side of the board. The third wiring stage is also illustrated in Fig. 6.

72. Solder two unsleeved wires, each 9in long, to the "SC" tags on output transformer T_1.

73. Fit R_{11} (1MΩ, matched 2%) between pin 2 of V_1 and the busbar, soldering at the busbar.

74. Mount the group board over the three long 2BA bolts, employing nuts and washers above and below. Adjust the nuts such that the group board is approximately $\frac{3}{4}$in above the chassis and tighten the mounting nuts. Temporarily pass the two 9in leads just soldered to the "SC" tags of T_1 over the rear apron of the chassis, so that they are out of the way until required.

75. Connect tag 1 of the group board to pin 6 of V_1, soldering both connections.

76. Connect tag 3 to pin 2 of V_1, soldering both connections.

77. Connect tag 6 to pin 1 of V_1, soldering both connections.

78. Connect tag 8 to pin 3 of V_1, soldering both connections.

79. Connect tag 10 to pin 8 of V_1, soldering both connections.

80. Connect tag 12 to tag 1 of the matching socket, soldering both connections.

81. Connect tag 15 to pin 7 of V_2, soldering both connections.

82. Connect tag 18 to pin 2 of V_2, soldering both connections.

83. Connect tag 21 to pin 6 of V_2, soldering both connections.

84. Connect tag 23 to pin 1 of V_2, soldering both connections.

85. Connect tag 25 to pin 5 of V_3, soldering both connections.

86. Connect tag 27 to pin 4 of V_3, soldering both connections.

87. Connect tag 29 to pin 1 of V_3, soldering both connections.

88. Connect tag 32 to pin 8 of V_4, soldering both connections.

89. Without sleeving, connect tag 37 to V_4 chassis tag, as indicated in Fig. 6.

90. Connect tag 40 to pin 5 of V_4, soldering both connections.

91. Connect tag 42 to pin 4 of V_4, soldering both connections.

92. Connect tag 45 to pin 5 of V_5, soldering both connections.

93. Connect tag 49 to pin 6 of the pre-amplifier outlet socket, soldering both connections.

94. Fitting sleeving, and shortening the previously-fitted lead as necessary, connect the right hand "SC" tag (see Fig. 6) of T_1 to tag 43, soldering at tag 43.

95. Fitting sleeving, and shortening the previously-fitted lead as necessary, connect the left hand "SC" tag (see Fig. 6) of T_1 to tag 28, soldering at tag 28.

96. Connect tag 22 to tag 1 of C_{16}. Solder both connections.

97. Without sleeving, connect tag 14 to tag 2 of C_{16}. Solder both connections.

Wiring up is now complete.

Amplifier Operation

The base-plate should next be fitted to the amplifier, this being secured by the long 2BA screws with nuts and washers on either side. The base-plate provides added strength for the amplifier chassis and helps to carry the weight of the chokes and transformers. It prevents any buckling of the chassis should the latter be accidentally dropped.

The mains voltage selection panel should be set to the correct tapping, bearing in mind the fact that the bridging plug must be fitted with a 2A fuse. A 250mA fuse also needs to be fitted, this being inserted in the FS_1 fuse-holder on the chassis. The valves and speaker impedance matching plug should next be inserted into their sockets, and the loudspeaker connected to the appropriate terminals. The amplifier should not be switched on without a loudspeaker connected.

All that remains to do is to connect up the pre-amplifier, whereupon the Cooper-Smith 20 watt Power Amplifier is ready for use.

Alternative Tuner H.T. Supply

In the circuit diagram given in Fig. 1, the h.t. supply fed to the tuner unit outlet socket is derived from the h.t. positive rail after decoupling by R_{17}. It is possible, if tuner units drawing a relatively high h.t. current are employed, for this method of connection to cause reduced h.t. potential to be available for V_1 and the pre-amplifier.

An alternative method of applying h.t. to the tuner unit consists of connecting R_{14} to the right hand side of R_{17} (Fig. 1), with the result that R_{14} drops the h.t. potential from the 400 volt h.t. rail to that required by the tuner unit.

This revised method of connection involves one change only in amplifier wiring. In step 92, pin 5 of V_5 was connected to tag 45 of the group board. With the revised method of connection, pin 5 of V_5 should be connected to tag 1 of condenser C_{16}.

Supplying the tuner unit from the 400 volt positive h.t. rail via a dropping resistor causes the full h.t. voltage to be applied to the tuner if the latter draws no h.t. current; as would occur, for instance, when its valve heaters were cold. If it is felt desirable to limit the voltage applied to the tuner unit during no-current conditions in the latter, a simple potentiometer circuit, as shown in Fig. 7, may be used. In Fig. 7, an additional resistor is connected between chassis and the junction of R_{14} and C_9, whereupon R_{14} forms the upper half of the potentiometer and the additional resistor the lower. The additional resistor may be mounted at the tuner unit.

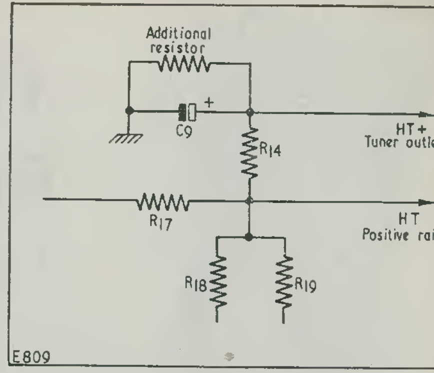
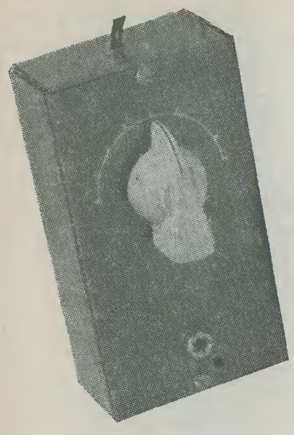


Fig. 7. An alternative method of applying h.t. to the tuner unit

The accompanying table gives values for R_{14} and the additional resistor for tuner units requiring 200 to 250 volts h.t. When the resistors are on nominal value the figures shown do not allow more than 0.8 of the h.t. voltage applied to R_{14} to be fed to the tuner unit under no-current conditions. Maximum tuner h.t. current is, in this instance, restricted to 28mA because of circulating current in the potentiometer.

TABLE

Tuner Unit H.T. Current	R_{14}	*Additional Resistor*
6–12mA	12kΩ 5W	47kΩ 3W
13–18mA	8.2kΩ 5W	33kΩ 5W
19–22mA	6.8kΩ 6W	27kΩ 5W
23–28mA	4.7kΩ 8W	18kΩ 5W



The Radio Tuner

A Recorder Feeder Unit

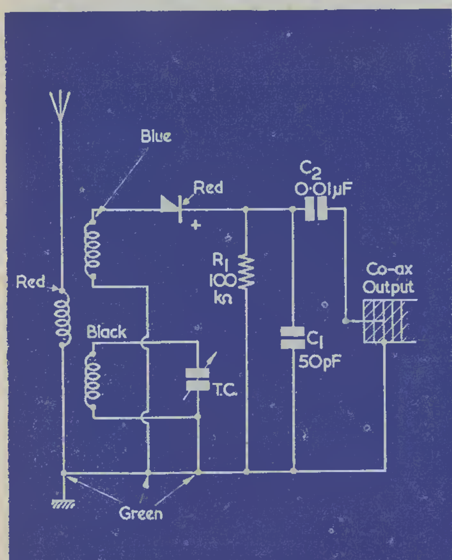
Described by R. A. Langis

THE OWNERSHIP OF A MAGNETIC TAPE recorder, whether purchased or constructed, sooner or later brings in its train the problem of providing a "front end" for the reception of radio programmes. For the portable recording enthusiast the most obvious solution to this problem is the simple crystal receiver, the output of which is then, with a simple modification, fed into the recorder input circuit.

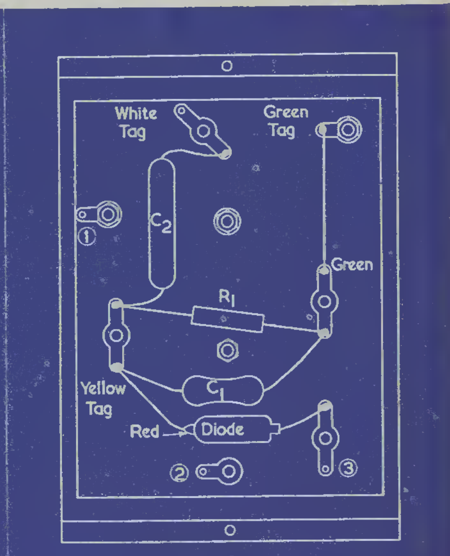
The main advantages of such a unit are low initial cost, light weight and consequent portability with no running costs. The resultant quality obtainable from a crystal tuner unit is excellent and the absence of an a.c. power supply, and therefore hum at the input level, is of inestimable value to the recording enthusiast.

The great disadvantage of the normal type of crystal tuner unit is the lack of selectivity, this being mostly occasioned by the damping load of the crystal detector across the tuned circuit.

With the circuit about to be discussed, the selectivity problem has been largely overcome by including a triple wound coil. Specifically designed by the manufacturer for use with germanium crystal diodes, maximum selectivity, together with a high signal output, has been successfully achieved by the minimum damping of the tuned circuit, a separate winding being provided for the crystal diode. The inclusion of this type of coil within the circuit therefore removes the main objection to crystal tuner units.

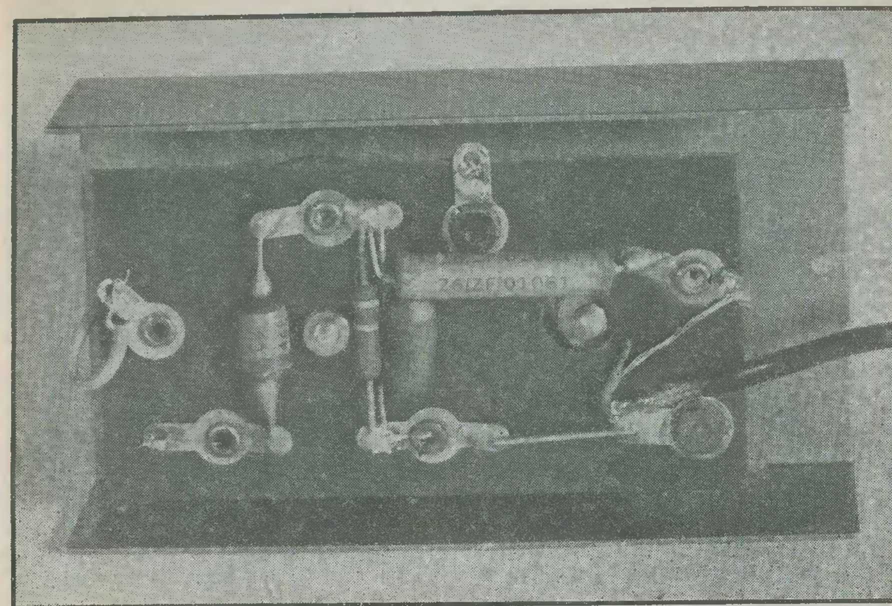


Circuit of the Radio Tuner



Wiring Diagram

M917



Under-chassis view of the Recorder Feeder Unit

Circuit

The circuit, shown alongside the point-to-point wiring diagram, is simplicity itself and requires but little explanation. The variable condenser is of the solid dielectric type and is more compact than the normal air-spaced component. The coil/condenser combination effectively covers the Medium wave band—this being that most favoured by constructors in general.

Following the germanium diode is the necessary load resistor of 100kΩ, the r.f. filter condenser (50pF) and the 0.01µF blocking condenser. The filtered audio output is then fed into the input circuit of the tape recorder via a short length of coaxial cable.

Construction

The construction of this little unit is extremely simple, the illustration showing that the components, except for the variable condenser, are mounted and soldered on to a Paxolin board already fitted with five eyeletted solder tags.

Mount the insulated aerial input socket to the front panel. (See heading illustration.)

The potted coil should next be mounted, by means of the securing nut, to the plain side of the Paxolin board.

The Paxolin board should now be secured to the variable condenser by means of the two securing nuts shown in the illustration—firstly having fitted the solder tags under the nuts as shown. The whole now comprises a small sub-assembly which may be completed by adding the remaining components.

The wiring of the circuit is clearly shown in the diagram alongside the circuit. Solder into circuit R_1, C_1, C_2, the germanium diode

Components List

R_1 100kΩ
C_1 50pF
C_2 0.01µF
TC 500pF variable (R.C.S. Products (Radio) Ltd.)
Coil (R.C.S. Products (Radio) Ltd.)
Metal case (R.C.S. Products (Radio) Ltd.)
Paxolin board (R.C.S. Products (Radio) Ltd.)
Germanium diode (R.C.S. Products (Radio) Ltd.)
Aerial socket (R.C.S. Products (Radio) Ltd.)

and the connection from the green tag to the junction of R_1 and C_1.

The coil should next be dealt with as follows. Solder the black coil lead to tag 1 on the Paxolin board. Connect the red lead of the coil to tag 2 on the board. When the assembly is, later, secured to the metal panel, tag 2 will be connected to the aerial socket. Join the blue coil lead to tag 3 of the Paxolin board. Solder the green wires to the solder tag marked "Green" on the wiring diagram.

Having completed the wiring thus far, the whole assembly should now be secured to the metal panel by means of the variable condenser securing nut. Wire into circuit the aerial input socket as outlined above.

