# PRACTICAL WIRELESS

DECEMBER 1963

2/-

**FREE inside!**

DOUBLE-SIDED

**BLUEPRINT**

*TO BUILD*

*CRYSTAL-CONTROLLED*

**SHORT WAVE TRANSMITTER**

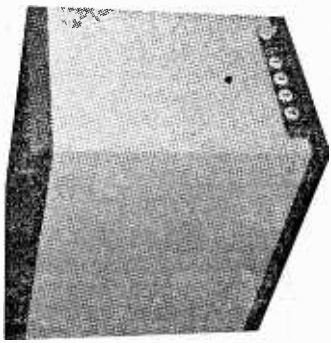
10 watts c.w.

Two-knob tuning

Simple aerial matching

160,80,40 and 20m bands

# THE R.S.C. BASS-MAJOR 30 WATT GUITAR AMPLIFIER



**A MULTI-PURPOSE HIGH FIDELITY, HIGH OUTPUT UNIT FOR VOCAL AND INSTRUMENTALIST GROUPS**

**Equally suitable for bass lead or rhythm guitar**

- ★ Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in. diameter speech coils. Designed for efficiently handling full output of amplifier at frequencies down to 25 c.p.s.
- ★ Dual Cone in second speaker reproduces frequencies up to 17,000 c.p.s.
- ★ Heavily made cabinet of convenient size 24 x 21 x 14in. has an exceptionally attractive covering in two contrasting tones of Vynair.
- ★ For 200-250 v. to 50 c.p.s. A.C. mains operation.
- ★ Four jack socket inputs and two independent vol. controls for simultaneous connection of up to four instrument pick-ups or microphones.
- ★ Separate bass and treble controls providing more than adequate "Boost" or "Cut".
- ★ LEVEL frequency response throughout the audible range.
- ★ SUPERIOR TO UNITS AT TWICE THE COST.

**39½ Gns.** Send S.A.E. for leaflet. OR DEPOSIT of £4.3.0 and 12 monthly payments of £3.9.11. Carr. 17/6.

**R.S.C. JUNIOR GUITAR AMPLIFIER** 5-watt high quality output. Separate bass and treble "cut" and "boost" controls. Sensitivity 15 m.v. Two high impedance inputs. 10in. loudspeaker. Handsome, strongly made cabinet (size 14 x 14 x 7in. approx.) finished in attractive and durable polychrome. 200-250 A.C. mains operation. **£8.19.6** Or DEPOSIT £1 and 9 monthly payments of £1. Carr. 7/6.

**LINEAR TREMOLO/PREAMP. UNIT** Designed for introducing the Tremolo effect to any amplifier which is fitted with a reserve power supply point for smoothed H.T. and 6.3 v. A.C. L.T. This applies to practically all amplifiers of our manufacture, and to those of several other manufacturers. The unit plugs into power supply point and any input socket of amplifier. Controls are Speed (frequency of interruptions), Depth (for heavy or light effect), Volume and Switch. Three sockets are for two inputs and Foot Switch. ONLY **4 Gns.**

**R.S.C. SENIOR Guitar Amplifier** 14 watt high-fidelity push-pull output Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-up can be used at the same time. Two loudspeakers are incorporated, a 12in. high flux 14 watt bass unit, and a 6 x 4in. elliptical for treble. Cabinet is well made and finished as Junior Model. Size approx. 18 x 18 x 8in. Only **16 Gns.** Carr. 10/- Send S.A.E. for leaflet. Or DEPOSIT 37/- and nine monthly payments of 37/-.

## R.S.C. B20 BASS GUITAR AMPLIFIER

A highly efficient unit incorporating a massive 15in. high flux loudspeaker specially constructed to withstand heaviest load conditions. Rating 25 watts. Individual bass and treble controls give ample "boost" and "cut". Two high impedance jack socket inputs are separately controlled. All controls are conveniently positioned in a recesson top of the cabinet. Cabinet is of substantial construction and attractively finished in two contrasting tones of Rexine and Vynair. Size approx. 24 x 21 x 13in. Operation from 200-250 v. 50 c.p.s. A.C. mains.

Send S.A.E. for leaflet.

**29½ Gns.** Or Deposit £3.2.0 and 12 monthly payments of 56/10. Carr. 17/6.

# DERBY

NOW OPEN AT 26 Osmaston Road THE SPOT

**TRANSISTOR SALE.** Mullard OC71 3/9, OC45 4/11, OC44 4/11, OC72 4/9, OC81 4/11, OC171 8/9, Ediswan XA101 3/9, XB102 3/9, XA112 3/9, XB113 3/9, XB104 3/9, XC101A 3/9. Postage 6d. for up to 3 Transistors.

**D.C. SUPPLY KIT.** 12 v. 1 a. consisting of a partially drilled metal case, mains trans., F.W. Bridge Rectifier, 2 fuseholders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable for Electric Trains. Limited number available at 29/11.

**SELENIUM RECTIFIERS**

| F.W. BRIDGE | | | |
|---|---|---|---|
| 6/12 v. 1 a. | .. 3/11 | 24 v. 2 amp. | .. 14/9 |
| 6/12 v. 2 a. | .. 6/11 | 24 v. 20 amp. | .. 89/9 |
| 6/12 v. 3 a. | .. 9/9 | H.T. TYPES H.W. | |
| 6/12 v. 4 a. | .. 12/3 | 150 v. 40 mA | .. 3/9 |
| 6/12 v. 6 a. | .. 15/3 | 250 v. 50 mA | .. 3/11 |
| 6/12 v. 10 a. | .. 26/9 | 250 v. 60 mA | .. 4/11 |
| 6/12 v. 15 a. | .. 35/9 | 250 v. 80 mA | .. 5/11 |
| | | 250 v. 250 mA | .. 11/9 |

**CONTACT COOLED.** 250 v. 75 mA. F.W. (Bridge), 10/11. 250 v. 50 mA, F.W. (Bridge), 8/11. H.W. 250 v. 60 mA. 5/11.

**HI-FI 10-WATT AMPLIFIERS.** Brand New Complete Units. **£7.19.9** Carr. 5/6. Manufacturers' discontinued Model. Push-Pull output. Latest high efficiency valves. Dual separately controlled Inputs for "Mike". Separate Bass and Treble Controls. High sensitivity. Output for 3 or 15 ohm speaker. Guaranteed tested and in perfect working order.

**HUGE PURCHASE OF BRAND NEW 24 v. 20 Amp. F.W. (Bridge) SELENIUM RECTIFIERS.** each **49/9**

**HEAVY DUTY LOUDSPEAKERS IN SUBSTANTIAL REXINE COVERED CABINETS.** Type BG1. Suitable for Bass Guitar. Speaker Unit 15in., High Flux, 15 ohms, 25 watts. Cabinet size approx. 24 x 21 x 13in. Only **19½ Gns.** Or Deposit 42/- amd 12 monthly payments of 34/9. Type BG2. Suitable for Bass Guitar. Super Sensitive, 15in. 15 ohms high flux speaker. Cabinet size approx. 30 x 21 x 14in. Attractive covering of two contrasting tones of Rexine and Vynair. Rating 50 watts. Only 29 gns. Or Deposit £3.7.6 and 12 monthly payments of 50/-.

Type BG3/2. Suitable Bass and Lead Guitar. Two 12in. high flux 15 ohms 25 watt speakers, one with aluminium speech coil and dual cone to provide smooth frequency response from 25 to 17,000 c.p.s. Cabinet size approx. 30 x 21 x 14in. Covered in two contrasting tones of grey Vynair and Rexine. Rating 50 watts. Only 29 gns. Or Deposit £3.7.6 and 12 monthly payments of 50/-.

**LARGE REXINE COVERED SPEAKER CABINETS.** Heavy blockboard construction. Very attractive two tone covering of Rexine and Vynair. Size 30 x 21 x 16in. cut for 15in. or 18in. speaker or for two 12in. 11 gns. or Deposit 25/9 and 9 monthly payments 25/9. Size 30 x 30 x 16in. cut for 15in. or 18in. speaker 13 gns. or Deposit 30/4 and 9 monthly payments 30/4. Suitable speakers available.

**FANE EXTRA HEAVY DUTY LOUDSPEAKER 15in. TYPE 153.** 40 watts. Total flux 375,000 lines. Extremely high sensitivity. 15 ohm voice coil. Only 18 gns. or Deposit 35/- and 12 monthly payments 35/-.

**FANE EXTRA HEAVY L/SPEAKER 183.** 18in., 15 ohms, 60 watts, 3in. diam. Speech Coil. Total Flux 375,000 lines. High sensitivity. ONLY 25 gns. or Deposit 52/9 and 12 monthly payments of 43/-. Send S.A.E. for leaflet on 153 and 183.

**EX. GOVERNMENT ACCUMULATORS.** Size 7¾ x 4 x 2in., 2 v. 16 A.H. brand new. 6/9 each, 3 for 15/6.

**EX. GOVT. SMOOTHING CHOKES.** 200 mA. 3-5 H, 50 ohms. Parmeko 8/9; 150 mA. 10 H, 50 ohms 9/9; 80 mA. 20 H, 900 ohms 5/9; 120 mA, 12 H, 100 ohms 8/9; 50 mA. 50 H, 1,000 ohms 6/9; 100 mA. 10 H, 100 ohms 6/9; 60 mA, 5-10 H, 250 ohms 2/11.