Connect the outer braid of the coaxial cable to the green tag (see illustration) and the inner lead to the white tag. The connection at the other end of the coaxial cable will depend, of course, upon the type of input arrangement existing in individual equipments, that most commonly in use being a plug and jack.

This little unit will be found ideal for those requiring a simple, inexpensive yet efficient radio tuner.

TACKLING CAR RADIO INTERFERENCE

By R. Gausden

When one buys a "packaged" car radio nowadays the question of the very necessary suppression of interference to reception caused by the various electrical units on the car seldom arises, as either the suppressing equipment is included with the receiver or adequate provision has been made by the car manufacturer if the latter is one of comparatively recent manufacture. Do not be misled by the last statement, however, as many different makes of vehicle are fitted with forms of suppressors which are incorporated to prevent radiation of interference which will spoil t.v. reception, and, as such, are not intended to be effective in minimising the interference picked up by a radio receiver installed in the car. It is to overcome a few of the difficulties resulting from car radio interference that this article is offered, as it is felt that there must be a great number of home constructors who have successfully built and installed a car radio, or have reconditioned a discarded car set. There are some quite commonly known remedies for what may be termed average cases of interference radiation. These will be covered here with additional notes on some of the lesser known causes, together with effects and suggested cures.

Types of Car Radio Installation

First of all let us consider the various types of installation that may be encountered.

(1) Superhet receiver having all supplies drawn from the car accumulator, with vibrator or rotary converter for h.t. supply and the car accumulator used for valve heater supplies.

(2) "Hybrid" superhet receiver with the r.f. end of the receiver composed of valves designed for low anode and screen-grid voltages (12V) and the output end consisting of transistors giving a high level of audio.

(3) An "all-dry" type portable.

Some of the above types are for Medium wave reception only, which restricts the area over which the B.B.C. Light programme can be received, whilst many have the addition of Long waves to overcome this objection. It is unlikely that constructor designs incorporating a Short wave band as well will be found, but a number of commercially made receivers include this facility. A type now on the market is the a.m./f.m. set and mention of suppression for this type of reception will be made later. Finally, the "all-dry" portable, which has the disadvantage that its self-contained aerial is usually screened within the confines of a metal-bodied car and which suffers from bad attacks of fading as the surrounding countryside varies the signal strength. Furthermore, as the direction of the car is changed the aerial has to be pointed all the time in the direction of the station being received to obtain optimum signals. The only advantage is, of course, that it can be used independently of the car, a fact which appeals to many people. In order to overcome this difficulty of change of direction giving varying signal strengths, it is the practice now to fit a portable, or "clip-on", type of rod aerial, a lead from which plugs into a socket in the transistor or "all-dry" portable set. In the case of a receiver using a Ferrite frame aerial this is coupled to the aerial rod but there is no disconnection of the normal tuning circuit. The result is that, with the set inside the car being unscreened, no diminution in electrical interference occurs. The writer does not contend that the use of an external aerial is not worthwhile, but merely draws attention to the limitations of such an addition. Full and efficient suppression can be obtained more easily with a well designed and installed car radio proper.

Power supplies which are likely to require attention to obviate electrical noise include the vibrator type of h.t. supply. The vibrator converts the direct voltage of the car accumulator into an alternating, or more correctly a "pulsed" direct voltage which, after being stepped up by a transformer, is rectified again, either by an additional set of contacts or by a rectifier valve. Without condemning these devices it can be stated that in some cases they can be a most frequent cause of car radio failure. Suffice it to say that the vibrator contacts can get dirty in use causing a fall in output and noisy reception. Similarly, the rotary converter can suffer from sparking between the carbon brushes and the commutator, and here the remedy is obvious. It might, however, be necessary to have the commutator "skimmed" by a competent electrical engineer if fine glass paper or a glass wool pencil brush fails to achieve a satisfactory result.

If the receiver is of the "hybrid" type it is, perhaps, superfluous to mention that battery connections should be checked and made 100% efficient before setting about extensive work in tracing interference. The job must be commenced with the certainty that the unwanted noises only occur as the result of radiation from some equipment on the car, and from nothing connected with the radio itself.

Electrical Installation Layouts

To make diagnosis easier it is as well to have a fair working knowledge of the electrical installation of the car. Although each make of car will be found to vary, it is intended to cover here a reasonably universal group of items such as will be found on the average car. If the car you are tackling does not possess one or other of the items about to be described then obviously your luck is in, and the amount of work to be done is cut down by that amount.

The electrical installation can be divided into two groups as follows:

A. Those items which supply the current for the operation of the vehicle and which are directly responsible for its working.

B. Those items which consume current, some of which are of an auxiliary nature.

In Group *A* we find the following:

(1) The battery, which is the source of supply for all electrical equipment when the engine is not running. In addition to the usual 6 or 12 volt types on private cars and small vans there is a 24 volt type to be found on heavy lorries; the capacity varying between 25 and 125 ampere hours.

(2) The dynamo, which is driven by the engine and charges the battery, and which supplies current for a number of items of equipment. As the engine speed varies and the load on the battery varies from time to time it is necessary to have some form of voltage control or regulator for keeping the voltage constant.

(3) The voltage regulator, which attends to the automatic switching on and off of the dynamo as required. This is necessary in order that the battery, when fully charged by the dynamo, does not discharge back into the dynamo when the latter is running at a low speed and thereby giving an output below the voltage of the battery. A further function of the regulator is to keep the dynamo voltage at the correct level for all the equipment should the battery be undercharged.

(4) The ignition system is the last of this group and, of course, takes care of the generation and regulation of ignition sparks to the sparking plugs. Consisting, as it does, of an ignition coil, contact breaker, distributor and sparking plugs, there is plenty of need for suppression here. It should be noted that the battery supplies low tension through a contact breaker (acutated by the rotation of the engine) to a coil in the form of an auto-transformer which steps it up to the region of 15–20 thousand volts, as many unwary mechanics have found to their cost. The writer does not think any deaths have been recorded, but to some people the shock is sufficiently severe to make it undesirable to repeat the dose. Fig. 1A shows areas of the system so far discussed where radiation can be produced, and Fig. 1B the same after the addition of suppressor devices.

In Group *B* the pieces of equipment which may need suppression are as follows:

(1) Windscreen wiper, which is driven by a small electric motor if it is not a mechanical or suction device. Here again brushes and commutator are the cause of trouble, with sparking occurring.

(2) Radiator thermostat (actuated by a thermal relay device which varies a resistance) variation being duly recorded on a dashboard meter.

(3) Electrical indicators such as oil level, temperature, etc. These make use of small

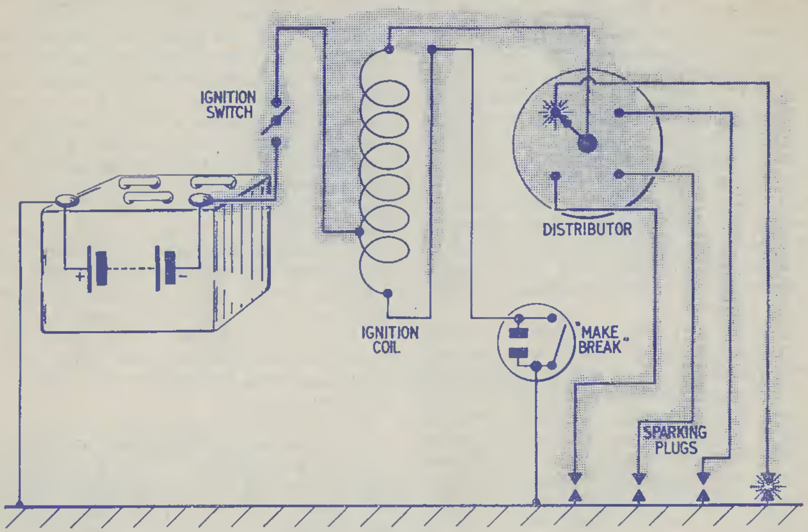


FIG. 1A
UNSUPPRESSED IGNITION SYSTEM
Showing Radiation Area

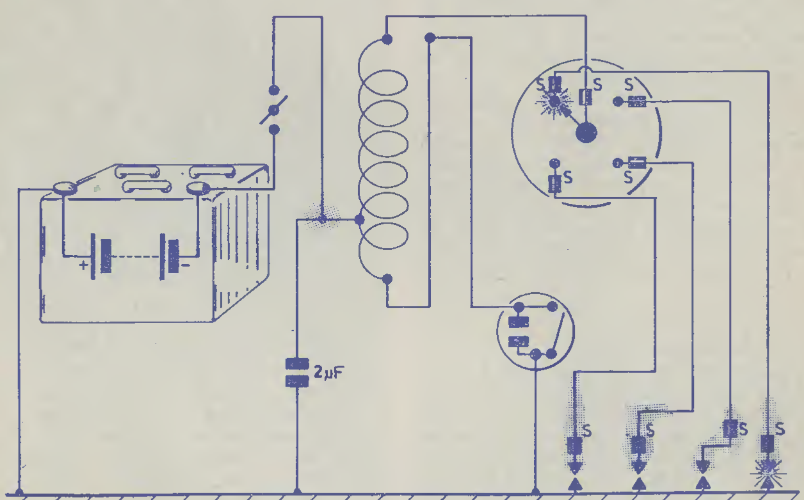


FIG. 1B
SUPPRESSED IGNITION SYSTEM
Showing Reduced Radiation
S = Suppressor

G650

relays which can cause odd clicks as they make and break and which may be sufficiently troublesome to warrant attention.

(4) Electric clocks. These frequently require suppression unless they are of the type operated by a spring which is wound up electro-magnetically every so often.

(5) Flashing type direction indicators. These can cause clicks which have an irritating persistence.

(6) The electric fan or heating system. This utilises a motor which may give the usual brush and commutator interference.

by making sure that the various main metal portions of the vehicle are electrically bonded together. Special bonding strips may often be needed to supplement the normal car manufacturer's nut and bolt fixing, because lacquer, rust or crystalisation may be preventing a good electrical contact between parts. It is as well to remember that a motor mechanic might not have the same ideas about a clean connection as a radio mechanic.

Installation Points

Before giving details of suppression devices it is necessary to state the requirements for a good car radio installation, and it is as well to commence with the aerial. Assuming that there is little essential difference between a car radio and a domestic radio, the conditions under which the former must work are not conducive to best results and, therefore, care must be taken to provide the best form of aerial available. The restrictions placed on the aerial in regard to height, length and position make a reasonable signal to noise ratio relatively difficult to attain, so that care

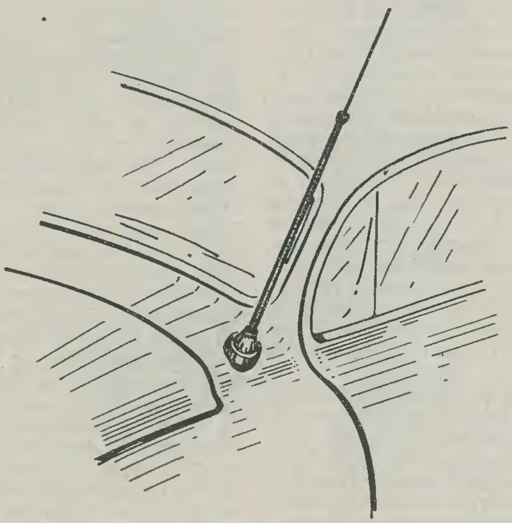


FIG. 2
SHOWING PREFERRED POSITION FOR THE TELESCOPIC AERIAL

G651

From the above list it will be seen that interference stems mainly from sparking and the job resolves itself into tracking down the causes by a process of elimination, and of fitting the necessary curative appliance. This usually takes the form of a resistor, condenser or choke. What would, at first sight, appear to be a disadvantage, namely the amount of metal in a car, can be put to good use by making it into as solid a screen as possible which will then assist in the suppression process. A solid screen can be achieved in siting the aerial is essential. Choose a position at the side of the car opposite to the distributor and ignition coil for a start, and you will most likely find that you are also on the side away from the sparking plugs as well, except in the case of old type cars which have the plugs mounted on the top of the cylinder head. The best spot is on the forming which holds the windscreen, generally called the "scuttle", as shown in Fig. 2. Such a fixing point has the advantage that it can usually be reached from the front window when it is necessary to extend the aerial, if this is of the normal telescopic type. Moreover, it is fixed to the main body part and not to a wing or other attached part, with the result that the aerial lead does not have to pass through the main engine compartment but can be run through behind the engine bulkhead, gaining an advantage in screening from the ignition and other systems connected directly to the engine. The aerial lead must be screened lead and the screening should be reliably connected to the metal of the car at the point where the aerial is mounted. When running the lead along behind the dashboard it is as well to observe certain precautions in order to lessen the amount of suppression needed for individual pieces of equipment. Avoid running near to the electric clock or anything which is capable of producing interference. The ammeter and ignition switch should also be avoided.

Home constructed car radios, and indeed some commercially made types, often derive their power from vibrators or rotary transformers built in a separate unit. When such is the case, this power unit must be mounted well away from the engine compartment and any known interference producing accessories, whilst efficient earthing of the unit casing is essential to cut down modulation hum. Take care to see that the mounting point is, in fact, electrically connected through to the radio unit itself, otherwise much unwanted interference will be heard. The connection from the battery to the power unit will probably turn out to be quite short if the recommendations above are followed but, in any case, since the battery circuit is low impedance interference is unlikely to be picked up at this point. Do not be tempted to take your battery supply connection from, say, the ignition switch if connection can be made elsewhere. If a good point for connection is not selected initially much time may have to be spent later on finding a suitable one, with the result that it might be found that some suppressor already fitted is not necessary after all.