**COMPLETE POWER PACK KIT, 19/11** Consisting of Mains Trans., Metal Rectifier. Double electrolytic. smoothing choke chassis and circuit. For 200-250 v. A.C. mains. Output 250 v., 60 mA, 6.3 v., 2 a.

**R.S.C. POWER PACK, 39/9.** Louvred metal case only 8 x 5½ x 2½in. Stove enamelled. For 200-250 v. A.C. mains. Output at 4 pin plug and socket 250 v. 60 mA, fully smoothed and 6.3 v. 2 a. Suitable for power requirements of almost any Pre-amp. or Radio Tuner.

**R.S.C. BABY ALARM or INTER-COMM. KIT.** Complete set of parts with diagrams, etc. Housed in two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250 v. A.C. mains. Fully isolated. Controllable at both units. An Intercomm. of this class would normally cost £20-£30. Only 89/6, carr. 5/- or assembled ready for use 6 gns.

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

**R.S.C.** (Manchester) Ltd.

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

**LEICESTER** 32 High St. Half-day Thursday

**BIRMINGHAM** 6 Gt. Western Arcade (Opp Snow Hill Sta) No half-day

**SHEFFIELD** 13 Exchange St. Castle Market Bldgs. Sheffield Half-day Thursday

**HULL** 51 Savile St., Hull

**LIVERPOOL** 73 Dale St. Liverpool 2

**BRADFORD** 56 Morley St. (above Alhambra Theatre) Bradford Half-day Wednesday

**MANCHESTER** 8-10 Brown St. (Market St.) Manchester 2 No half-day

**LEEDS** 5-7 County (Mecca) Arcade Briggate, Leeds Half-day Wed.

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

**REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR** Incorporating the latest Collaro Studio Tape Transcriptor. The audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 14½ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets **TERMS. Deposit £2.13.9** and 12 monthly payments of **44/-**. Cash price if settled in 3 months.

## HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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

Two input sockets with associated controls allow mixing of "mike" and gram., as in A.10 High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 db. 30-30,000 c/s. Six negative feedback loops. Hum level 60 db. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs for **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, LEAD OR RHYTHM GUITARS,** etc. **OUTPUT SOCKET** with plug provides 300 v. 30 mA, and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/- extra.) If required louvred metal cover with 2 carrying handles can be supplied for **18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9** and 9 monthly payments of **24/9.** Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Microphones, etc., with cash and credit terms.

**LINEAR TAPE PRE-AMPLIFIER. Type LP/1, Switched Negative feedback equalisation. Positions for Record 1¾in., 3¾in., 7½in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9 gns. S.A.E. for leaflet.**

**ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS**

**HI-FI CRYSTAL PICK-UP HEADS.** (Cartridges.). Acos Standard replacement for Garrard, B.S.R. and Collaro, **16/9.** Acos Stereo-Monaural, **29/9.** Ronette Stereo-Monaural **59/6.** B.S.R. Stereo **39/9.**

**BRADMATIC RECORDING HEADS.** High Impedance: Record/Playback **22/-.** Low Impedance Erase, **12/6.**

**MARRIOTT RECORDING HEADS.** High Impedance, Record/Playback **15/-.** Low Impedance, Erase, **10/-.**

**PICK-UP ARMS.** Complete and with latest Acos/hi-fi Turnover Cartridge **29/11.**

**CRYSTAL MICROPHONES.** Hand type NP110 **14/9,** R.T.C. **19/9,** Acos Mic 40 **25/9,** Acos Mic 45 **29/9,** Stick type Acos 39-1 **39/9,** BM3 with neck band and heavy table stand **59/9.** Lapel type **35/9.**

**COLLARO JUNIOR** 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only **£3.19.6.**

**B.S.R. UA14 4-sp'd AUTO-CHANGERS** with hi-fi turnover head, **£6.19.6.** Carr. 4/6.

**GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER** with high fidelity pick-up. Latest model. For 200-250 v. A.C. mains, **£7.19.6.** Carr. 4/6.

**GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTOCHANGERS.** Turnover GC8 head, for 200-250 v. A.C. mains, **£11.9.0.**

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

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

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

A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. Ganged Bass and Treble Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10-watt amplifier. Valve line-up ECC83, ECC83. EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-. Kit can be supplied assembled ready to use for **59/6** extra.

## SENSATIONAL STEREO OFFER

A complete set of parts **(4 Gns.)** to construct of a good quality Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. Stereo Pick-up Head **19/9** extra with above only.

**SOLDERING IRONS.** 230-250 v. 30 watts. First quality. For Radio work, **18/9.** Spare elements and bits available.

## R.S.C. BATTERY CHARGING EQUIPMENT

**All for A.C. Mains 200-250v., 50 c/s. Guaranteed 12 months.**

**Assembled 4-5amps 6/12 v.**

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

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

**BATTERY CHARGER KITS** Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders. Grommets, panels, Heavy Duty Clip, circuit. Carr. 3/6 extra.
6 v. or 12 v. 1 amp..... **22/9**
As above, with Ammeter **28/9**
6 v. 2 amps..... **19/9**
6 v. or 12 v. 2 amps..... **25/9**
6 v. or 12 v. 2 amps, inclusive of Ammeter..... **35/9**
6 v. or 12 v. 4 amps..... **45/9**
6 v. or 12 v. 4 amps, with Ammeter and variable charge rate selector..... **52/9**

**CHARGER AMMETERS** 0-1.5 a., 0-3 a., 0-4 a., 0-7 a., 0-60 a. **8/11.**

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

## R.S.C. MAINS TRANSFORMERS

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

**TOP SHROUDED DROP THROUGH**

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

**FULLY SHROUDED UPRIGHT**

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

**FULLY (GUARANTEED)**

**FULLY SHROUDED (continued)—**

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

**OUTPUT TRANSFORMERS**

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

Following types for 3 and 15 Ω speakers:

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

**MIDGET MAINS** Primaries 200-250 v. 50 c/s. 250v. 60mA, 6.3v. 2a .. .. .. 11/9
250-0-250v. 60mA, 6.3v. 2a .. **12/11**
Both above size 2½ x 2½ x 2½in.

**FILAMENT TRANSFORMERS**

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

**SMOOTHING CHOKES**

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

**CHARGER TRANSFORMERS**

All with 200-230-250v. c/s Primaries: 0-9-15v. 1a, **12/9;** 0-9-15v. 2a, **14/9;** 0-9-15v. 3a, **16/9;** 0-9-15v. 5a, **19/9;** 0-9-15v. 6a, **23/9;** 0-9-15v. 8a, **28/9.**

**AUTO (Step up/Step down) TRANS.** 0-110/120-230/250v. 50-80 watts, **13/9;** 250 watts, **39/9;** 150 watts, **27/9.**

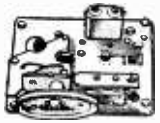
**MICROPHONE TRANSFORMERS** 120 : 1 high grade, clamped, **8/9.**

## SPECIAL PURCHASE! TURRET TUNERS

by famous maker

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

## F.M. TUNER HEAD



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

## GORLER F.M. TUNER HEADS

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

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

FURTHER HUGE PURCHASE enables us to offer these 67/6 P. & P. at 4/6.

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

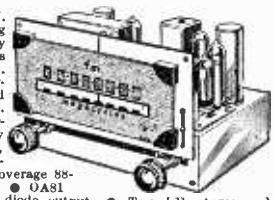
## RECORD PLAYER AMPLIFIER

2 valve (EZ80. ECL82), A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7in. w. x 2¼in. d. x 5¼in. h. 55/-. P. & P. 3/-. Suitable speakers: 6in. 15/-. P. & P. 1/6. 10 x 6in., 25/-. P. & P. 1/6.

## SPEAKER & CABINET FABRICS

Oatmeal, Red and Gold fabrics and various patterns in Vynair and Tygan for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard. OUR PRICE 13/6 per yard length, plus P. & P. 1/6. (Minimum order 1 yard) Send S.A.E. for samples

## HARVERSON'S F.M. TUNER Mk.I



● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● QA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5¼in. ● All parts sold separately. Set of parts if purchased at one time £5.19.6, plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye, front panel and brackets, £6.12.6. P. & P. 8/6.

**Mark III Version** as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6. **Handsome Metal Cabinets.** Choice of Grey, Black or Green. To fit Mark I, 25/-. P. & P. 2/6. To fit Mark II, 17/6. P. & P. 2/6.

## 6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 waveband transistor superhet. ● Printed circuit panel (size 8½ x 2¼in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.

**All parts sold separately.** Set of parts if purchased at one time.

**ONLY £4.5.0** P. & P. 2/6

## 35 OHM SPEAKERS

*Suitable for use with above.* 2in. Goodmans. Ideal replacement for most pocket portables 8/6; 2½in. 10/6; 3½in. 12/6; 5in. 17/6; 7 x 4in. 21/-, P. & P. 1/6 per speaker.

## Portable CABINET

Size approx. 9½ x 6¾ x 3½in. Suitable for above using 3½in. peaker, 25/-. P. & P. 2/-.

## COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

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

## QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker.

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

DITTO. Mounted on board with output transformer and 6in. speaker.

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

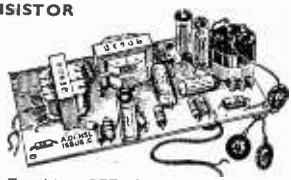
## QUALITY PORTABLE RECORD PLAYER

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.

**PRICE £3.9.6.** Carr. 5/-.

## HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT

Type TA1

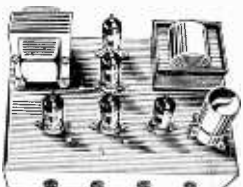


● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or S1 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.

**SPECIAL PRICE 45/-** P. & P. 2/6.

Also ready built and tested, 52/6. P. & P. 2/6. A pair of TA1's are ideal for stereo.

## 10/14 WATT HI-FI AMPLIFIER KIT



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

**All parts sold separately.** ONLY **£6.19.6** P. & P. 6/6. Also available ready built and tested complete with input jack pluge, **£8.15.0** P. & P. 6/6.

## BRAND NEW 3 OHM LOUDSPEAKERS

2½in. 12/6; 5in. 12/6; 6½in. 15/-; 8in. 21/-; 10in. 25/-; 12in. 27/6
E.M.I. 2½in. tweeter .. 10/6
8in. x 5in. By famous maker .. .. .. 10/6
E.M.I. Ceramic Magnet 13½in. x 8½in. high flux .. 36/-
Rola Celestion approx. 9in. x 6in. middle register speaker 10/6
10in. x 6in. .. .. .. 26/-
also 15 ohm 12 inch, 30/-
P. & P. up to 6in. 1/6; over 6in. 2/6 per speaker.

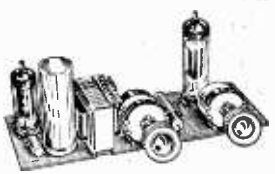
## AMPLIFIER CARRYING CASES

BRAND NEW

Strongly made wooden construction, tough vynide covered, complete with carryng handle. Overall size 13½in. wide x 9in. deep x 8in. high with sloping front panel. Weight only 4½ lbs. Ideal for our 10/14 watt amplifier and many others.

BARGAIN PRICE P. & P. 4/-. **28/6**

## AMPLIFIER ON PRINTED CIRCUIT BOARD



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

## B.S.R. AUTO UNITS

160 v. Suitable for use with above. (Slightly soiled.) £4.4.0.

**LARGE CABINET** Complete with 3 ohm speaker. £3.9.6. Carr. 5/-

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

## BARGAIN CORNER ! !

**ACOS CRYSTAL MIKES.** High imp. For desk or hand use. High sensitivity, 18/6. P. & P. 1/6.

**TSL CRYSTAL STICK MIKE.** Listed at 45/-. Our price 18/6. P. & P. 1/6.

**CARBON MIKE INSERTS.** Brand new, 2¼in. dia., 3/6. P. & P. 9d.

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

**MIDGET 2-GANG CONDENSERS.** Capacity 195 and 100 pF. Polystyrene case with built-in trimmers. Size ¾ x ¾ x ¼in. Not used but removed from P/C boards. Two for 9/-, plus 1/- P. & P.

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

**3 PUSHBUTTON TRANSISTOR SWITCH.** D.P.—D.T. Each switch 5/6 and 1/- P. & P.

**MAINS TRANSFORMER**

Drop thru' type. Tapped primary 110v., 200v., 220v., 240v. 320-0-320v. at 80mA and 6.3v. at 3 amps. Generous core. Stock size 3¾ x 2¾ x 1¾in. Weight 4lbs. ONLY 15/-. P. & P. 3/6.

**MAINS TRANSFORMER**

Tapped Primary. ½ wave or Bridge Rectifier. Secondary 250v. at 75mA 6.3 volts at 2 amps. 10/6 each. P. & P. 3/-.

**MAINS TRANSFORMER**

Impregnated and fully shrouded. Size 4½ x 3¼ x 2¾in. Weight 6 lbs. Tapped primary 205, 225, 245v. Electrostatic screen. Output 360-0-360v. at 120mA D.C. plus 1050v. half wave at 3mA D.C. 6.3v. at 3.5 amps, centre tapped 5v. at 2½ amps and 6.3v. at .6 amps. PRICE ONLY 21/- each. P.P. 5/-.

**4-WAY NON-TANGLE TELEPHONE CABLE**

Latest spring back coil type, extends 12in. to 5ft. Complete with rubber bushes. 3/6 each. P. & P. 1/-.

◀ LOOK OPPOSITE FOR MORE BARGAINS

# HARVERSON SURPLUS CO. LTD.

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

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

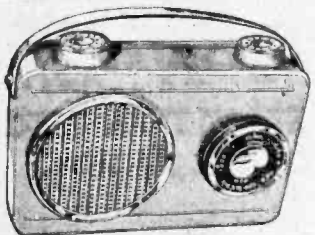
*A few minutes from South Wimbledon Tube Station.* *(Please write clearly)*

**PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.** (S.A.E. ALL ENQUIRIES)

# PORTABLE TRANSISTOR RADIOS

## BACKED BY SUPER AFTER SALES SERVICE

## ROAMER SIX



● 8 stages-6 transistors and 2 diodes.

Listen to stations half a world away with this 5 waveband portable. Tunable on Medium and Long waves, Trawler Band and two Short waves. Sensitive ferrite rod aerial and telescopic aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings Size 6½ x 4½ x 1½in.

Total cost of all parts now only **£4.19.6** P. & P. 3/6.

*Parts Price List and easy build plans 3/-.*

## TRANSONA SIX NEW!

● 8 stages—6 transistors and 2 diodes.

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade powerful magnet 3in. speaker makes listening a pleasure. Push pull transformers for ample power. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6½ x 4½ x 1½in. (Uses PP4 battery available anywhere). (Carrying strap 2/-ex.)

Total cost of all parts now only **59/6** P. & P. 3/6

*Parts Price List and easy build plans 1/6*

## ROAMER SEVEN Mk III

● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves, Trawler Band and two Short Waves to approx. 17 metres. Push-pull output for room filling volume from rich toned heavy duty 5in. speaker. Ferrite rod aerial for M & L waves and telescopic aerial for S Waves. Air spaced ganged tuning condenser ensures wonderful station selection. Simulated hide case with gilt trim and shoulder and hand straps. Size 9 x 7 x 4in. approx. **The perfect portable and the ideal car radio.** (Uses PP9 battery available anywhere.)

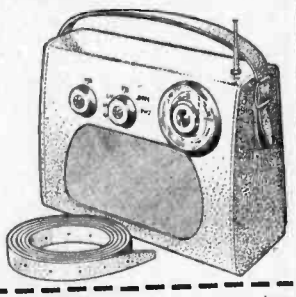
## 5 WAVEBAND PORTABLE OR CAR RADIO

*Amazing performance and specification*

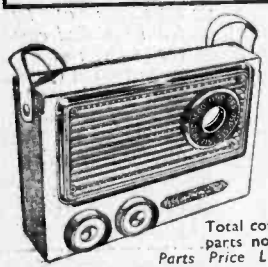
Total cost of parts now only

**£5.19.6** P. & P. 5/6

*Parts Price List and easy build plans 3/-.*



## SUPER SEVEN



● 9 stages—7 transistors and 2 diodes

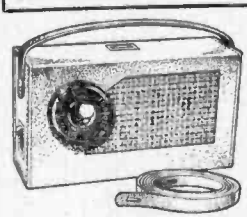
Covers Medium and Long Waves and Trawler band. The ideal radio for home, car or can be fitted with carrying strap for outdoor use. Completely portable—has built in aerial for wonderful reception. Special circuit incorporating 2 R.F. stages, push pull output, 3in. speaker (will drive larger speaker). Size 7½ x 5¼ x 1¼in. (Uses PP6 battery available anywhere.)

Total cost of all parts now only **£3.19.6** P. & P. 3/6

*Parts Price List and easy build plans 2/-.*

## MELODY SIX

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



● 8 stages—6 transistors and 2 diodes.

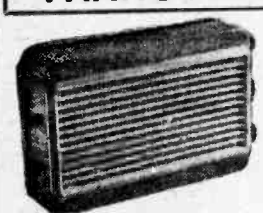
Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather look pocket size case, only 6¾ x 3¾ x 1¼in. approx., with gilt speaker grille and supplied with hand and shoulder straps.

Total cost of all parts only **£4.9.6** P. & P. 3/-.

*Parts Price List and easy build plans 2/-*

## TRANSONA FIVE

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



● 7 stages—5 transistors and 2 diodes.

Fully tunable over medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic speaker, etc. Attractive case. Size 6½ x 4½ x 1¼in. with red speaker grille. (Uses 1289 battery available anywhere).

Total cost of all parts now only **42/6** P. & P. 3/6.

*Parts Price List and easy build plans 2/-*

## POCKET FIVE

● 7 stages—5 transistors and 2 diodes.

Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round super-sensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5½ x 1½ x 3½in. (Uses PP4 battery available anywhere).

Total cost of all parts now only **42/6** P. & P. 3/-.

*Parts Price List and easy build plans 1/6*

***All components used in our receivers may be purchased separately if desired. Parts price lists and easy build plans supplied free with sets of parts or available separately at prices stated.***

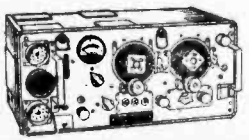
## Radio Exchange Co.

27 HARPUR STREET, BEDFORD

Phone 2367 ● Opposite Co-op. ● 10—1 p.m. Sats.