Devices Which May Be Used

Most of the suppression devices are simply resistors, chokes or condensers fitted with special fixing devices which make fitting an easy matter. As is shown later it is necessary to take more elaborate precautions with different types of sets, the requirements being given for convenience here in list form.

1. *Sparking plug resistors* have a value of 5,000Ω and can either be of a type which screws under the sparking plug terminal or which can be inserted in the plug lead. A more efficient type is one that is covered by a can or shield which earths on the body of the plug being, in effect, a very good r.f. filter. These latter type are effective at higher frequencies and are suitable for Short wave and f.m. sets.

2. *Distributor suppressors* consist of resistors in each lead to the plugs, together with one in the main lead to the rotor from the ignition coil. The output terminal suppressors are also of 5,000Ω value as is the one in the main lead. (The latter may, however, be 10kΩ if it is employed on its own.) The total resistance offered by the three resistors must not exceed 15,000Ω. Where screw-in types cannot be fitted, they must be inserted in the leads as close to the distributor as possible. Beware of certain types, which incorporate a carbon pick-up brush for the rotor of 12,500Ω resistance. No resistors must be added to the leads at all where the car is already so equipped.

3. *Condensers* are of the metal can type and can usually be bolted closely to the offending electric motor, etc. Care should be taken to reduce the length of the flying lead provided for connection to the "live" point as much as possible. Various values can be obtained and 2μF and 0.5μF will be found most useful to cover all bands including f.m. Do not forget that it may be necessary to remove paint from the point of attachment, and that it is in any case advisable to clean the points of contact. The condenser will not be able to perform its work correctly if it is not mounted directly on to the equipment causing the interference. In other words, a nearby place such as the engine bulkhead is useless when the dynamo requiring suppression is mounted on the engine.

4. *Filters* for the voltage regulator. Some manufacturers of voltage regulators issue a warning to the effect that condensers should not be used for suppressors, with the result that, if trouble is traced to this point, recourse has to be made to a condenser-less type of filter. As the lead between the dynamo and the voltage regulator causes considerable interference on Short wave and f.m. only, the ordinary Medium wave/Long wave installation should not require any attention.

5. *Phosphor bronze bonnet springs.* On occasion, sundry odd crackles can be traced to a rubbing contact between the car bonnet and the car body proper, and a form of bonding is necessary. Flexible braid is of little practical use therefore a phosphor bronze spring clip must be devised which can be bent in the form of a hinge and bolted near the bonnet hinges to ensure good contact between the two parts when the bonnet is closed. (See Fig. 3.) Again, this fault is evident on Short waves and f.m. only (with relevant remarks as in 4 above).

In general it is as well to ascertain what provision for suppression is made by the car manufacturer. For instance some American cars are fitted with resistance sparking plug leads, or sparking plugs with built in resistors, together with high resistance distributor brushes. It may be that these measures are only partially successful and therefore the reader may be faced with fitting ordinary plugs instead, together with ordinary suppressors.

The above three suppressors will reduce noise level considerably, and it may only be necessary to add one or more of the following measures to secure complete immunity from interference.

(*d*) A 5kΩ resistor in each sparking plug lead as near to the plug itself as possible ($R_{6, 7, 8, 9}$).

(*e*) A 2μF condenser from the voltage regulator terminal marked "B" to earth (C_4).

(*f*) Earth bonnet with phosphor bronze clips fitted at 1/4, 1/2 and 3/4 the width of the bonnet, putting them under the rubber sealing and cleaning cellulose off at point of attachment and point of contact.

(*g*) Auxiliary equipment as follows:

An 0.5μF condenser from the windscreen motor wiper terminal to the wiper housing (C_5).

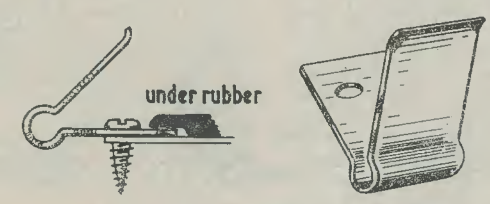


FIG. 3

BONNET CLIPS

G652

The following lists have been devised to present, in practical form, the various requirements which are desirable and which may be necessary for the different receiver combinations described in the beginning of this article

1. *Measures for Superhet Receivers with Medium and Long wave tuning* (Fig. 4):

(*a*) A 2μF condenser connected to the lead from the ignition switch to the ignition coil (C_1).

(*b*) An 0.5μF condenser connected from the armature winding of the dynamo to earth (C_2).

(*c*) A 10kΩ resistor in the main distributor lead (R_1).

An 0.5μF condenser from the heater fan lead to the heater housing (not on the motor) (C_6).

An 0.5μF condenser from the clock lead to its housing if the latter is not already sufficiently earthed (C_7).

An 0.5μF condenser between the live terminal of any electric temperature gauge thermostat, or petrol gauge and nearest earth ($C_{8, 9, 10}$).

2. *Measures for Superhet Receivers with Medium, Long and Short wave tuning*

(*a*) (*b*) (*c*) (*d*) (*e*) (*f*) (*g*) of 1 above as well as the following:

(*h*) A commercial type filter in the lead going to terminal "F" of the voltage

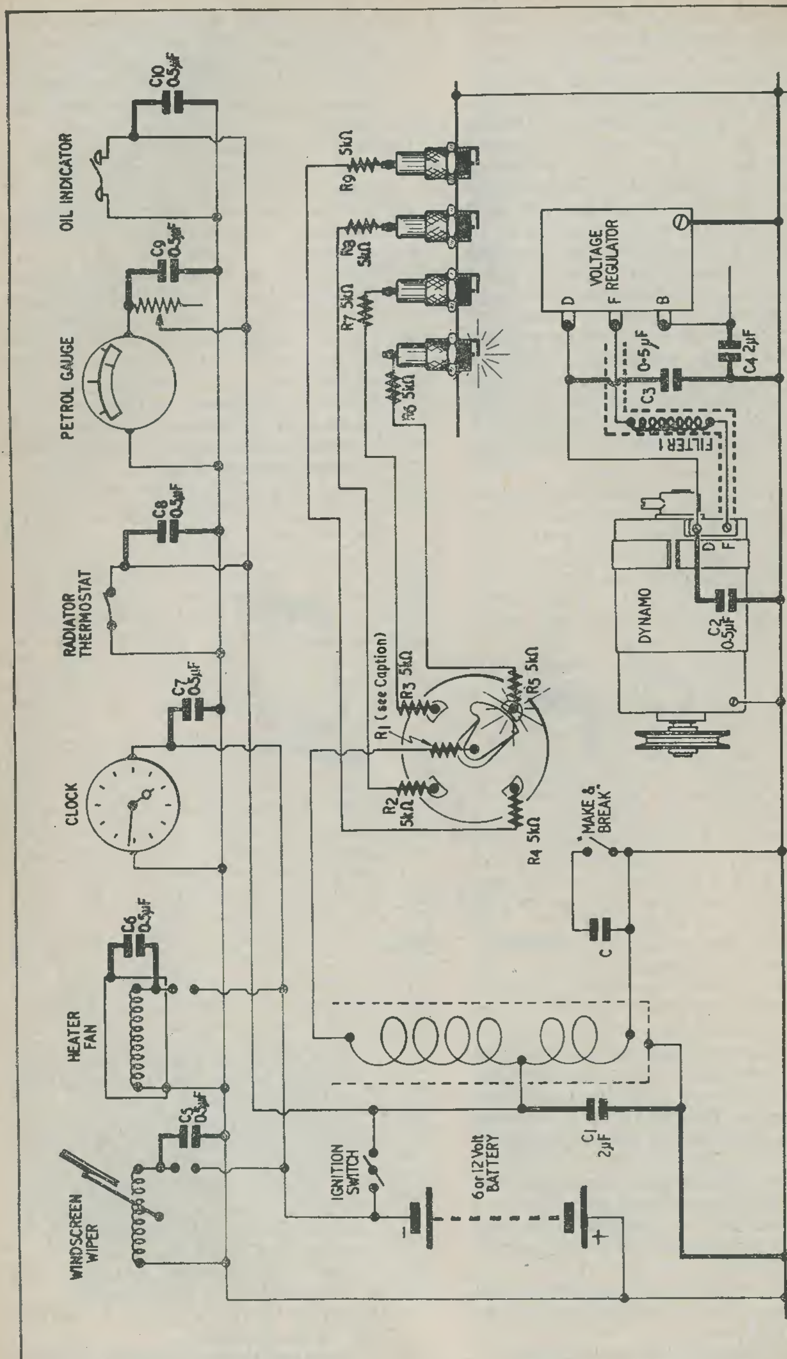


FIG. 4

Suppression Devices shown with Values and are required as described in Lists. (see text)

NOTE.— C is already incorporated in the Distributor Base. R_1 Resistor in Main Distributor Lead to be 10kΩ if R_2–R_5 not fitted.

regulator which meets the requirements of the regulator manufacturer. (Filter 1.)

(*i*) If interference still persists (which would be most likely to occur on Short waves), an additional can or screen over each sparking plug and containing the usual resistor should be used.

3. *Measures for a.m./f.m. receivers*

(*a*) (*b*) (*e*) (*f*) (*g*) of 1 above as well as the following:

(*h*) (*i*) of 2 above.

(*j*) Every distributor output terminal with at 5kΩ resistor ($R_{2, 3, 4, 5}$). R_1 should then have a value of 5kΩ.

(*k*) An 0.5µF condenser from terminal "D" on the voltage regulator to nearest "earth" (C_3). There will then be a condenser at each end of this lead.

N.B.—With regard to voltage regulators, it may be desirable to earth the cover to the main body as these are sometimes insulated. All attached suppressor condensers must be earthed to the main body of the car and not to the cover of the regulator. Generally speaking, the regulator only requires suppression for Short waves and f.m. When it causes interference on Long waves a 2µF condenser between terminal "B" and earth will suffice. It is recommended, however, that the manufacturers or agents of Lucas, Bosch, Auto-Lite, Delco, etc., equipment be approached for information regarding the advisability or otherwise of connecting condensers to their respective voltage regulators.

Additional Information

One or two more points should be dealt with before concluding, and it is advisable to mention some further precautions which have been found necessary in extreme cases.

Firstly the question of static charge caused by the friction of the tyres on the road may arise. The familiar chain dangling from the rear of a car can take care of this form of annoyance, although means have been used whereby the wheel bearings of the car are bridged by coil springs to give contact from the main body of the car to the road. Another method described is that, in addition to the bearing "bridge", rubberised metal paint is applied on the inside of the wheels to link electrically the wheel and tyre wall and thence to the road.

Other instances have occurred where rubber bushes now common on rear springing have had to be bridged to overcome isolation of the body from the road contacting part of the car. Convenience is made of the top bolt of the rear axle housing in such a case, due allowance being made for the action of the road springs.

Finally, if having conscientiously carried out all possible requirements listed, consult the following list as a complete check.

Check List

Make sure:

(1) That the various suppressor devices make contact with cables or accessory terminals.

(2) That the condenser cases, bonnet springs, etc., are making good earth contact.

(3) That the original car wiring is running clear of sources of interference; the main points to avoid being ignition coil, distributor and voltage regulator.

(4) That the aerial lead, which must be screened, does not pass too near to leads carrying interference.

(5) That the interference is not coming in by way of the supply cable. This is most unusual and can be checked, if necessary, by connecting direct to the battery temporarily.

(6) That "earth" continuity exists between engine and body. If this is not so, the remedy is a thick braided copper link between convenient points.

(7) That the lead from ignition switch to ignition coil or from ignition switch to battery does not pass too near to the receiver case. A temporary check may be made by taking the ignition coil direct to the battery with the existing switch lead removed.

(8) That any part attached to the main body such as wings, metal running boards, exhaust pipe, steering column, petrol tank, etc, is, in fact, electrically connected. Remedy is as for 6 above.

BRITISH ELECTRONIC COMPONENT EXPANSION

EXHIBITION TO BOOST £1 MILLION-A-MONTH EXPORTS

Britain's go-ahead radio and electronic component industry will hold its 17th Radio and Electronic Component Show from 30th May to 2nd June at Olympia, London.

The Component Show has grown too big for Grosvenor House, Park Lane, London, where it has been held for many years, and at Olympia it will be three to four times its previous size.

Mr. Arthur Bulgin, chairman of the exhibition organising committee of the Radio and Electronic Component Manufacturers' Federation, said: "It will not only be easily the biggest, but also the most comprehensive yet held. We are inviting 45,000 engineers, technicians and industrialists from all parts of the world. The exhibits will include the latest electronic applications—components for computers, machine tool controls, satellites and missiles, and nuclear engineering."

Anyone not receiving an invitation can obtain a ticket from an exhibitor or from the Radio and Electronic Component Manufacturers' Federation (21 Tothill Street, London, S.W.1), or can pay five shillings at the door. Overseas visitors will be admitted free.

radio topics

BY RECORDER

One of my many short-comings as a home-constructor is that I tend to be too impatient to get a job finished and in working order. This is a failing which, I think, I share with quite a few other enthusiasts! In my own case, the consequence is that quite a few of the chassis I have made in the past would have looked far more presentable had I been just a little less hasty during their manufacture. Normally, after I have drilled out and bent a chassis, my fingers are itching to start bolting valveholders and tagstrips on to it and to get down to the wiring.

Now and again I have spent a little more care than usual on a job with the result that, having made the chassis, I have given it a coat of enamel before commencing assembly and wiring. I only wish I could say that my attempts at gilding the lily in this respect have been successful! Apart from waiting at least twelve hours for the enamel to set really hard I have, even then, encountered some points where it had been laid on too thickly, inasmuch that the enamel under the hardened outside surface was still tacky.

Aerosol Paints

An answer to this problem came, completely out of the blue, in a letter from a reader who recommended in the most glowing terms the aerosol paints manufactured by Plasti-Kote. The reader, pointing out that these were readily available at his local paint shop, described them as "every amateur constructor's dream", and was especially impressed by the hammer finishes in the range. I decided to find out more about Plasti-Kote.

After writing originally to Plasti-Kote Incorporated in Ohio, I was directed to Plasti-Kote Ltd., Silbury Street, London, N.1. The information I received from both offices enables me to summarise some of the most important points of Plasti-Kote aerosol paints. Plasti-Kote paints consist of a finely dispersed pigment and resin in a propellant solution, the mixture being sealed in a can fitted with a screw-on valve. The valve is only fitted when the can is initially required, and it is supplied as a separate item. Pressing the valve causes the paint to be released in a fine spray. At room temperature (70°F.) the pressure from the propellant is about 40 lb per square inch. Whenever the can has been used it should be inverted and the valve pressed for three seconds; this causes the gas in the can to blow out any paint remaining in the valve, and prevents clogging. So you can use the can over and over again for small jobs, regardless of the time interval between applications, until the paint is exhausted. The spray paint should not be used in a room where there is a gas fire or naked flame, owing to the risk of flash fire. There is a very wide colour range in enamels, lacquers and stains, and there are five hammer finishes. At room temperature the enamels will dry dust free in one hour, and hard in three to four hours, whilst the lacquers dry dust free in five minutes and hard in twenty minutes. Each aerosol can contains approximately one pint and has a retail price, for all colours, of 16s. in the U.K.

Plasti-Kote Ltd., London, gave me the following hints:

(1) You require far less paint than you would think.

(2) The instructions tell you to be about 12 to 16 inches away, but the temptation always is to be too close and, if you are, you will almost certainly get runs and blobs. Far better to be too far away and then come in.

(3) On metal articles there is no need for priming or undercoat. First put on a *very* thin spray (so thin you can hardly see it) then a second more liberal coat.

(4) On wood, hardboard and other porous unpainted surfaces you must seal, unless you want to be extravagant.

(5) On previously painted surfaces act as in (3) above. (Don't forget that all grease, dirt or polish should be removed and that scratch marks—unless previously filled or removed—will show through).

(6) Finally, to get a finish at least as good as you'll see on any car (not with the hammer finishes) wait till the article is really dry and give it a polish with car polish ("Auto-brite" is recommended).

Trial Run

After all this, I had a trial run, and I must emphasise that I started entirely from scratch. The lacquer I chose was Marine Lacquer, 328 Mercury Green.

I cleaned up two small tinplate sheets (8in by 3in) and started my test. The spray paints are stated to work best at a room temperature of 70°F. It so happened, however, that the room in which I did the spraying was colder than this, at approximately 50°F. After shaking up the can as directed on the label I screwed on the valve and immediately set to work spraying the first tinplate sheet. I was too generous with the lacquer (and too close!), and I applied too much. Nevertheless, the experience I gained, even by spraying this small area, enabled me to tackle the second sheet in more correct style. After ten minutes the lacquer on both sheets was fairly dry, the first being sufficiently tacky to take thumb prints readily. I then took the sheets into a room at normal temperature and left them for twenty minutes. At this time (half an hour from the original spraying) the first sheet was still tacky in the places where I had been especially over-generous, whilst the second could be handled quite freely. Some ten minutes after this the second sample was rock-hard, and so after a further twenty minutes was the first. The colour of the lacquer, whether applied too thickly or not, was exactly the same over all surfaces, and the finish was beautifully smooth.

The last paragraph describes the results obtained by myself, and I must stress that I have never before used an aerosol paint and that the only spraying experience I obtained was with the first tinplate sheet. I think the results speak for themselves; and I would definitely recommend Plasti-Kote aerosol paints to any constructor who requires an extremely quick-drying "professional" finish without any fuss or bother whatsoever.

Infra-red Telephone

In the December issue I gave a few brief notes on the infra-red telephone introduced by Infrared Industries Inc., Massachusetts. The Infrared Industries telephone, called the "Infraphone", enables speech communication to be made between two points, the linkage being by infra-red beams. Two Infraphones are needed to set up a system, and reception and transmission at either end can occur simultaneously. Each Infraphone projects an infra-red beam which is modulated at voice frequency, and it contains a receiver which responds to a similarly modulated beam from the complementary instrument. The Infraphone units are about the size of a dual-lens reflex camera and they are "aimed" at each other with the aid of a tubular rifle-like sight. Communication is possible within line-of-sight, or around corners with the aid of mirrors. The initial price of the Infraphone, at about $20 a unit, is surprisingly low.

I also stated in the December issue that I hoped to provide further technical details about the Infraphone. This information is now to hand.

The sensing device for the receiver section of each unit is an "Infratron" lead sulphide photoconductor, which is also manufactured by Infrared Industries Inc. An Infratron photoconductor consists of a film of lead sulphide hermetically sealed between a window and a substrate (in this case, roughly, a supporting surface). Except for special applications, both the substrate and the window are of quartz. Connections to the lead sulphide are made via evaporated gold conductors. The resistance of the lead sulphide varies according to the amount of light falling on it. In the Infraphone the modulated infra-red light from the complementary instrument passes through an infra-red filter to a 3in diameter parabolic reflector focusing on to the lead sulphide cell.

Following the lead sulphide photoconductor is a conventional three-stage p.n.p. transistor a.f. amplifier which operates from an h.t. voltage of 4.5 provided by three flash-lamp cells in series. The second and third transistors in the amplifier are connected in conventional earthed emitter mode, the output transistor coupling directly to a 3,000Ω hearing-aid type earphone. The first transistor is an emitter-follower, the lead sulphide cell being connected between the h.t. negative rail and its base, and a fixed resistor between the base and the h.t. positive rail. The amplifier gives a nominal voltage gain of 800 times.

The transmitter section employs no electronics. A 4.5 volt flange-type flash-lamp bulb (G.E. type PR-3) is powered by the same three cells that provide h.t. for the three-transistor receiver amplifier. A parabolic reflector behind the bulb directs its rays on to a reflective Mylar (polyester) diaphragm and thence, through an infra-red filter on the front of the instrument, to the complementary Infraphone. The voice of the operator causes the diaphragm to vibrate in sympathy, whereupon there is a corresponding spread of the transmitted infra-red beam. A maximum modulation of about 30 to 40% is obtainable with this system.

The transmitted beam width from an Infraphone is of the order of 3°, and this enables communication to be obtained over long distances (300 to 500 yards) despite the fact that only a watt of infra-red power is available from the flash-lamp bulb. The latter, incidentally, has 65 to 70% of its radiation in the infra-red spectrum. An infra-red filter is not necessary over the transmitter section of the Infraphone, and the filter fitted may be lowered out of position, if desired. Its only purpose is to prevent attracting the attention of others. On the other hand, the infra-red filter over the receiving photoconductor is essential since it reduces background radiation which, in bright sunlight, would seriously affect sensitivity. There is a trigger switch on each Infraphone; when this is pressed it switches on both the receiver amplifier and the transmitting bulb.

The earphone used with the Infraphone has a resonance around 1,200 c/s. To partially compensate for this the reflecting transmitting diaphragm is stretched with sufficient tension to provide a resonance peak at about 400 c/s, mechanical damping being applied to the diaphragm to control the bandwidth of this resonance. I should add that the infra-red filters employed with the Infraphone are manufactured by Infrared Industries Inc. also.

News in Brief

An attractive range of new cabinet handles has been introduced by Fenny Electrical Co. Ltd., Aylesbury Street, Bletchley, Bucks. These handles fasten to the cabinet at two points, and the ends are tapped or threaded as required. Handle cross-section is circular, and they are made from mild steel bar finished in high quality chromium plate. The appropriate nuts, screws and washers are supplied.

To hand is the January copy of *Medium Wave News*, a duplicated publication dealing with Medium wave Dx, and technical points concerned with Medium wave Dx reception. Interesting features are the reports on present Cuban transmissions and on Radio Veronica, the "pirate" station on a converted lightship moored off the coast of Holland. *Medium Wave News* reports that this station runs a commercial radio service to Holland on 1562 kc/s (≏192 metres) between 1200 and 2400 hours. Radio Veronica is expected to be on the air in English from 0600 to 1200 and from midnight to 0300 in 1961 using call-sign CNBC. All these times are G.M.T.

U.N.E.S.C.O. publication *Television Teaching Today* (20s. bound, 15s. paper cover) by Henry R. Cassirer, deals principally with educational television in the United States, subsequent chapters covering Canada, France, Italy, the United Kingdom, the Soviet Union, and Japan. It is conservatively estimated that half a million school pupils and college students are taking televised courses in the U.S. In 1959 there were 3,000 schools in France and 10,000 schools in Japan with television sets. Mr. Cassirer warns: television is not merely a substitute for traditional ways of teaching . . . it is a medium with its own psychological and emotional disciplines and personalities. It should not be used as "emergency relief" to cope with a lack of normal education facilities.

Marconi's Wireless Telegraph Co. Ltd. have secured a repeat order from the Czechoslovakian Television Authority for their "fast pull-down" telerecording equipment. This equipment, already used in this country by the B.B.C. and Granada Television, is employed also in Bavaria, Italy, Australia and Canada. It has a unique feature in that the film is pulled down to the next frame in the brief (approximately 2 millisecond) interval between successive television pictures. Thus, each television picture is photographed in full on each film frame, with a consequently high picture quality.

MINISTER OF STATE TO OPEN TENTH ELECTRICAL ENGINEERS EXHIBITION

The Minister of State, Board of Trade, Rt. Hon. Frederick Erroll, M.A., M.I.E.E., A.M.I.Mech.E., M.P., will open the Tenth Electrical Engineers' Exhibition (Earls Court, London, 21st–25th March) on Tuesday 21st March, 1961, at 12 noon. Before his appointment as Minister of State, Mr. Erroll, himself a qualified electrical engineer, was a director of several engineering and mining companies.

Educated at Oundle and Trinity College, Cambridge (honours degree Mech. Science Tripos) he started his career with Metropolitan-Vickers, later moving to the staff of the research department of Evershed & Vignoles. War service took Mr. Erroll to Italy, India and Burma. He attained the rank of colonel and took part in the first large-scale amphibious operation. He carried out various missions in Germany and Austria for B.I.O.S.

Mr. Erroll has been Conservative M.P. for Altrincham and Sale since 1945. He was a member of Parliamentary delegations to Germany (1946), West African Colonies (1947), Burma (1950) and U.S.S.R. (1954). From 1949–52 he was deputy chairman of the Parliamentary and Scientific Committee; Parliamentary Secretary to the Ministry of Supply, 1955, to the Board of Trade, 1956. In 1958 he was appointed Economic Secretary to the Treasury. In 1948, jointly with the late Earl of Verulam, he read a paper on "High Voltage Direct Current Transmission" to the Institution of Electrical Engineers. He has contributed to many electrical journals.

10 to 30 MC/S AERIAL MATCHING UNITS for Balanced and Unbalanced Feeders

By J. B. DANCE, M.Sc.

Our contributor discusses the problems of receiver aerial matching in general terms and describes the construction of matching units suitable for balanced and unbalanced feeders

The best possible performance from any receiving aerial can be obtained only if the impedance of the aerial is the same as (i.e. matches) that of the receiver. A receiver designer cannot arrange for perfect matching between the aerial and the receiver because it is not known in advance which type of aerial or aerials will be used. Therefore, it is improbable that the best possible performance will be obtained, the loss, however, not being very great unless the mismatch is considerable.

Matching errors can be corrected by alteration to the number of turns on the aerial coupling coil of the receiver or by alteration of the spacing between the coupling coil and the tuned winding. Assuming that the receiver has already been constructed, however, it is simpler to use an aerial tuning unit such as the one to be described. The use of such a unit is also very convenient when it is desired to operate a receiver from different aerials at differing times.

Signal to Noise Ratio

If an appreciable mismatch occurs, the maximum possible power will not be transferred from the aerial to the receiver input circuit. In larger receivers the resulting loss of gain will probably be quite unimportant, but, at frequencies around 30 Mc/s or more, the signal to noise ratio will be reduced. This latter must be avoided if satisfactory reception of weak signals is to be obtained.

Matching

Ideally, the impedance of the aerial (which is measured in ohms) should match both the impedance of the feeder (or "lead-in") and the input impedance of the receiver. This is obviously of importance in amateur and broadcast transmitting installations, but at simple receiving stations such points are often not even considered. If, owing to a mismatch, only half of the possible power output of a transmitter is transferred to the aerial, the arrangement would not be considered to be satisfactory. At the same time, if half the input to a receiver were lost by mismatching, the reduction in signal to noise ratio might be appreciable. In some circumstances, however (namely, a low signal frequency and a good aerial), the reduction would be quite negligible.