## NEW! 1 mA PANEL METER—CLEAR PLASTIC WITH PANEL LIGHT 35/-

### No. 19. 2-8 Mc/s TRANSMITTER RECEIVER



This most famous Army Trans/Receiver covers 2-8 Mc/s (150-37 metres in two bands). Has an intercom, amplifier. Designed for 12 and 24 volt operation but supplied with "P.W." Mains conversion details. Uses a 6 valve superhet receiver, I.F. being 465 Kc/s, and a 6 valve transmitter designed for voice and C.W. operation. Incorporates test and tuning meter for voltages, aerial loading and current tests. Panel Controls: Frequency tuning, P.A. tuning, Gain control, MCW CW, R/T switch. Het-tone netting. Off-on Quench aerial, AVC LT-HT—Drives tests. Supplied complete with instructions book.

NOW ONLY **55/-** Carr. paid.

**12ft. WHIP AERIAL (U.S.A.), 10/-.**

### SIGNAL INJECTION PROBE ITI.I.

Push button operation. Ideal for making rapid checks on radios, TV, Amps tuners, etc. PRICE **42/6**

### AUTOMATIC SOLDERING IRON SF.I.

30 watt. First in the country that feeds solder automatically. Easy one hand action, lightweight and extremely robust, gives you a third hand. Tip and solder are replaced at the exact spot needed, any required amount of solder can be automatically fed to the tip by adjustable feed roller. Standard A.C. mains. Fully guaranteed.

ONLY **52/6**

### PORTABLE HIGH-FIDELITY RADIOGRAM MODEL RP.200

Now you can have the best of both worlds: a super sensitive and highly selective radio combined with a high fidelity record player housed in a luxury two-tone washable case. Plays any records up to 12in. at 16, 33⅓, 45 or 78 r.p.m. Has turntable adaptor for 45 r.p.m. records as well as rubber turntable mat to protect your records. Lightweight pick-up arm has turnover cartridge with individual sapphire styli for LP's or 78's. Expertly designed amplifier and high-fidelity speaker provide faithful sound reproduction from radio or records. On/off Volume Control; 200/250 v.; Size 8½ x 15 x 4½in. Choice of two-tone grey or two-tone beige.

PRICE **£18.6.0**

S.A.E. for leaflet.

### HAWAIIAN PORTABLE RECORD PLAYER Model HN707

Uses a unique pick-up unit, turntable and special speaker to give amazing volume and reproduction without the use of valves or transistors. Battery operated, plays up to 12in. records at 33⅓ or 45 r.p.m. Separate fine speed and volume controls, 45 r.p.m. adaptor and stroboscope. Durable plastic cabinet, fully waterproof with carrying handle and record storage compartment. Size 9in. dia. x 3½in. deep. Weight 2 lb. 9 oz.

SPECIAL OFFER NOW ONLY **£5.19.6**

### MM4 4-CHANNEL TRANSISTORISED MICROPHONE MIXER

Add musical highlights and additional sound effects to your recordings. The MM-4 permits mixing of four signals such as microphone, records, tuner etc. into a single output. Inputs and output take standard plugs. Fully transistorised and self-contained in handsome case.

PRICE ONLY **59/6**

### MINIATURE PORTABLE TAPE RECORDER MODEL TC601

★ Fully transistorised.
★ Dual track.

★ Combined microphone/speaker.
★ Size only 10½" x 3⅝" x 2⅝".

Completely portable, self-contained, full function miniature tape recorder utilising advanced transistor circuitry with 4-transistor push-pull output stage to give you quality reproduction you would only expect from units three times the price. Simple control for rewind/stop/playback/record, and variable volume control. Attractive tan and gold high impact poly-vinyl case with transparent snap on plexiglass top enabling unit to be operated with top in position. Complete with dual purpose microphone/speaker, 200 ft. of tape, batteries and instruction book.

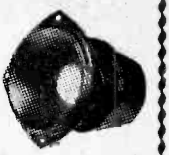
PRICE **£8.19.6**

### LEAD ACID ACCUMULATORS

(Unspillable).

2 volts 16 A.H. Brand new. Size 4in. x 7in. x 2in. Six for 20/- (min.). (2/6 each for callers).

### CT.10 HORN TWEETER



For true high fidelity reproduction of the upper, middle and top frequency ranges in multi-unit speaker installations. Pressure unity type utilizing a spun aluminium diaphragm. Output 10 watts. Frequency response 1500-18000 c.p.s. Impedance 16 ohm. Finished in matt black, flanged and drilled for baffle mounting. PRICE **29/6**

### RELDA EXCLUSIVE!!! 100,000 O.P.V. MULTI-TESTER

**MODEL EP.100K.** A handy size high sensitivity multi-tester with a shock-proof meter of 9.5μA. Incorporates three germanium diodes and simplified meter scale for easy reading. **RANGES: D.C. Volts:** 0.5V, 2.5V, 10V, 50V, 250V. (100,000 ohm/V), 500V, 1,000V, (35,000 ohm/V), **A.C. Volts:** 2.5V, 10V, 50V, 250V, 1,000V (12,500 ohm/V). **D.C. Amps:** 10μA, 250μA, 2.5mA, 25mA, 250mA. **Ohms:** 0-20K ohm, 0-200K ohm, 0-2M ohm, 0-20M ohm. Centre—160 ohm, 1.6K ohm, 16K ohm, 160K ohm. **L.I.:** 18μA, 180μA, 1.8mA, 18mA. **L.V.** 3V.

Decibels: minus 20db—plus 62db. Size: 5½in. x 3½in. x 2½in.

ORIGINALLY £14.14.0.

OUR PRICE **£6.19.6** COMPLETE

### 10,000 O.P.V. MULTI-METER IN SEMI-ASSEMBLED KIT FORM

**RANGES: D.C. voltage: 0-6-30-120-600-1,000 v.** 10,000 o.p.v.). **A.C. voltage: 0-6-30-120-600-1,200 v.** (10,000 o.p.v.). **D.C. Current: 0-120μA, 0-12-300 mA.** Resistance: 0-20K, 0-2 Meg. (150 ohm, 15K at centre scale). **Decibels:** —20 to +63dB (600 ohms 1 mW., odbm=0.775 v.). **Accuracy: D.C. voltage and current** ±2% f.s. **A.C. voltage** ±4% f.s. **Resistance** ±3% of total scale length. Size: 4½in. x 3¼in. x 1in. Complete with test leads, battery and instructions.

ONLY **69/6**

### 3-WAY SLIM CRYSTAL MICROPHONE

**MODEL 100C.** May be hand-held, floor stand or desk stand mounted or suspended by lavalier cord. Response 60-10,000 cps. Built in on/off switch. Output level—52dB. Omni-directional head. Clips on or off standard stand adaptor permitting tilting for multi-angle use. Satin chrome finish. *Supplied complete with table stand, cable and lavalier cord.*

PRICE **48/-**

### ALL DIRECTIONAL STUDIO CRYSTAL MICROPHONE

**MODEL MC-70**

A professional microphone with 360° pickup, using a new variable "D" shock mounted crystal cartridge for added power and sensitivity. Smooth response (50-12,000 cps.) and natural reproduction. Size 7in. high x 3in. wide. Complete with shielded cable and ⅜in. stand holder.

ONLY **59/6**

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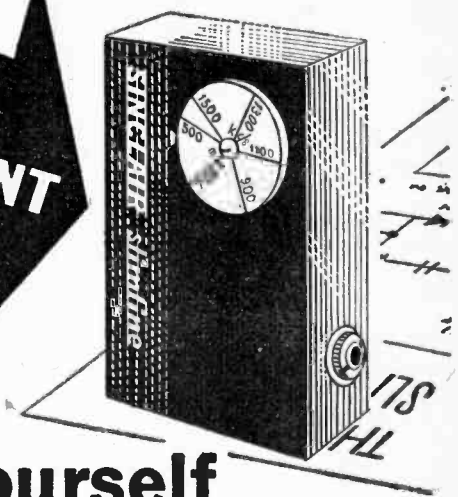
(DEPT. P), 32a COPTIC STREET, LONDON, W.C.I.

Relda Radio Ltd.

CALLERS WELCOME AT
87 TOTTENHAM COURT ROAD, LONDON, W.I. MUS 9606

# THE SINCLAIR SLIMLINE

## THE SET YOU WILL NEVER WANT TO BE WITHOUT




**THE MOST FANTASTIC TRANSISTOR PERFORMANCE YET—GIVES YOU EUROPE IN THE PALM OF YOUR HAND**

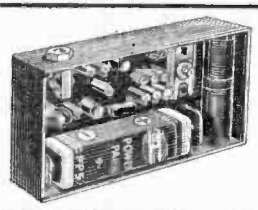
# Build one for yourself

# *Give one for Xmas!*

**UNBELIEVABLY SMALL - $2\frac{15}{16}$ x $1\frac{11}{16}$ x $\frac{3}{4}$"**

**BUILD IT IN A COUPLE OF HOURS**

**This is the ultimate in personal radios—so small, you can take it with you everywhere—so powerful it will give you many programmes from which to choose and with selectivity and quality that are truly astounding. Once you have heard the Slimline, you will never want to be without it. Building it is fascinating too, and if you want to give presents that will really be welcome—build and give the Slimline for Xmas. It's so elegant and takes up no more space than a packet of cigarettes. Tunes over the entire medium waveband.**



## A MASTERPIECE OF DESIGN AND PERFORMANCE

The heart of the Slimline is its wonderful MAT Transistors and highly efficient circuitry. Building is so easy, too. With well presented instructions, improved solid dielectric tuning capacitor, printed circuit board, sub-miniature components, blue and gold case and featherweight high quality earpiece, total cost comes to **49/6**

## LIGHT PROGRAMME 800 MILES AWAY

*From M.V. "Orelia", E.D.H.W. writes—*
"I have just completed your Slimline Receiver and I am amazed at the results. 800 miles from the U.K. I could still hear the light programme. I have built quite a number of receivers in the last few years but none with as good a result as the Slimline. I have now my shipmates interested, and more orders will be forthcoming in the future."
*The original of this and many more enthusiastic comments can always be seen at the offices at any time.*

**FULL SERVICE FACILITIES ALWAYS AVAILABLE**

## POST TO-DAY

*To* **SINCLAIR RADIONICS LTD., 69 HISTON RD., CAMBRIDGE**

**PLEASE RUSH**.....

**FOR WHICH I ENCLOSE £**.....:.....**s**.....**d.**

NAME.....