If a simple horizontal or vertical dipole aerial is used without a reflector or any directors, the impedance is about 72 ohms. The most common type of coaxial cable is

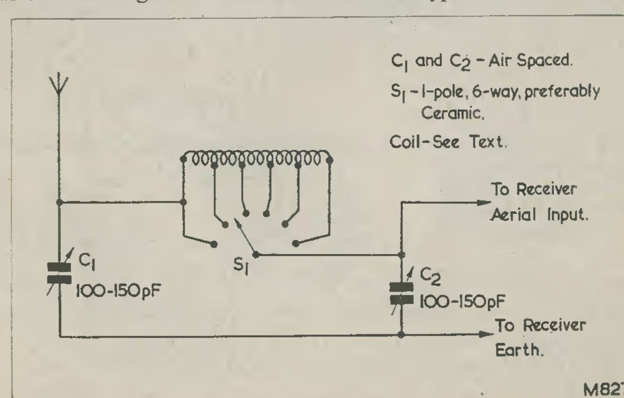


Fig. 1. Circuit diagram of an aerial coupling unit suitable for unbalanced systems. Moving vanes of the condenser should be earthed

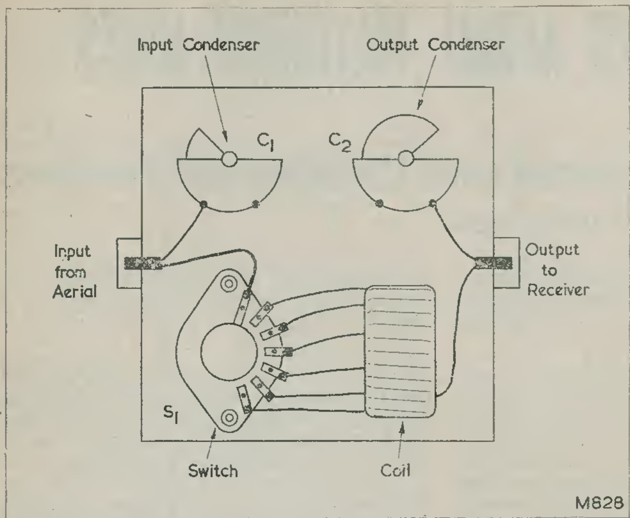


Fig. 2. Wiring diagram for the circuit shown in Fig. 1

made with a characteristic impedance of 72 ohms also, so that it will match into a simple dipole aerial. Coaxial cable with other impedances is also obtainable. It is not possible to discuss the actual meaning of the words "impedance of a cable" without certain theoretical considerations which it would be inappropriate to give here. If the first r.f. stage of a receiver is designed to be used with a 300 ohm twin wire feeder, appreciable losses will occur if the receiver is fed from a dipole by a 72 ohm coaxial feeder. Similarly, losses will occur if a 300 ohm twin feeder is used to supply signals to a receiver designed for use with a 72 ohm coaxial feeder. In such cases it is possible, however, to match the impedance of the feeder to the impedance of the receiver input by means of a simple aerial tuning unit (also known as an aerial coupling, or aerial matching, unit) such as that described here. In effect a unit of this type acts as a transformer.

Practical Details

The circuit shown in Fig. 1 is that of an aerial coupling unit designed for use at frequencies of 10 to 30 Mc/s. It can be constructed in a small screened box (about 2$\frac{1}{2}$ x 4 x 4in) which can be placed in the receiver case or in the aerial lead near to the receiver. If it is placed in the receiver case, however, the necessary three controls must be brought out to a suitable point. The unit will enable any aerial within a fairly wide impedance range to be matched perfectly into any receiver which is within the usual range of input impedance.

The components required are shown in Fig. 1. The coil has 40 turns single-layer wound on a former (preferably of polystyrene or similar low-loss material) of diameter 0.4in. The coil should be tapped at 2, 6, 13 and 28 turns, the 2 turn tap occurring at the aerial end. 22 s.w.g. double cotton, silk, or rayon covered enamelled copper wire is suitable. The switch should be connected so that the number of turns in circuit becomes greater as it is rotated. No part of the coil should be within half an inch of any earthed object. The metal screening of the box should, of course, be earthed.

By means of the two variable condensers and the switched coil, the coupling (matching) can be adjusted as desired. Normally all three controls should be adjusted for maximum signal, as this will also give maximum signal to noise ratio. If a very powerful signal is being received, however, one or both of the condensers can be adjusted in order to reduce the input somewhat and so prevent cross-modulation or "blocking" trouble.

Fig. 2 shows a suitable layout for the unit. It is preferable (but by no means essential) that a ceramic switch should be used in order to minimise coupling to undesired parts of the coil. Plug-in coils could be used to eliminate the necessity for the switch, but coil changing is rather inconvenient.

The unit need not be removed from the aerial lead when it is desired to receive signals at lower frequencies than those for which it is designed (i.e. less than about 10 Mc/s), as it is necessary only to set the two variable condensers to their minimum capacity value and to switch the inductance out of circuit.

Small components can be employed in the coupling unit; these are perfectly satisfactory for reception purposes because the power in the aerial circuit is very low. Small components would not, however, be suitable for a transmitter aerial coupling unit by virtue of the much greater amount of power which they would be required to withstand.

Assuming that only one aerial is used, it will be necessary to alter the aerial coupling (i.e. adjust the unit) only when a fairly large alteration of receiver tuning is made. Once the correct setting of the coupling has been obtained, it will not be necessary to alter this coupling whilst tuning through any one broadcast or amateur band. The coupling should always be re-adjusted if the aerial is changed or if the frequency of the tuning is altered by more than about 2 Mc/s.

Balanced Coupling Unit

The circuit of Fig. 1 is for use with an "unbalanced" feeder. A feeder is unbalanced when only one wire passes from the aerial to the receiver, or when one of the wires is earthed, i.e. as in a coaxial feeder.

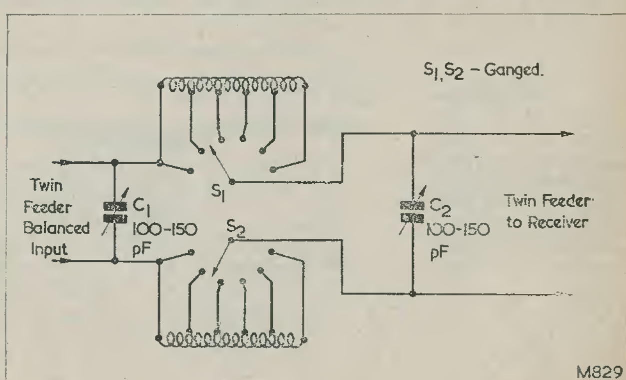
If a balanced feeder (such as standard 300Ω or 600Ω twin wire feeder) is used, an extra coil is required for the aerial coupling unit and it should be connected as shown in Fig. 3. Both coils in this circuit can be made to the same specifications as have been given for the coil of Fig. 1. A 2 pole 6 way single wafer switch is required and it must be connected so that the same number of turns of each of the two coils is in circuit at any one time. The moving vanes of the condensers in the circuit of Fig. 3 cannot be earthed and therefore the two variable condensers should be mounted on a suitable plate of insulating material. Arrangements must be made for the two condenser spindles to be insulated from the earthed screening box. Whilst the spindles can be brought out directly through holes in the screening, it may be found more convenient to use an insulated coupling.

Lower Frequencies

The aerial coupling units described have been designed for use with high frequency reception, this being where correct matching is of the greatest importance when good signal to noise ratios are required.

It is not possible to state here what improvement in performance is likely to be obtained from the use of an aerial coupling unit. If the receiver and aerial were perfectly matched before the unit was introduced, no improvement whatsoever will be noted. If, however, the mismatch was considerable, an improvement, both in signal to noise ratio and in gain, of 6 to 10dB or even more may be obtained.

Fig. 3. Circuit diagram of an aerial tuner unit suitable for use with a balanced input



MASTICATE THIS !

Dr. Allen Brewster, of the School of Aviation Medicine at Brooks Air Force Base in Texas, is currently utilising miniature radio transmitters embedded in artificial teeth in order to further the study of tooth erosion. The Lilliputian transmitters send out a signal on each occasion that the upper and lower teeth make contact, according to a report published in the London *Evening Standard* dated 27th January.

"personal" STEREO

By B. G. ALEXANDER

In the light of his own experiences, our contributor describes an unusual method of obtaining stereophonic reproduction in the home

From the inception of stereophony the author has experimented with numerous equipments of varying standards—these employing two or more speakers, centre bass arrangements, or sum and difference circuitry—and he is of the opinion that stereo reproduction can only be, at its best, a good impression of the original because of the adverse acoustic effects of the normal room. Further, to overcome any "hole in the middle" effect which may be apparent, a third or even fourth speaker may be necessary with some form of complicated crossover or matrixing to vary the amount of left and right signal directed to the centre speaker or speakers. It is impossible to avoid a number of lengthy connecting wires whichever way things are arranged.

Of course, there will always be those who repudiate the whole conception of a "hole" between two stereo speakers, the argument put forward being that when everything is regulated properly, and the listener is seated correctly with respect to the speakers, there is no awareness of "separateness". The effect, in copywriters' jargon, is described as a "*curtain of sound*". The author agrees with this provided the exact listening spot is used

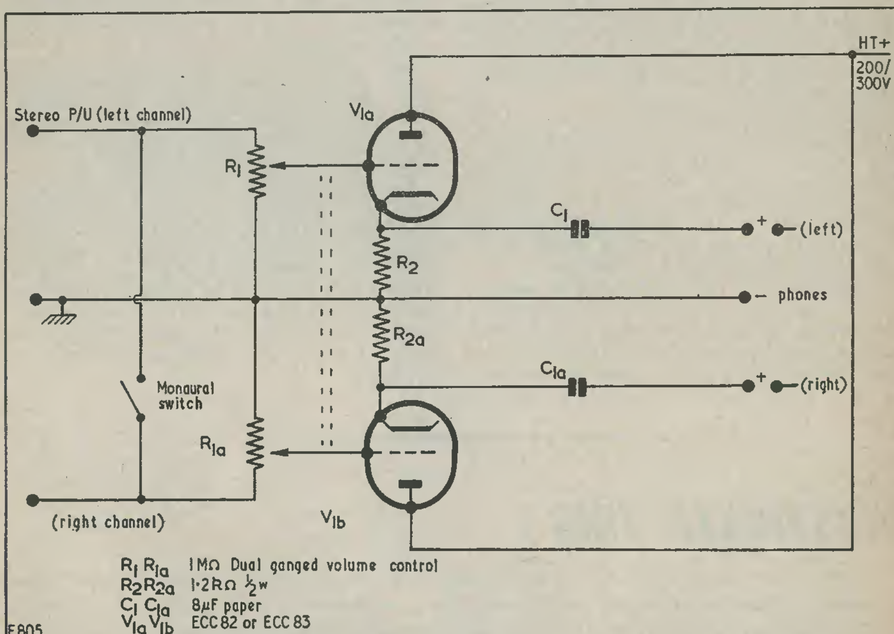


Fig. 1. The one valve amplifier employed by the contributor for "personal" stereophonic listening A monaural signal may be applied to either of the inputs

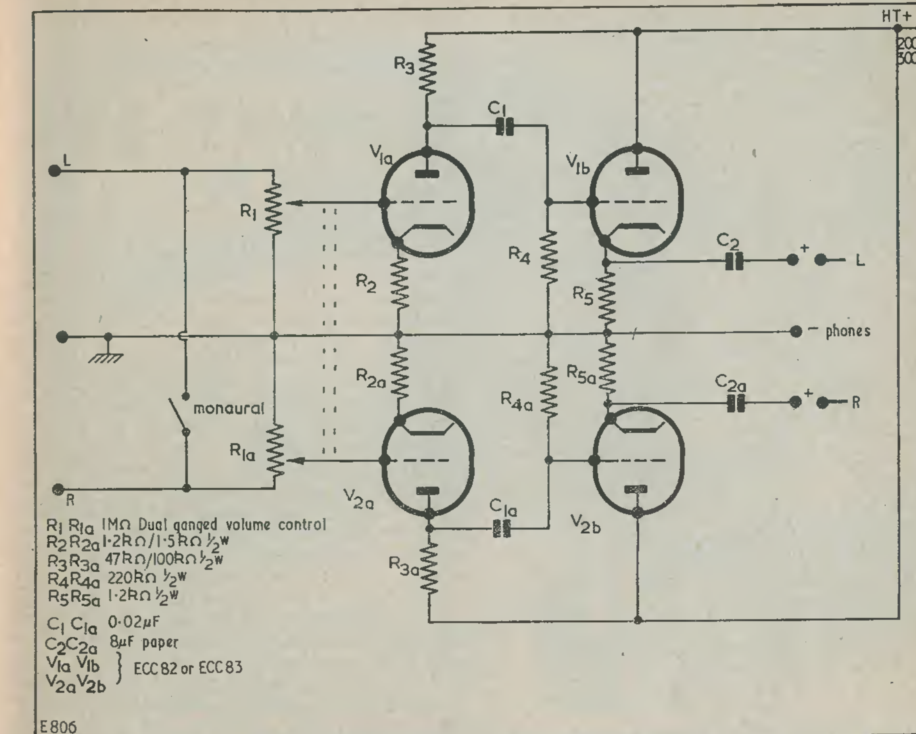


Fig. 2. A two valve amplifier which provides additional gain and which allows the introduction of an equalisation circuit for the pickup

and all other elements are perfectly balanced. (By the way, a step ladder makes a suitable seating device midway between the speakers, if more than one listener is to hear the required stereophonic effect!) To quote a particular example, it was found that the suggested minimum 8ft separation of speakers in one room of an average home was possible only by positioning these against the wall opposite to the fireplace. Consequently the family no longer face the fire when listening to stereophonic music; they have their backs to it and, even then, cannot all be in the central position relative to the speakers. The alternative is to haul in the speakers close to the firebreast walls (because of corner located furniture), with about 3 to 4 feet spacing, whereupon the family can live once again like normal human beings! The writer feels that to falsify the stereo effect by adopting close spacing of speakers or one-piece cabinets is utterly worthless and believes it causes the development of stereo much harm.