ADDRESS .....

.....

Block letters please ..... 12

## Infra-Red Heaters

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated 19/6, plus 2/6 post and insurance.

## Limited Quantity Only

Waterproof heater wire. 16 yds. length. 70 watts. Self-regulating temperature control, 10/-, post free.

## Microphone Inserts

American made. Dynamic type. Real bargain at 3/6, plus 6d. postage.

Crystal type 5/6.

## Beginner's Superhet

As supplied to many schools and colleges. A simple basic superhet—easy to understand and which can be progressively extended—deal for students—components include—valves—metal rectifier tuning condenser—I.F. transformers, etc. In fact complete superhet except speaker. Price £3 plus 3/- post and insurance. Data included free or sep. 1/6.

## TV CAMERA LENSES

16 mm. lens in mount, f8.5 and triple anastigmatic suitable for vidicon tube, £3.10.0.

## Cabinet Snip

This fine cabinet as illustrated but less control knobs is available this month at a special snip price of 15/6, plus 4/6 post and insurance. Size is 13½in. x 9in. x 4in. and it is nicely covered in two tone I.C.I. fabric.

## Yaxley Switches

| | | | |
|---|---|---|---|
| 1 pole, 2 way | 2/- | 1 pole, 3 way | 2/- |
| 1 pole, 4 way | 2/3 | 1 pole, 5 way | 2/6 |
| 1 pole, 7 way | 3/- | 1 pole, 9 way | 3/- |
| 1 pole, 11 way | 3/- | 1 pole, 12 way | 3/3 |
| 2 pole, 2 way | 2/3 | 2 pole, 4 way | 2/6 |
| 2 pole, 5 way | 4/- | 2 pole, 6 way | 3/6 |
| 2 pole, 12 way | 5/6 | 3 pole, 3 way | 2/- |
| 3 pole, 6 way | 4/- | 3 pole, 12 way | 8/6 |
| 4 pole, 2 way | 2/- | 4 pole, 3 way | 3/6 |
| 4 pole, 4 way | 3/6 | 4 pole, 5 way | 6/6 |
| 4 pole, 6 way | 6/6 | 4 pole, 11 way | 10/6 |
| 4 pole, 12 way | 11/6 | 5 pole, 3 way | 4/6 |
| 5 pole, 6 way | 8/- | 5 pole, 12 way | 14/6 |
| 6 pole, 2 way | 3/6 | 6 pole, 3 way | 4/6 |
| 6 pole, 6 way | 9/6 | 6 pole, 11 way | 16/6 |
| 6 pole, 12 way | 17/6 | 8 pole, 2 way | 4/6 |
| 6 pole, 4 way | 6/6 | 8 pole, 6 way | 11/6 |
| 8 pole, 12 way | 23/6 | 12 pole, 2 way | 6/6 |
| 12 pole, 5 way | 16/6 | 12 way fader | 3/6 |

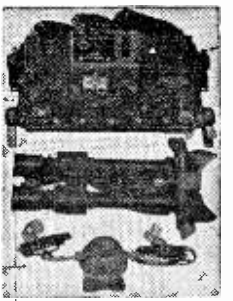
1 pole, 6 way incremental shorting, 3/6

## Bargains For Callers

We always have plenty, e.g., T.V. Cabinets, ideal for shelves etc., 2/6 each.

## CABINET & PICK-UP

Made for a famous company intending to make a Battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a Cosmocord pick-up with crystal cartridge and sapphire stylus. Both items new and perfect. Only 19/6, plus 4/6 post and insurance.



## Tabby Equipment

With details to make Closed Circuit TV Lens System. "See in the dark" equipment comprising 5,000V power pack which contains ignition coil vibrator etc. Control unit, interconnecting cables and Infra-red binoculars. Offered for one month only at the give away price of £3.19.6, plus 10/- carriage. These are unused, just as received from the Ministry, believed in good working order but sold without guarantee.

## THIS MONTH'S SNIP

### E.M.I. SINGLE PLAYER

Complete with turnover crystal pickup with Sapphire styli—standard 4 speeds. Good quality product using shaded pole motor carefully trued for best performance. Fitted 8¾in. turntable and rubber mat.

**Offered this month only at 59/6**

Post & Insurance 6/6.

## MAINS MOTOR

Suitable to drive fan, small model drilling machine etc. A.C. only, self starting. Size 2in. diameter by 2in. long (plus spindle). Only 9/6, plus 2/6.

Tape recorder type motor syncronous working 230 volts. 12/6, plus 2/6 post. Ditto but more powerful 20/-, plus 2/6.

## "CORONET" Mk. III

An excellent pocket size set using 3 MAT transistors for the oscillator and I.F. stages and 3 junction types including a matched pair for the output stage. It fully covers the medium-wave band and that part of the long-wave band to bring in B.B.C. Light. The circuit includes a highly efficient slab aerial and Pleasey tuning condenser incorporating wave change switch. Overall size approximately 4½ x 2½ x 1¼in. Supplied complete with carrying case, this two-wave pocket set is available whilst stocks last at the very low price of £3.12.6.

## MULTI-METER BARGAIN

Model number EP10K. Extra wide scale fitted corner wise for compactness, extra accurate as it uses 1% components. Sensitivity 10,000 ohms per volt A.C. and D.C. ranges. D.C. voltage up to 1.2KV in 5 ranges. A.C. voltage up to 1.2KV 5 ranges. D.C. current up to 300mA 3 ranges. Resistance up to 2 meg. Capacities .005 to .15 mfd and decibels. Complete with full instructions and test prods and battery for ohms range. A real bargain not repeatable once stocks cleared. Price £3.19.6. Carriage and insurance 5/-.

## BUILDING THE DOUBLE BEAM 'SCOPE?

We can supply VCR517 brand new. 9/6, plus 6/6 carriage and packaging. also 1750 v. mains transformer, 22/6, plus 6/6 carriage and packaging. Other parts in stock. send for list.

## Speaker Bargain

12in. High-fidelity loudspeaker. High flux permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new, by famous maker. Price 27/6 plus 3/6 post and insurance.

## Timer Kit

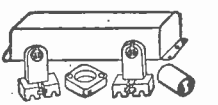
Special offer of all components except metal box to make mains operated interval timer for photography etc. 12/6 plus 2/6 post.

## 5000 mfd Condensers

12 V. working—Pleasey—perfect. 2/- each, 18/- doz.

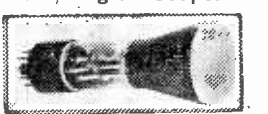
## Fluorescent Light Bargain

For pelmet or window lighting, etc. Kit of parts comprising: choke, two lamp holders, starter holder and starter. 40 watt, 19/6; 80 watt., 27/6.



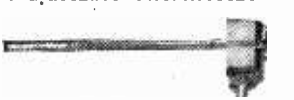
Plus 2/6 post and insurance.

## Building A 'Scope?



3in. oscilloscope tube, American made type No. 3FP7, 6.3 v. 0.6 amp. heater, electrostatic deflection, brand new and guaranteed with circuit diagram of scope, 15/- each. plus 2/6 post and insurance.

## Adjustable Thermostat



Suitable for Industrial or domestic purposes, such as controlling furnace oven, immersion heater, etc. Can also be used as a flamestat or fire alarm. Made by Sunvic these are approximately 17in. long and adjustable over a range 0 to 550°F. The contacts are rated at 15 amps., 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at £3 or £4 each, these are offered at only 8/6, plus 2/6 postage and insurance.

## Ice-Stat

This is a small thermostat which cuts on and off at around freezing point. Has many uses, one of which could be an ice warning device to be fitted under your motor car. Price 7/6, post 1/-.

## Refrigerator Thermostat

Standard type with adjustment for all normal refrigerator temperatures, 7/6, plus 1/- post.

## Simmerstat Heater Regulator

Suitable to control elements, heater, soldering irons and boiling rings up to 2,500 watts. Complete adjustable normal price 55/- each, special snip price 12/6, plus 1/6 postage and insurance.

## 15 amp. Thermostat

Adjustable over a fairly wide range of temperatures but set for 70°F., suitable for wall mounting to control room heaters. Exceptional bargain at 9/6, plus 1/- post and insurance.

# ELECTRONICS (CROYDON) LTD

## 266 LONDON ROAD, BROADGREEN, CROYDON

(Opposite SAVOY CINEMA)

# Important announcement!

**STERN RADIO LTD., CLYNE RADIO LTD., PREMIER RADIO**
**Three well-known names with a reputation for quality and service announce their amalgamation into**

# STERN-CLYNE LIMITED

**Combined resources, technical knowledge and over 50 years' experience gives you an organisation offering a fully comprehensive specialist service in the rapidly expanding world of electronics.**

## HOW THIS WONDERFUL NEWS BENEFITS YOU

- **STERN-CLYNE** means a wider range of exclusive equipment available from one source, including our speciality—MULLARD DESIGNS—for the home constructor or ready assembled.
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- **STERN-CLYNE** offers the finest possible range of equipment and components by all leading manufacturers.
- **STERN-CLYNE** carry a comprehensive range of transistors, miniature components and transistor radios.
- **STERN-CLYNE** retail shops, showrooms and demonstration rooms throughout London and the provinces all carrying extensive stocks.
- **STERN-CLYNE** Mail Order Service—geared to give prompt and efficient attention.
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- **STERN-CLYNE** Hi-Fi advisory service to help you in choosing the right equipment.
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| WEST END: | 18 Tottenham Court Road, W.1. | MUSeum 5929/0095 | Half-day Sat. |
| | 23 Tottenham Court Road, W.1. | MUSeum 3451/2 | Half-day Thurs |
| | 309 Edgware Road, W.2. | PADdington 6963 | Half-day Thurs |
| CITY: | 109 Fleet Street, E.C.4. | FLEet St. 5812/3 | Half-day Sat |
| NORTH LONDON: | 162 Holloway Road, N.7. | NORth 8161/5 | Half-day Thurs |
| SOUTH LONDON: | 9 Camberwell Church Street, S.E.5. | RODney 2875 | Half-day Thurs |
| CROYDON: | 12 Suffolk House, George Street. | MUNicipal 3250 | Half-day Wed |
| BRISTOL: | 26 Merchant Street, Bristol 1 | Bristol 20261 | Half-day Wed |
| MANCHESTER: | 10 Withy Grove, Manchester 4. | BLAck Friars 5379 | Half-day Wed |

*Mail Orders and enquiries to Dept. P.W.*
162 Holloway Road, London, N.7. NORth 8161/5

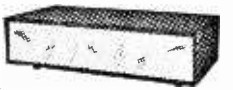
**SEE FOLLOWING PAGES FOR DETAILS OF STERN-CLYNE PRODUCTS**

**Great Britain's Greatest Electronic Hobbies Organisation**

# STERN-CLYNE

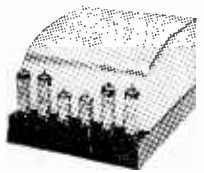
*INTRODUCTION OFFER ! ! Available Shortly*

FOR ONLY **48 gns**



Plus 15/- Pkg. & Carr.

THE TUDOR STEREO HI-FI SYSTEM, comprising a Self Powered AM/FM Tuner, Stereo Pre-amplifier, 12 watt per channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal cabinets for shelf mounting, with silver metal dials and matching knobs. Specifications: **Tuner**—Outstanding quality providing full VHF/FM long and medium waveband coverage, frequency range FM 87.5-108.5 Mc/s, AM/MW 522-1630 Kc/s, LW 145-270 Kc/s, 100mV output, mains supply 105/240 AC. Valve line-up: ECC85, ECH81, EBF89, EF80, EB91, EM84, ECC83. Multiplex outlet provided. **Pre-amplifier**—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pickups, direct play from Tape-Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion 0.1%, tape outputs 100mV from 90 K.ohm source, inputs—Microphone 5 mV, Tape 5.3 mV, R.I.A.A. 4.3 mV, flat 250 mV, Tuner 100 mV. Valve line-up: 2—EF86, 4—ECC83. **Power Amplifier**—14 watts per Channel, sensitivity 1 volt r.m.s. for 14 watts output, frequency response ± 0.5db 20 c/s.—20 Kc/s. Speaker impedance 4, 8 or 16 ohms. surplus power available for Tape Pre-Amp. mains supply 105/240 v. A.C. Valve line-up. 2—ECC83, 4—EL84. 1—GZ34.



## MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Designed mainly for Mullard Range of Amplifiers, also suitable for any Amplifiers requiring input up to 250mV, Incorporates 5 input Channels, including for Tape and Magnetic Pickups. Separate Bass and Treble controls. High pass filter 20 to 160 c/s., low pass filter 5-9 Kc/s. Totally enclosed in case size 11½" x 4½" x 4". KIT OF PARTS **£10.0.0** (Carr. & Ins. 5/-). ASSEMBLED & TESTED **£13.13.0**

*Instruction book and detailed price list available separately at 3/6 Post Free*

## MULLARD "5-10" MAIN AMPLIFIER

For use with MULLARD 2 or 3 valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS AND MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer. COMPLETE KIT (Parmeko Output Trans.) **£10.0.0**

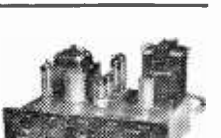
ASSEMBLED AND TESTED **£13.10.0**

(Carr. & Ins. 6/6.)

ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 **extra.**

*Instruction book and detailed price list available separately at 2/- Post Free.*

## THE MULLARD 5-10RC AMPLIFIER

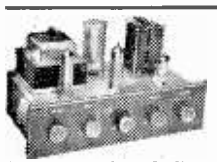


The popular complete "5-10" incorporating Passive Control Unit providing up to 10 watts high quality reproduction with input of 600 mV. Specified components and new MULLARD VALVES. Includes PARTRIDGE MAINS TRANSFORMERS and choice of PARMEKO or PARTRIDGE Output Transformers. Surplus Power available for Tuner.

COMPLETE KIT **£12.0.0**

ASSEMBLED AND TESTED **£16.0.0** (Carr. & Ins. 7/6). With PARTRIDGE OUTPUT TRANS. £1/6/0 ex.

*Instruction book and detailed price list available separately at 2/- Post Free.*



## THE MULLARD 3-3RC

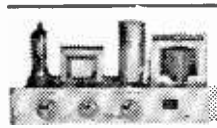
A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN.

KIT OF PARTS **£8.8.0**

ASSEMBLED AND TESTED **£11.10.0**

Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available. (Carr. & Ins. 6/6). Please state L.S. impedance.

*Instruction book and detailed price list available separately at 2/- Post Free.*



## THE "MONO-GRAM".

A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls. PARTRIDGE output Transformer producing up to 3 watts undistorted output. (Carr. & Ins. 3/6). Kit of Parts **£4.10.0** Assembled and Tested **£6.0.0**

*Instruction book and detailed price list available separately at 2/6 Post Free.*

SEND STAMP FOR COPY OF OUR INTERESTING LITTLE BOOKLET **"What is High Fidelity !"** *and Suggestion List of Budget Hi-Fi Systems.*

## SPECIAL PURCHASE! THE SHURE MODEL M3D

Professional Dynetic Stereo Cartridge with diamond Stylus, the Shure Dynetic Moving Magnet System combines the most faithful and distortion-free reproduction with complete reliability. Specifications: Diamond Stylus 0.7 thou. Load imp. 470K ohms. Output 5mV. Range 20-15,000 c/s ± 3 dB. Stylus pressure 3-4 grammes. PRICE **12 Gns.**

## MODEL CR3/S TAPE RECORDER

**MODEL CR3/S** incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1⅞in., 3¾in., and 7½in. speeds. Complete with microphone and 1,200ft. tape.

KIT OF PARTS **£33.8.0**

ASSEMBLED AND TESTED **£43.0.0**

(Carr. & Ins. 15/- extra).

*Instruction book and detailed price list available separately at 3/- Post Free.*

## MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard AMPLIFIERS but also perfectly suitable for other makes with input up to 250 m/V.

★ Equalisation for the latest R.I.A.A. characteristics.

★ Inputs for Crystal Pick-ups and variable reluctance magnetic types.

★ Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier.

★ Sensitive Microphone Channel. ★ Wide range BASS and TREBLE Controls.

KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£9.10.0** (Carr. & Ins. 5/-).

*Instruction book and detailed price list available separately at 2/- Post Free.*

### PRICE REDUCTIONS

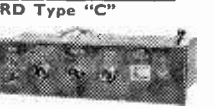
(a) THE KIT OF PARTS to build both the "5-10" **Amplifier** and the **2-Valve Pre-Amplifier**..... **£15.15.0**
(Carr. & Ins. 8/6).
(a) Assembled and Tested..... **£21.10.0**
(b) THE KIT OF PARTS to build both the "5-10" **Amplifier** and the **3-Valve Pre-Amplifier**..... **£19.10.0**
(Carr. & Ins. 10/-).
(b) Assembled and Tested..... **£25.10.0**
With PARTRIDGE OUTPUT TRANSFORMER £1.6.0 extra.