Whilst the writer does not intend to imply that, if adequate speaker separation is inconvenient we should forget entirely about loudspeaker stereo in the home, he would like to submit that another, more personal mode, is available by means of which it is possible to get a little closer to overall perfection. This consists of using stereo headphones, whereupon the listener obtains complete separation of sound channels in a small area with none of the problems attendant upon loudspeaker reproduction. The use of stereo headphones represents a simple solution which can be carried out without economic pain. Furthermore, the amplifying equipment can be made compact and portable, listening being possible in the same room with others who are occupied with different interests. There is no need to slip off into another room to enjoy those precious recordings. At extra late hours, an additional advantage when using phones is that the volume does not disturb neighbours or other occupants in the flat or house.

Headphone listening is now favoured by those in the author's household, even to the exclusion of the existing radio receiver, this having been present but rarely used because the television set is more often employed. Indeed, the headphones may be quite conveniently employed for broadcast reception, all that is necessary being the addition of a simple Stereo-Monaural switch in the associated amplifier, the latter being coupled, when desired, to the output of an f.m. tuner. When considering headphones for high-fidelity listening it should be stated that, like loudspeakers, due attention must be given to their choice if acceptable results are to be achieved. It is recommended, therefore, that specially manufactured headsets, such as "K" Stereophones, manufactured by S. G. Brown Ltd., may be selected. Such headphones have been used exclusively with the units to be described. The "K" type phones are supplied to professional users and are available to the home constructor through the normal supply channels. To "gild the lily" the author's first choice is the Super "K" stereophones, a newcomer to the range.

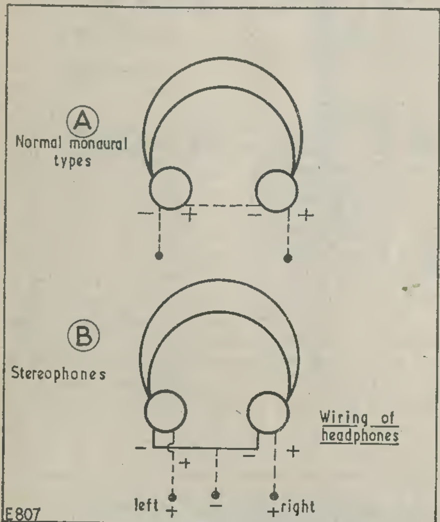


Fig. 3. Method of wiring stereophonic phones as opposed to monaural phones.

Amplifiers

The amplifier employed with the headphones, need only be capable of producing a few milliwatts, an output which may be accomplished with a minimum of components. Power consumption is also low, this favouring economy without in any way detracting from the performance. Hum and noise are unnoticeable in the designs used by the author, the quality and response of stereo discs being restricted mainly by the class of pick up used and the condition of the record. It should be noted further that the relatively expensive component, the output transformer (two required for stereo) is no longer needed. Fig. 1 shows a simple cathode follower unit using a voltage amplifier type valve, a dual ganged volume control, two cathode resistors and two condensers. To the perfectionist the expense of the paper condensers, specified in the diagram, will not be embarrassing.

If increased gain is necessary, Fig. 2 depicts a version having two double triodes in a voltage amplifier/cathode follower configuration, this allowing the particular equalisation needed for the pick-up to be included. Since the costs are small, the writer does not doubt that many enthusiasts will be interested in constructing either the one or the two valve circuit described in this article for personal stereo—the slight effort required in building either of them is more than repaid from the first instant of listening.

Editor's Note

The output impedances of the cathode followers employed in Figs. 1 and 2 are higher than the impedances of the phones specified. The writer states, however, that the arrangement functions satisfactorily in practice.

Catalogue Received

Messrs. J. T. Filmer, 82 Dartford Road, Dartford, Kent, recently released the revised and enlarged 7th edition of their component catalogue, which is free to readers upon receipt of a 6d. stamp to cover return postage.

The catalogue is of 56 pages plus stiff card cover, 8¼in by 5½in (approx.), and lists in alphabetical order (pages 1–33) almost every type of component from aerial accessories to valveholders. Pages 34–39 feature valves, complete with equivalents, types and prices. Pages 40–53 list the most currently popular kits for home constructors from the Mullard ten watt to the twenty watt amplifier described in the *Mullard Circuits for Audio Amplifiers* to the Jason and Denco f.m. tuners. A book list of interest to the home constructor plus a price list of popular valves completes the text pages. An index to the catalogue is reproduced on the inside of the rear cover.

This is an extremely useful publication and one which we feel will be popular with those readers who prefer to purchase quality components by mail order.

SCOTTISH INSURANCE CORPORATION LTD

38 Eastcheap London EC3

TELEVISION SETS, RECEIVERS AND TRANSMITTERS

Television Sets, Receivers and Short Wave Transmitters are expensive to acquire and you no doubt highly prize your installation. Apart from the value of your Set, you might be held responsible should injury be caused by a fault in the Set, or injury or damage by your Aerial collapsing.

A "Scottish" special policy for Television Sets, Receivers and Short Wave Transmitters provides the following cover:

(*a*) Loss or damage to installation (including in the case of Television Sets the Cathode Ray Tube) by Fire, Explosion, Lightning, Theft or Accidental External Means at any private dwelling-house.

(*b*) (i) Legal Liability for bodily injury to Third Parties or damage to their property arising out of the breakage or collapse of the Aerial Fittings or Mast, or through any defect in the Set. Indemnity £10,000 any one accident.

(ii) Damage to your property or that of your landlord arising out of the breakage or collapse of the Aerial Fittings or Mast, but not exceeding £500.

The cost of Cover (*a*) is 5/- a year for Sets worth £50 or less, and for Sets valued at more than £50 the cost is in proportion. Cover (*b*) and (ii) costs only 2/6 a year if taken with Cover (*a*) or 5/- if taken alone.

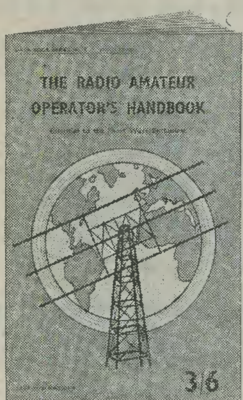
Why not BE PRUDENT AND INSURE your installation—it is well worth while AT THE VERY LOW COST INVOLVED. If you will complete and return this form to the Corporation's Office at the above address, a proposal will be submitted for completion.

NAME (Block Letters)..............................

If Lady, state Mrs. or Miss

ADDRESS (Block Letters)..............................

.... J/B



Radio Amateur Operator's Handbook

1960/61 Edition

Essential to both the Transmitter and the Listener, this latest publication is chock full of such information as Amateur Prefixes (both in alphabetical and country order), Radio Zone Boundaries—1/40, Call Areas, Amateur Band Frequency Allocations, Local Time Conversion, Mileage Table, Amateur Codes and Abbreviations, the Amateur Licence, International Morse Code, QSL Bureaux of the World, Standard Frequency Transmissions, Operating Technique, Charts on which countries, states, zones and counties heard or worked can be recorded, Prefix/Directional Bearing List, 2 Metre Band Plan with Map, Weather Forecast Areas Map, Frequency/Wavelength Conversion Chart, etc.

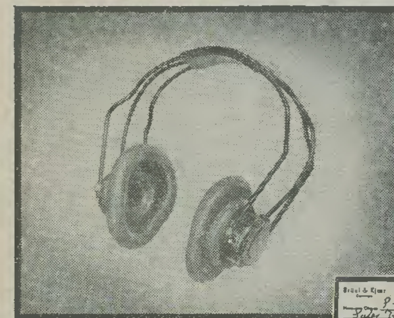
Indispensable to the Amateur Transmitter and Short Wave Listener

PRICE 3/6 *Postage 4d.*

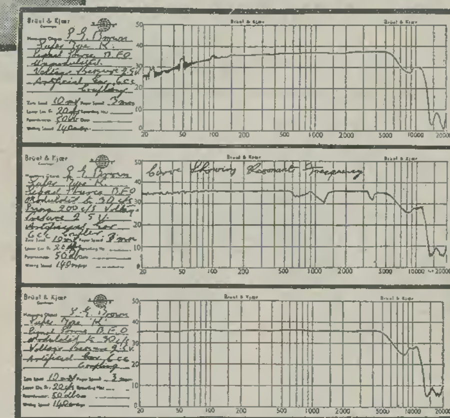
DATA PUBLICATIONS LTD 57 Maida Vale London W9

• Designed for "Personal Stereo"

by S.G.Brown



SUPER K Stereophones



Span Nine Octaves!

The "Super K" Headphones are the newest product of S. G. Brown Ltd., and are designed especially for High Fidelity Stereo requirements. They are attractive in appearance, extremely comfortable to wear and incorporate plastic head band and earpieces.

- **The frequency Response curves above were produced under the following conditions:** BEAT FREQUENCY OSCILLATOR Type 1014 producing a signal of 2.5 V. (modulated to 32 c/s with a swing of 30 c/s) to SUPER K EARPIECE close coupled to ARTIFICAL EAR Type 4109 with 6 cc. coupler, measured signal being amplified by MICROPHONE AMPLIFIER Type 2603 and recorded on a Type 2304 LEVEL RECORDER.

  Recorded Medium shows Response flat ± 1 dB 20 c/s-6,000 c/s; 6 dB reduction to 8,000 c/s; 6 dB reduction to 12,000 c/s, with continued reduction to 20,000 c/s.

  Nine octaves pianoforte coverage from 24 c/s to 7,800 c/s.

  Low Impedance

Write for full details to:

S.G.Brown LTD

SHAKESPEARE STREET . WATFORD . HERTS

Telephone **Watford 27241**

THE SELRAY BOOK CO

BOOKS FOR THE CONSTRUCTOR

A New Practical Way of understanding
Basic Electricity. 5 parts, **55s.**
Basic Electronics. 6 parts, **66s.**
Basic Synchros and Servomechanisms. 2 parts, **32s.**
The New Picture Book Way.
The Complete Set sent on payment of first instalment. Learn while you pay.
Write for Free Illustrated Prospectus giving details of Instalment Plan.

Transistor Circuits for the Constructor, No. 1, 2, 3. **3s. 6d.** each. By E. N. Bradley. *Postage 4d.*
Servicing Transistor Receivers. F. R. Pettit. **6s.** *Postage 6d.*
Using an Oscilloscope. D. W. Easterling. **6s. 6d.** *Postage 6d.*

Radio Servicing. G. N. Patchett. Vol. 1 **5s.** Vol. 2 **8s. 6d.** Vol. 3 **5s.** Vol 4 **5s.** *Postage 6d. each.* The series covers the syllabus of *City and Guilds* and *R.T.E.B.* examinations.
Electronic Novelties. E. N. Bradley. **5s.** *Postage 6d.*
Electronic Gadgets. E. N. Bradley. **3s. 6d.** *Postage 6d.*
Radio Control of Models. Sommerhoff. **5s.** *Postage 6d.*
Guide to Broadcasting Stations. Twelfth Edition (*Wireless World*) **3s. 6d.** *Postage 4d.*
Radio Valve Data. Sixth Edition. (*Wireless World*). **5s.** *Postage 9d.*
Mullard Circuits for Audio Amplifier. Second Edition. **8s. 6d.** *Postage 1s.*

Dpt. RC • **60 HAYES HILL • HAYES • BROMLEY • KENT** • Telephone HURstway 1818

NEW SURPLUS . . . *BY RETURN*

1L4	3/6	6K8M	9/–	12SK7M	5/–	ECC83	6/6
1R5	6/–	6H6M	2/–	12SQ7M	8/6	ECH42	10/6
1S5	6/–	6L6G	7/–	35Z5GT	8/6	EF36	2/6
2A3	8/6	6L6M	9/–	35Z4G	5/–	EF39	3/6
2X2	2/6	6L7M	8/6	42	7/6	EF50	1/6
3A5	9/–	6Q7G	7/6	50L6GT	9/6	EF50(S)	2/6
3Q4	5/6	6Q7GT	9/–	80	6/6	EF91	3/–
5R4GY	9/6	6SJ7M	5/6	446A	10/6	EL32	3/–
6AC7M	4/–	6SL7GT	5/6	830B	8/6	EL41	9/6
6AK5	5/–	6SN7GT	4/–	959	5/–	EM80	9/6
6AL5	3/–	6ST7M	5/–	1629	4/–	GZ32	10/–
6AM6	3/–	6V6G	7/6	5763	10/6	KT33C	6/6
6AU6	6/–	6X4	5/6	AR8	3/–	PCC85	9/–
6B8G	2/6	12A6M	5/–	DC70	4/–	PCF82	7/6
6BA6	6/–	12AT6	7/–	DET24	10/–	PEN25	4/–
6BH6	5/6	12AU6	7/6	DF73	4/–	PY80	6/6
6BJ6	5/6	12AU7	6/6	DL70	4/–	PY83	7/6
6F32	2/6	12AX7	6/6	EA50	1/6	TT11	3/–
6F6M	5/6	12BE6	7/6	EAC91	3/–	U25	12/6
6J5M	5/–	12C8M	7/6	EAF42	8/6	UAF42	9/6
6J6	3/6	12K7G	5/–	EB91	3/–	VLS631	10/–
6J7G	5/–	12Q7G	5/–	EBC33	5/–	VP23	3/–
6K7G	2/–	12SC7M	2/6	EBF80	7/6	VR150/30	
6K8G	5/–	12SJ7M	5/–	ECC82	5/6		7/6

Post and Packing 6d. per valve. Free over £2

TAPE DECKS—BSR Monardeck. Brand new and boxed, only **£8.10.0** each, plus 3/6 carr.
COLLARO JUNIOR. 4 speed single player with Acos HGP54 turnover crystal pick-up. Brand new boxed, only **£3.10.0** each, plus 3/6 carr.
SPECIAL VALVE OFFER. Any 12 for **£1** (plus 2/6 p.p.). EF91, EB91, EL32, TT11, EF50(S), 6AM6, 6AL5, 6B8G, 6F32, 1626, 1629, 6J6, AR8, VP23, 2X2, 6K7G.