## STEREO TAPE PRE-AMPLIFIER

**MODEL STP-1.** For use with current TRUVOX BRENELL or COLLARO "STUDIO" ¼ and ½ track Stereo Decks. Incorporates Ferrox-cube Oscillator, 4-speed Equalisation Signal Level Meter and separate Gain Control. Includes separate Power Unit. KIT OF PARTS **£22.0.0** (Carr. & Ins. 8/6). ASSEMBLED **£28.0.0**

*Instruction book and detailed price list available separately at 5/- Post Free.*

## TAPE PRE-AMPLIFIER MULLARD Type "C"

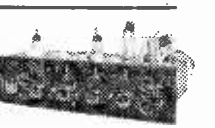


Suitable for most ¼ track, Mono Tape Decks. Incorporates Ferroxcube Push-Pull Oscillator, Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit

KIT OF PARTS **£14.0.0** (Carr. & Ins. 7/6). ASSEMBLED **£19.10.0**

*Instruction book and detailed price list available separately at 3/6 Post Free.*

## MULLARD TAPE AMPLIFIER MODEL HF/TR3/MK.II

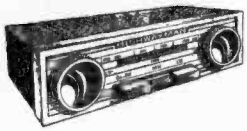


Based on Mullard's Type "A" design and suitable for most ¼ track Mono Tape Decks. Incorporates Ferrox-cube Treble Inductor, Gilson Output Transformer, and 3-speed Equalisation. Includes separate Power Unit. using PARTRIDGE Mains Transformer.

KIT OF PARTS **£13.13.0** (Carr. & Ins. 7/6). ASSEMBLED **£19.0.0**

*Instruction book and detailed price list available separately at 3/- Post Free.*

# NEW LOW PRICES — NOW YOU CAN AFFORD A CAR RADIO



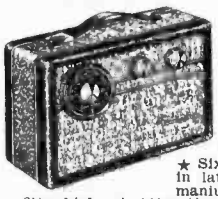
## THE 'HIGHWAYMAN'

### OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE

Look at these features: ★ Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valves types EBF83 and ECH83. ★ No Buzz, high output and sensitivity. ★ Printed circuit (latest type). ★ 7 x 4in. high flux p.m. speaker and baffle. ★ Medium and Long Waves. ★ Push button for fingertip control. ★ Extremely low battery consumption (less than ¼ amp). ★ Easy to fit any make car. (Positive earth only.) ★ 12-volt operation. ★ Compact size, measures only 7 x 7 x 2in. deep. ★ Easy assembly, supplied with dial and drive already mounted.

Special inclusive price of ONLY **£7.19.6** Plus 5/- P. & P.
All parts available separately. Individually priced parts list and comprehensive instruction booklet 2/6 post free. (Deducted from cost if complete parcel purchased later.)

## THE "AIR KING"



Our highly successful six-transistor luxury portable with the "SLIM Line" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as Car Radio, with full MEDIUM wave and LONG wave coverage.
Look at these features: ★ 500 milliwatt output to high flux 7 x 3¼in. high fidelity loudspeaker. ★ Six selected MULLARD TRANSISTORS in latest supersensitive circuit plus germanium diode. ★ Compact size only 9½ x 3½ x 6¼in. high. ★ Attractive three-tone cabinet, black, dark grey and silver grey with gilt control knobs and all gilt fittings. ★ Coax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal Ferrite rod aerial. Special inclusive price for **£7.19.6** (Plus P. & P. 4/-). all required components. ONLY
*Alignment service available. Full assembly details and individually priced parts list, all of which are available separately! price 1/6 post free.*

## TRANSISTORISED SOUND MIXER

Mixing 4 channels from high impedance source, giving professional results. Inputs for high impedance Microphone, Tuner, Gram and/or Tape Recorder. Compact and beautifully styled, size 6" x 2½" x 2¼". Standard Jack socket inputs.

PRICE **79/6** P. & P. including PP3 battery circuit 2/6. diagram and instructions.

## THE HE30 4-BAND COMMUNICATION RECEIVER

Outstanding Bandspread Selectivity and sensitivity with a built-in Q-multiplier combine to make the HE30 one of the finest general coverage bandspread Receivers available at this price. Covering 550Kc/s—1600Kc/s, 4.8Mc/s—14.5Mc/s, 1.6Mc/s—4.8Mc/s, 10.5Mc/s—30Mc/s. For amateur bands an illuminated slide rule dial is provided, calibrated every 5Kc/s on 80 & 40 metres taking 16 revolutions of the bandspread dial to cover each of these bands, every 20Kc/s on 20 and 15 metres and every 15Kc/s on 10 metres plus an edgewise S-meter. For the SWL a 0-100 logging scale for instant reset plus coverage from 0.55-30Mc/s. The 8 valve plus Rectifier superhet circuit provides an RF Stage with an Aerial Trimmer for peak performance plus 3 IF Stages for improved sensitivity of 1.0 microvolts for 10db S/N ratio. The B.F.O. variable pitch control can be used to separate CW stations whilst the Q-multiplier adds the selectivity needed for crowded phone band operation. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier) Frequency (BFO), Band Selector, IF Gain, Trimmer, AVC-MVC Switch, Ant Switch, Main Tuning, Bandspread Tuning and Headphone Jack. Selectivity —60db at 10Kc/s, 0.8Kc/s at 6db (with Q-Multiplier) IF-455Kc/s, External PM Speaker reqd., 4 or 8 ohms impedance, Output 1.5 watts. 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. Size 15 x 10 x 7¼in. Grey crackle finish. Full instructions and circuit diagram supplied. PRICE **40 Gns.** Carr. & Pkg. 15/-.

## ACOS MONAURAL STETHOSCOPE HEADSETS

Suitable for Tape Recorders or monitoring tape recordings. 100 ohm impedance. magnetic. Complete with lead. Originally 21/-. ONLY **12/6** P. & P. 1/6.

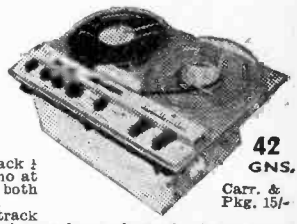
## THE "TRAVLER" Mk II

Introducing our new ready built transistorised car radio for ONLY **9½ Gns.** P. & P. 5/-. including 7 x 4" speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions **£2.19.6**
**H.P. Terms:**
**Deposit (Plus 5/- P. & P.) and 7 monthly payments of £1.2. 6**
**Star Features:** ★ Handsomely Styled. ★ Mullard Valves and. Transistors. ★ Push Buttons. ★ 1½ watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily Fitted. ★ Radio Luxembourg (and many other foreign stations) 12 volt Positive Earth Only (applies to 99.8% of the cars on the road). ★ Dimensions 7 x 2 x 7" depth

## POCKETCORDER TRANSISTORISED RECORDER

Why be bothered with a notepad? Take Pocketcorder with you on those business trips, the mighty Midget is Ideal. Simple to operate, a unique 4-way push-button Switch for record/playback, etc., ensures complete ease of handling. A remote Control Switch is also included for discreet recording, fully adjustable speed through the life of Batteries and the volume and tone from the 2½" internal speaker is outstanding. All accessories included such as Leather Case and Accessory Case, Remote Control switch and Crystal Earpiece, Tape, Batteries and Microphone, no other extras required. Up to 34 mins. recording time, operates on 1-9 volt PP3 and 2-1½ volt U12 Pen Batteries. Size 5½ x 4 x 2". Weight 24ozs. PRICE **12 Gns.** P. & P. 4/-

## STEREO TAPE DECK WITH BUILT IN PRE-AMPLIFIER



A professional addition to your Hi-Fi Stereo System consisting of two basic Units, the Tape Deck and Pre-amplifier, which employs 4 Transistors and 4 Valves. The Unit with record and playback ¼ track stereo or ¼ track mono at either 7½ i.p.s. or 3¾ i.p.s. both speeds being fully equalised.
Features: Track System: ¼ track 2 channel stereo or monaural record and playback. Independent single channel recording on either channel while playback on other channel. Head Type: ¼ track 2 channel inline stereo and associated erase heads. Low loss laminated pole pieces. Level indicators: 2 Meters, 1 per channel. Digital Counter: 3 digit tape position indicator. Automatic Stop: When tape runs out or breaks. Inputs: Microphone 1mV (50 K. ohms impedance) Gram/Tuner 50mV (high impedance). Output: (cathode follower). Monitor Sockets: 2 x 5K ohms impedance. Audio Output: 500mV. Oscillator: Pushpull 80 Kc/s. S/N Ratio: —45dB or better at 7½" tape speed. Separation: 45dB or more between stereo channels. Frequency Response: 40 to 15,000 cycles per sec. at 7½ i.p.s., 40 to 9,000 cycles per sec. at 3¾ i.p.s. Single Motor: 4 pole heavy duty induction type. Power Supply: 240v A.C. 50 cycles. Size: 6¼" x 10½" x 15". Tape Size: Up to 7". Line Up: 4-2SB173 Transistors, 2-12AT7, 1-12AU7, 1-12BH7 Valves.