S.A.E. ENQUIRIES

JOHN ANGLIN
385 CLEETHORPE ROAD GRIMSBY LINCS
Telephone 56315

Ask "ARTHURS" First

NOTE NEW ADDRESS AT
125 Tottenham Court Road
London WC1
Close to Warren Street Station

You will have the same service and obtain all your requirements in Radio Components, Electrical Goods, Accessories and Television as previously.

Test Instruments in stock include Avo, Advance, Cossor and Taylor. List on request

VALVE MANUALS AVAILABLE
Mullard 10/6 Brimar No. 8 6/–
Osram Part 1, 2nd Edition 7/6
Post and packing 9d. each extra

Arthurs first Est. 1919

Proprietors ARTHUR GRAY LTD

Gray House
125 Tottenham Court Road
London WC1
Telephone EUSton 5802/3/4

BARGAIN OFFERS *For the Constructor!*

TAPE RECORDER

Manufacturers' brand new, current production offer. Latest 5-valve circuit based on Mullard's famous design. Magic eye level indicator. Volume and tone controls. T.C.C. printed circuit already wired. Only power pack and controls to assemble and wire. Valves EF86, ECC83, EL84, EM84 and EZ80. A sensitive quality recorder at Special Unit Prices.

Wired printed circuit, power pack components, controls and knobs, etc.	**£5.15.0** *P. & P. 2/6*
Set of 5 valves, as above	**£2. 5.0** *P. & P. 1/–*
B.S.R. Monardeck Tape Unit ...	**£8.19.6** *P. & P. 4/6*
Bargain reduction for complete kit	**£16.10.0** *carr. 5/–*
Attractive two-tone cabinet and 9" x 5" speaker to house above at special discount price	**£3. 5.0** *P. & P. 4/6*
Illustrated handbook with full details	**2/6** *post free*
Collaro Studio Tape Deck can be supplied with modified circuit as alternative for approx.	**£5.10.0** *extra*
Cabinet & Speaker to house Collaro Deck	**£3.15.0** *P. & P. 4/6*

RECORD PLAYER BARGAINS

All brand new latest 4-speed Models—fully guaranteed. **Single Players**—B.S.R. (TU9) with "FUL-FI" P.U. **90/–**. Garrard 4 S.P. with GC8 Crystal **£6.17.6.** Garrard TA Mk. 2 with Plug-in GC8 Head **£7.19.6.** Garrard 4HF Transcription Unit **£17.19.6** Carr. 3/6 **Auto Changers.** *New reduced prices.*—B.S.R. (UA8) **£6.15.0.** UA8 Stereo **£7.10.0.** UA14 **£7.19.6.** Collaro Conquest **£7.15.0.** Carr. 4/6.

SPECIAL—NEW RELEASE

Garrard RC210. New 4-speed Autochanger Model with all the latest features and GC8 Plug-in Head, wired for Stereo. Bargain **10 gns.** Carr. 4/6.
EMI 4-speed Single Player with Auto Stop/Start Dual Turnover Cartridge for Stereo and Monaural L.P. and 78—Bargain Buy at **£6.19.6.** Carr. 3/6.

RE-GUNNED TV TUBES

Prices Reduced Again!

New Heater, Cathode and Gun Assembly fitted to all tubes, and now re-screened and aluminised at no extra cost!
12" £5 14" £5.5.0 17" £5.10.0
Mullard and Mazda types ex-stock carr. and ins. 10/– 10/– part exchange allowance on your old tube. 12" tube allowance 5/–

RECORDING TAPE BARGAINS

SPECIAL PURCHASE. Famous American manufacturers. 1st grade tape in brand new sealed boxes.

Standard		Long Play	
5", 600ft ...	**15/–**	900ft	**19/6**
5$\frac{3}{4}$", 900ft ...	**16/6**	1,200ft ...	**22/6**
7", 1,200ft ...	**21/–**	1,800ft ...	**32/–**

Plastic Tape Reels, special offer. Manufacturer's surplus. 3" **2/6**, 5" 3/–, 5$\frac{3}{4}$" **3/3**, 7" **3/6.**

TRANSISTOR PORTABLE

Famous manufacturer's 6 + 1 design based on Mullard and G.E.C. developments. Printed circuit, 6 BVA first grade transistors, XA102, XA101 (2), OA70, XB103, XC101 (2) or equivalents. Quality components only supplied to ensure best results at attractive price.

Set of 6 BVA transistors and diode...	**70/–** P. & P. 6d.
Printed circuit, IF's, osc. coil, driver trans. and ferrite rod aerial	**51/6** P. & P. 1/6
Resistors, condensers, twin-gang, and volume control	**37/6** P. & P. 1/6
7" x 4" quality 35Ω matching speaker	**25/–** P. & P. 1/6
Complete Kit at special offer ONLY ... ... **post free**	**£8 . 19 . 6**
Handbook and circuit details	**2/–** post free

COAX 80-OHM CABLE. Now only **6d.** per yd. High grade low loss. Aeraxial air-spaced Polythene Coax—famous manufacturer—standard $\frac{1}{4}$" diameter bargain prices. 20 yds. **9/–**, P. & P. 1/6; 40 yds. **17/6**, P. & P. 2/–; 60 yds. **25/–**, P. & P. 3/–. Special lengths. Coax Plugs **1/–**. Coax Sockets **1/–**. Couplers **1/3**. Cable end sockets **1/6**. Outlet Box **4/6**.

VOLUME CONTROLS—5k-2 Megohm. ALL LONG SPINDLES, MIDGET TYPE, 1$\frac{1}{8}$" diam. Guar. 1 yr. LOG. OR LIN. ratios less sw, **3/–**. D.P. sw. **4/6**. Twin gang stereo controls log. or linear less sw., **6/6**. With d.p. sw. **8/–**.

CRT. HTR. ISOLATION TRANSFORMERS

New improved types, low capacity, small size and tag terminated, a.c. 200/250V. Secondaries nil, +25%, +50% **BOOST** for 2V, 4V, 6.3V, 10.5V, 12V or 13V tubes. Each type **12/6** each. P. & P. 1/6.

JASON FM TUNER UNIT KITS (87-105 Mc/s)
Standard Model (FMT1)—as previously extensively advertised. **Complete Kit—5 gns.** P. & P. 2/6. Set of 4 spec. valves now only **20/–**.
Model FMT2—attractively presenteds helf mounting unit in enclosed metal cabinet with built-in power supply. **Complete Kit £7.** P. & P. 3/6. Set of 5 spec. valves, **37/6.**
Latest Model—JTV2—Switched Band 1-2-3 AM/FM Unit with AFC. **Kit £12.19.6.** P. & P. 2/6.
Tuner Coil Set, IFs and Ratio Detector, etc., 26/–.
New Jason Comprehensive FM Handbook 2/6, post free. 48-hr. Alignment Service, **7/6.** P. & P. 2/6.

CONDENSERS—Silver Mica. All pref. values, 2pF to 1,000pF, **6d.** each. Ditto ceramics, **9d.** each. Tubulars 450V T.C.C., etc., 0.001-0.01μF and 0.1 (350V, **9d.** each, 0.02–0.1/500V, **1/–** each. 0.25 Hunts **1/6**, 0.5 T.C.C., **1/9**, 0.001 6kV, **5/6**, 0.001kV, **9/6**.
RESISTORS—Full range 10 ohms–10 megohms 20% $\frac{1}{4}$W and $\frac{1}{2}$W **3d.**, $\frac{3}{4}$W **5d.** (Midget type modern rating), 1W **6d.**, 2W **9d.** 10% Hi-Stab. $\frac{1}{4}$W **5d.**, $\frac{1}{2}$W **7d.** 5% $\frac{1}{2}$W **9d.** 1% **HI-STAB.**, $\frac{1}{2}$W **1/6** (10-100 ohms **2/–**).
LOUDSPEAKERS—P.M. 3 ohms, 2$\frac{1}{2}$" E.M.I. **17/6**, 3$\frac{1}{2}$" Goodmans **18/6**, 5" R. & A. **17/6**, 6" Celes. **18/6**. 7" x 4" Goodmans **18/6**, 8" Rola **20/–**, 10" R. & A. **25/–**, 12" Plessey **30/–**, etc.
TYGAN FRET (contemporary pattern)—12" x 12" **2/–**, 12" x 18" **3/–**, 12" x 24" **4/–**, etc.
SPEAKER FRET—Expanded bronze anodised metal 8" x 8" **2/3**, 12" x 18" **3/–**, 12" x 12" **4/6**, 12" x 15" **6/–**, 24" x 12" **9/–**, etc.

VALVES—New Reduced Prices—All Guaranteed

1T4	6/–	DK96	9/–	ECL82	10/6	EZ80/81	7/6
1R5, 1S5	7/6	DL96	9/–	EF80	8/–	MU14	9/–
3S4, 3V4	7/6	EABC80	8/6	EF86	12/6	PCC84	9/6
5Z4	9/–	EF89	9/–	EF91	5/–	PCF80	9/6
DAF96	9/–	ECC85	11/6	EL84	8/6	PCL83	12/6
DF96	9/–	ECL80	10/6	EY51	9/6	PL81	12/6
				EY86	10/–	U25	12/6

TRANSISTORS—BVA 1st grade—ex Mfrs. Mazda XA102, **16/6**; XA101, **14/6**; XC101, **10/6**; OC70, **9/6**; XB102, **10/–**; XA103, **15/–**; XA104, **18/–**; OA70, **2/9**. *Hours 9 a.m.–6 p.m., 1 p.m. Wed.*

TRS Est. 1946

RADIO COMPONENT SPECIALISTS
70 Brigstock Road Thornton Heath Surrey Telephone THO 2188
Terms C.W.O. or C.O.D. Post and Packing up to $\frac{1}{2}$lb, 7d., 1lb, 1/1, 3lb, 1/6, 5lb, 2/–, 10lb, 2/9

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, including address, minimum charge 2s. Trade advertisements will be accepted at 9d. per word, minimum charge 6s. If a Box Number is required, an additional charge of 2s. will be made. Terms: Cash with order. All copy must be in hand by the 12th of the month for insertion in the following month's issue. The Publishers cannot be held liable in any way for printing errors or omissions, nor can they accept responsibility for the bona fides of advertisers.

PRIVATE

FOR SALE: *Q.S.T.* unbound volumes 1950 and 1951, 12s. per volume. Ex-Admiralty Twin Re-entrant speaker, 39s. 6d. New Acos HGP-39-1 L.P. pick-up head, 15s.—Atkins, Holmdale Cottage, South Street, Litlington, Royston, Herts.

FOR SALE: Weyrad Signal Generator 100 kc/s, 70 Mc/s, £9. Wal Bulk Eraser, £4 10s. Jason TV/FMK1 assembled, good working order, £5. Elac 8 x 5in speaker, 12s. 6d.—4 Northcote Place, Newcastle, Staffs.

FOR SALE: VRL 19 valve Communications Receiver. 1.4 Mc/s to 28 Mc/s, calibrator, manual. Tape recorder, twin track, 10 watts, 7½ I.P.S. Offers? Buyer collects.—Morris, 12 Crwys Place, Roath, Cardiff.

FOR SALE: Ready built and tested Heathkit Resistance/Capacitance Bridge with manual. Offers?—Box No. F.123.

FOR SALE: VCR97 Televisor, complete, perfect tube. Needs attention. Ideal for 'scope. £3. Buyer collects.—Marsh, 35 Wandle Road, Hackbridge, Surrey.

ELDERLY ENTHUSIAST, forced to give up, has over £50 worth radio gear and magazines. £21 the lot, carriage paid. Details S.A.E.—York, Niagara, Broadhempston, Devon.

ELECTRONIC ORGAN kit. Nearly completed. Time and space no longer available. Meticulous care taken. Cost £200. Also for sale Taylor Signal Generator, 100 kc/s to 45 Mc/s, £10.—7 Ashurst Close, Goring-by-Sea, Sussex.

AVO VALVE TESTER, manual, adaptors and heater unit complete, £8 10s. Offer for Avo 7.—Mr. Potts, 7 Chedworth House, Geldeston Road, London, E.5.

WANTED: Old books on induction coil construction. —Roberts, 18 Alexandra Drive, Rock Ferry, Cheshire.

TRADE

LEARN RADIO AND ELECTRONICS the NEW Practical way. Very latest system of experimenting with and building radio apparatus—"as you learn". FREE Brochure from: Dept. RC10 Radiostructor, 40 Russell Street, Reading, Berks.

FREE FROM THE I.P.R.E. Syllabus of famous radio and t.v. courses. Membership conditions booklet 1s. Sample copy *The Practical Radio Engineer*, 2s. post free.—Secretary, 20 Fairfield Road, London, N.8.

MORSE CODE TRAINING. Special courses for Beginners. Full details from (Dept. R.C.) Candler System Company, 52 Abingdon Road, London, W.8.

PANL, recognised for many years as the unique one-coat black crackle finish. Brush applied, no baking. Available by post in eighth-pint cans at 3s. 9d. from G. A. Miller, 255 Nether Street, London, N.3.

CATALOGUE No. 14. Government surplus and model radio control, over 500 illustrated items, 2s. (refunded on purchase), p.p. 6d.—Arthur Sallis Radio Control Ltd., 93 (E) North Road, Brighton.

FIND TV SET TROUBLES IN MINUTES from that great book *The Principles of TV Receiver Servicing*, 10s. 6d., all book houses and radio wholesalers. If not in stock, from Secretary I.P.R.E., 20 Fairfield Road, London, N.8.

continued on page 638

TV TUBES

Guaranteed 12 mths.

NEW! Carr. free

12" MW 31-74 etc. £5.5s.
14" MW 36-24 etc. £6.6s.
(limited)
17" CRM 171, 172 ... £8

Also Rebuilt, Rescreened etc. Fully guaranteed.

ALL TYPES BARGAIN PRICES

LINE O.P. TRANS.

for nearly 500 sets.
Examples:
BUSH TV 11, 12 A, B 45/-
MURPHY 114, 116, 118C 45/-
PHILIPS 1114, 1115, 1437 ... ... 65/-
PYE V4, VT4, V7, VT7 ... ... 52/6
Post 2/6

SPECIAL!

Mains Transformers

New ex-equipment 350–0–350V at 80mA. 6.3V at 3 amp. 5V at 2 amp. Famous manufacturer.

ONLY 13/6 ea. P.P. 2/6

NEW OR SURPLUS VALVES

By return — Guaranteed

OZ4	5/–	6SL7	6/3
5U4G	5/3	6SN7GT	5/–
6AM5	3/6	6Q7GT	8/6
6AM6	3/–	6V6G	5/–
6B8G	4/6	7C6	8/–
6CH6	7/–	7H7	7/–
6F1	12/6	10FG	11/6
6F14	15/–	12AT7	5/–
6K7G	2/6	12AU7	6/–
6L6G	7/6	12AX7	6/–
6SC7	7/6	12E1	12/6
6SJ7	7/–	PCC84	7/6
6SK7	6/–	PCF80	7/3

Postage 6d. per valve

VOLTMETER — Pocket size. 0–25V and 0–250V. D.C. Complete with test prods and leather case. 12/6 (P.P. 1/6).
Brand New Guaranteed

Famous B.S.R. U.A.8 RECORD AUTOCHANGER
4 speeds £6.15s. carr. 5/-

COLLARO STUDIO TAPE TRANSCRIPTOR
3 speeds. All controls
BARGAIN at £12.10s. carr. 2/6

Westway Radio (RC) S.A.E. with enquiries: **5 Westward Way Preston Rd. Harrow Middx**

SPARES, VALVES, TUBES—1930-1960

Guaranteed perfect, set tested, ex-working equipment. LOTs from £1. FOTs, Osc. Tr. Def. Coils, etc., cheap. Tubes guaranteed 6 months, FITTED FREE. Picture shown to callers. 9" **30/–**, 12" **50/–**, 14" **60/–**, 17" **70/–**. VALVES—3,000 types stocked. EF50, SP61, **1/–**; EF91, EB91, 6H6, **2/–**; EF80, UF42, 6F1, 20D1, **3/–**; 10F1, 6V6, B36, KT61, **4/–**; PCC84, PCF80, PL81, PL82, PY81, FCL80, PCL83, 6K25, **5/–**; KT33C, 10P14, 10C1, UCH42, **6/–**; EL38, KT36, U22, U35, U281, **7/6**; PL38, PZ30, U24, 20P1, U25, 185BT, **10/–**; U801, 20P4, 27SU, U37, **12/6**. Pre-war 4, 5 and 7 pin, **5/–** each. Postage 6d. Constructor's Parcel—2lb assorted res., cond., pots., etc., from modern TVs, **7/6**, postage 2/6.

Send S.A.E. for list or with enquiries

Photo-electric Burglar Alarm, Garage Door Opener, Light Saver. Mains kit **£4.12.6**; built **£5.10.0.** Send 6d. stamp for details and circuit.

ST. JOHN'S RADIO
156 ST. JOHN'S HILL SW11 *Telephone* BAT 9838

TRADE—*continued from page 637*

SERVICE SHEETS from 1s. Catalogue 6,000 models 1s. Radio/TV spares, Valves. Transistor set kit 10s. S.W. kit 22s. 6d. S.A.E. Lists/enquiries.—Hamilton Radio, 13 Western Road, St. Leonards, Sussex.

ONE VALVE RECEIVER, mains driven, fantastic sensitivity, only 15ft aerial required. Constructional booklet, *The First One*, 1s. 3d. all booksellers; 1s. 6d. direct.—High Fidelity Company, 18 Melville Road, Birmingham 16.

"MEDIUM WAVE NEWS". Monthly during DX season.—Details from B. J. C. Brown, 196 Abbey Street, Derby.

RADIO KITS wired and tested.—Box No. F.122.

YOUR KITS built and tested. First class work. S.A.E. for details.—White, 63 Ashgate Road, Eastbourne, Sussex.

Transistor Components

Superhet AM Feeder Unit or Pocket Receiver only $4\frac{1}{2}$" x 3" x $1\frac{1}{2}$". Total cost **£5.10.0.** Constructor's booklet and circuits **1/9.**

"Weyrad" Transistor Receiver, Long and Medium wave. All components including Cabinet **£8.17.6.** Constructor's booklet 2/–.

"Mighty Atom" Single transistor, Long and Medium (Top-band also) as described in Bernards No. 4 Transistor Circuit Manual.
Circuit and Assembly Drawings 3d.

All components direct from manufacturers
Send S.A.E. for shopping lists.

WESTHAM RADIO SUPPLIES
Rear of 176 Abbotsbury Road, WEYMOUTH, Dorset.

LEARN
RADIO and T.V. SERVICING
for your own business / hobby

by a new exciting no maths system, using practical equipment recently introduced to this country

FREE BROCHURE FROM

RADIOSTRUCTOR
Dept. G103 Reading Berks. 3.61

German Radio Television and Phono Exhibition

Berlin 1961

August 25 to September 3

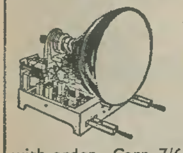
Exhibition ground at the W-Berlin radio tower

Information:
German Tourist Information Bureau
61 Conduit Street, London W 1

NYLON. P.T.F.E.

ROD BAR SHEET TUBE STRIP WIRE
No quantity too small *List on application*
BRASS COPPER BRONZE
ALUMINIUM LIGHT ALLOYS
H. ROLLET & CO LTD
6 Chesham Place SW1 BELgravia 4300
Also at Liverpool Birmingham Manchester Leeds

TV CHASSIS FOR SPARES 5/6



56 resistances, 7 variable controls, 54 condensers incl. electrolytics. Coils, 7 I.F. and R.F. Trans. Mains, output, line and frame Metal rectifier. Transformers. Fuse magnet, chassis I.F. strip separated. Chassis used, but working when stored. Six-page circuit with order. Carr. 7/6. Less Tube and Valves

10,000 valves from **9d.** to **7/9.** Salvage guarantee.

SEND FOR **FREE** *LIST* **TODAY**

P. P. COMPONENTS LTD.
219 ILFORD LANE ILFORD ESSEX
Stamp for FREE Catalogue.

Red Spot Transistors, **3/-**; White Spots, **3/-**; Yell./Gr., **3/6** Ediswan XA102, **12/-**; XA104, **10/-**; XA103, **10/-**; XA101, **10/-**; XB103, **9/-**; XB104, **8/-**; XC101, **10/-**; **Special Bargain set** for P.W. Superhet 6 Transistors (1-XA102, 2-XA101, 1-XB103, 2-XC101), plus Diode, **55/-**; Newmarket V15/10 P, **15/-**; Diodes, **1/-**; **2/6**; **4/-**. Transistor holders, **1/-**; Ardente Trans. D239, **8/6**; D240, **8/6**; D131, **10/-**; D132, **10/-**; Sub. Min. Electrolytics (15V) 2, 4, 8, 10, 25,50, 100 mfd., **3/-**; 32 mfd., **2/9**; P.W. Superhet, complete kit, **£9.17.0.** M.C. Earpiece (used as speaker), **5/-**; Balance Inserts (as earpiece or speaker), **2/6.** Silicon Rectifier bargain 70 p.i.v. ½ amp., **3/3;** Westalite Contact Rectifier 250V, 60mA, **7/6**; Transformer 250-0-250V, 6V and 5V, **15/-**; 6V, Vibrator Pack, 120V, 60mA, out, **12/6**;
TERMS.—Cash with order. Post extra, excess refunded. Morco Reflex Rx, best 2-transistor Receiver. Send 8d. stamps for notes.

MORCO EXPERIMENTAL SUPPLIES
8 & 10 Granville Street, Sheffield 2
Telephone 27461

QUALITY COMPONENTS **FOR CONSTRUCTORS**

capacitors, resistors, coils, valves, diodes, controls, chassis, transformers, speakers, pick-ups, cartridges, stylii and all types of components in stock.

1961 Catalogue Available on Request
Please send 6d. stamp for postage

CONSTRUCTIONAL PUBLICATIONS

Mullard Circuits for Audio Amplifiers ...	8/6
Mullard Tape Pre-amp "C"	2/6
Quality Amplifiers, 7 designs	4/6
Jason F.M. Variable Tuners	2/6

Price lists available on request

J. T. FILMER **82 DARTFORD ROAD DARTFORD KENT**
Telephone Dartford 24057

H.A.C. THE ORIGINAL SUPPLIERS OF SHORT-WAVE KITS

One valve Super Sensitive All-dry Short-wave Receiver Model "K". Complete kit including valve and chassis **77/–.** (Other S.W. kits from **25/–.**) Before ordering call and inspect a demonstration receiver, or send stamped envelope for full specification, catalogue and order form.

H.A.C. SHORT-WAVE PRODUCTS (DEPT. R)
44 OLD BOND STREET LONDON W1

TRANSFORMERS

Suppliers to B.B.C., I.T.A. and leading radio manufacturers, single or long runs, prompt delivery, home and export.

rewinds to all makes

FORREST TRANSFORMERS LTD
Shirley, Solihull, Warwickshire
Telephone SHIrley 2483

"GLOBE-KING"

WORLD-FAMOUS KITS AND RECEIVERS

for the Radio Amateur and S.W. Listener. Catalogue Free, enclose stamp for postage. Kits from **79/6** obtainable at your dealers or direct from sole manufacturers.

JOHNSONS (Radio)
ST. MARTINS GATE — WORCESTER

RADIO AMATEURS . . .

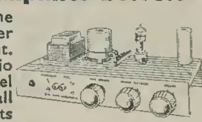
get your Licence in
Half The Usual Time!

You *must* be a good Morse operator!
A "slap-dash" 12 w.p.m. neither satisfies the authorities, yourself, nor your operator friends. Morse operating is an exacting art unless your training is made simple and is based on sound fundamentals. For this reason the Candler System was invented to take the "grind" out of Code tuition, turning a tricky subject into a pleasurable pursuit.

★ *Send 3d. stamp for the "Book of Facts"*

CANDLER SYSTEM CO
(Dept. 55 RC) 25b Abingdon Rd., London, W8
Candler System Company, Denver, Colorado, U.S.A.

Tape Recorder Amplifier £3.15.0



New modified circuit of the well tried D.W. amplifier "B" $3\frac{1}{2}$ watts quality output. Separate mic. and radio inputs. Latest EM84 level indicator. Suitable for all decks. Prices: Kit of parts for complete record playback amplifier, **£3.15.0.** Power pack, **35/–.** 4 valves, **35/–.**

Resistors, condensers, and small components. Comprehensive range. S.A.E. for lists.

WISEMAN'S
21a Ancaster Road Beckenham Kent

Published in Great Britain by the Proprietors and Publishers
Data Publications Ltd 57 Maida Vale London W9
Printed by A. Quick & Co. (Printers) Ltd Oxford Road Clacton-on-Sea England
Obtainable abroad through the following Collets Subscription Service Continental Publishers & Distributors Ltd
William Dawson & Sons Ltd *Australia and New Zealand* Gordon & Gotch Ltd Electronics Publications (Australia)
South Africa Central News Agency *Holland* "Radio Electronica"
Registered for transmission by Magazine Post to Canada (including Newfoundland)