**42 GNS.** Carr. & Pkg. 15/-

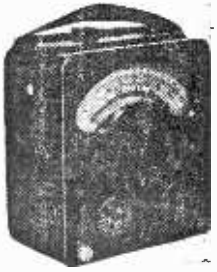
## THE HE-40 4-BAND COMMUNICATION RECEIVER

Completely built and ready to go. Not a Kit. High sensitivity Superheterodyne receiver covering 550 Kc/s —1,500 Kc/s, 1.6 Mc/s—4.4 Mc/s, 4.4 Mc/s—11 Mc/s, 11 Mc/s—30 Mc/s. Covers all amateur, Government aircraft and broadcast stations between 550 Kc/s and 30 Mc/s. Electrical bandspread tuning. Slide rule type tuning dial giving accurate logging of stations. Internal ferrite rod aerial for medium waveband reception and a 59in. 10 section chromium plated telescopic whip aerial for the short wave bands. Sockets for optional outdoor aerial. Internal high flux monitor loudspeaker. Latest modern miniature B7G base valves. High Q coils and I.F. transformers. Headphone socket (may also be used for external loudspeaker). Automatic noise limiter (ANL) for reduction of external interference. Beat frequency oscillator (BFO) for reception of CW (morse) signals. Receive/Stand-by switch. Signal strength meter calibrated in "S" units and reads to S9—10db. 220/240 volt A.C. mains, 50-60 cycle operation. Handsomely styled cabinet with grey crackle finish and handsome front panel, with chrome and satin chrome fittings. Measures 13¾in. x 8¾in. x 5¾in. (high) and weighs only 11½ lbs. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and short wave listeners of all ages. Come and hear this wonderful receiver at any of our many branches. PRICE **£24.15.0** Carr. & Pkg. 12/6

**Great Britain's Greatest Electronic Hobbies Organisation**

**SEE PAGE 697 FOR ADDRESSES OF STERN-CLYNE BRANCHES**

## UNIVERSAL AVOMETERS



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

## COSSOR 1035 DOUBLE OSCILLOSCOPES

Available in excellent condition, fully checked. **£45** each. Carr. 30/-.

## MICROAMMETERS

0-500 microamps. 2½in. circular flush panel mounting. Dials engraved 0-15, 0-600 volts. BRAND NEW. BOXED. 15/-. P. & P. 1/6.

## 230/250 VOLT A.C. MOTORS

4¼ x 3in. dia. 90 watts, 5,000 r.p.m. ¼in. spindle. Brand New. **22/6** each. P. & P. 2/-.

## FIELD STRENGTH METERS

Frequency coverage 1 to 250 Mc/s. Fitted with 200 micro-amp meter. Supplied with telescopic aerial, earpiece and instructions. **69/6** post paid.

## FIELD TELEPHONES TYPE "F"

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

## HEAVY DUTY AUTO TRANSFORMERS

0/115/230 volt step up or step down. Brand New, boxed. Ex U.S.A. 3,000 watt. **£7.10.0.** carr. 10/-. 7,500 watt. **£15.** carr. £1.

## MINIFLUX TAPE HEADS

Set of three, record, playback, erase. Only **29/6** set. P. & P. 9d.

## PANEL METERS

| | | | |
|---|---|---|---|
| 100μA | 2½" F.M. | D.C. | 42/6 |
| 100μA | 3½" F.M. | | 62/6 |
| 1 mA | 2½" F.M. | D.C. | 25/- |
| 30 mA | 2½" F.M. | D.C. | 12/6 |
| 30/0/30 mA | 2½" F.M. | D.C. | 9/6 |
| 350 mA | 2½" F.M. | D.C. | 10/6 |
| 15 amp. | 3½" F.M. | D.C. | 39/6 |
| 5/0/5 amp. | 3½" F.M. | D.C. | 25/- |
| 300 v. | 2½" Proj. | A.C. | 19/6 |
| 300 v. | 2½" F.M. | A.C. | 25/- |
| 500 v. | 2½" F.M. | A.C. | 25/- |
| 120 v. | 3½" F.M. | D.C. | 32/6 |

Postage extra.

## SILICON RECTIFIERS

| | |
|---|---|
| 400V. p.i.v. 4.7 amp | 7/6 |
| 200V. p.i.v. 6 amp | 5/6 |
| 800V. p.i.v. 500 mA | 5/6 |
| 400V. p.i.v. 500 mA | 3/6 |
| 70V. p.i.v. 1 amp | 3/6 |

OA 202 miniature silicon rectifiers 1/- each.
Discount for quantities.
Please add postage.

## R.C.A. AR.88 D RECEIVERS

New release, limited number available. Frequency coverage 550 Kc/s to 32 Mc/s on 6 bands. Operation 110/230 volts A.C. Offered in excellent used condition, fully checked and guaranteed perfect order. **£45** each. Carr. £2.

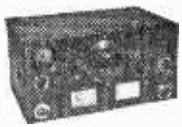
## P.C.R.2 COMMUNICATION RECEIVERS

Excellent performance for modest outlay. Frequency coverage on three bands 800-2,000 metres, 190-550 metres, 6-22 Mc/s. Output for phone or speaker. Supplied in perfect condition **£5.19.6** each. Carr. 10/-. The receiver can be supplied with an internal power supply to operate on 200/250 volt A.C. at **39/6** extra or plug in external power supplies are **35/-** extra. Full circuit supplied.

## AVO WIDE RANGE SIGNAL GENERATORS

Frequency coverage 50 Kc/s to 80 Mc/s in six turret operated ranges. For use on standard A.C. mains. Packed in original transit cases with accessories. Supplied in as new condition, fully checked before despatch. **£15.** Carriage 10/-.

## NATIONAL H.R.O. RECEIVERS



**SENIOR MODEL.** Supplied complete with full set of 9 coils covering 50 Kc/s to 30 Mc/s. Each receiver thoroughly checked and available as follows:—
TABLE MODEL. As new condition **£25.**
TABLE MODEL. Good used condition **£19.19.0**
RACK MODEL. As new condition **£22.10.0**
RACK MODEL. Good used condition **£18.18.0**

*NB*—Rack model is identical to table model with extended front panel to fit a 19in. rack. Carriage £1 extra.
200/250 volt A.C. power supplies for all above receivers, also sold separately. **59/6.** carr. 5/-.

## HALLICRAFTER S-36 V.H.F. RECEIVERS

F.M./A.M. 27-143 Mc/s. 110 volt A.C. transformer supplied for 230 v. A.C.). Improved version of S-27. Tested before despatch. Brand new boxed with instruction manual. **£40** each. Carr. £2

## LAFAYETTE BRAND TAPES

First grade quality American tapes. Brand new, guaranteed. Discounts for quantities.

| | | |
|---|---|---|
| 5in. | 600ft. Std. Acetate | 8/6 |
| 5in. | 900ft. L.P. Acetate | 10/- |
| 5in. | 1200ft. D.P. Mylar | 15/- |
| 5½in. | 1200ft L.P. Acetate | 14/6 |
| 5½in. | 1800ft. D.P. Mylar | 21/- |
| 7in. | 1200ft. Std. Mylar | 12/6 |
| 7in. | 1800ft. L.P. Acetate | 15/- |
| 7in. | 1800ft. L.P. Mylar | 20/- |
| 7in. | 2400ft. D.P. Mylar | 25/- |

Post 2/-, over £3 post paid.

## MULTIMETERS

**BRAND NEW—FULLY GUARANTEED LOWEST EVER PRICES**
**Supplied with Leads, Batteries and Instructions.**

**1,000 Ω/VOLT**
0/15/150/1,000 v. A.C. and D.C.
0/150 mA. D.C.
0/100 KΩ etc.
**39/6.** P. & P. 1/6.

**20,000 Ω/VOLT**
0/10/50/250/500/1,000 v. A.C. and D.C.
0/50μA/0/25/500 mA. D.C.
0/50K/500K/5 meg.. etc. **97/6.**
P. & P. 2/6.

**30,000 Ω/VOLT**
0/1/1/10/50/250/500/1,000 v. D.C.
0/10/50/250/500 v. A.C.
0/50μA/0/10/250 mA. D.C.
0/10K/1 meg./10 meg.. etc. **£5.10.0.** P.P. 2/6.
**30,000 Ω/VOLT**
0/1/1/2½/10/25/100/250/500/1,000 v. D.C. and A.C.
0/50μA/5/50/500 mA/0/12 amp. D.C.
0/60K/6 meg./60 meg., etc. **£8.17.6.** Post paid.
**50,000 Ω/VOLT**
0/10/50/250/500/1,000 v. D.C. and A.C.
0/25μA/2.5/25/250 mA. D.C.
0/10K/100K/1 meg./10 meg.. etc. **£7.10.0.**
P.P. 2/6.
**100,000m/VOLT**
.5/2.5/10/50/250/500/1,000 v. D.C.
2.5/10/50/250/1,000 v. A.C.
10/25μA/2.5/25/250 mA/10 amp. D.C.
20K/200K/2 meg./20 meg. ohm, etc.
**£6.19.6.** Post paid.

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

# MARCONI

## CR 100/8 RECEIVERS BRAND NEW

Packed in original transit cases and complete with handbook/manual. 60 Kc/s to 30 Mc/s. 200/250 volt A.C. operation. Tested before despatch.

**£35** Carriage £2.

A few CR.100 receivers available in good used condition, **£21.** Carr. 5/-.

## COLLARO/MAGNAVOX STUDIO TAPE DECKS

Latest 1963 model. Fitted with latest bradmatic heads and interlock button. Brand new, guaranteed, with instructions and fixings. **£10.10.0.** Carr. 5/-.

## MINE DETECTOR No. 4A

Will detect all types of metals. Fully portable. Complete with instructions. **39/6** each. Carr. 10/-. Battery 8/6 extra.

## MODEL RX60 AMATEUR COMMUNICATION RECEIVER

Four bands, 550 Kc/s-30 Mc/s. Special features, S meter-anl-dfo-electrical band spread—internal 5in. speaker—head set socket—tone control—standby switch—3 aerials, loop, wire, telescopic—200-250 volt A.C./D.C. Brand new guaranteed with manual **£24.15.0** each. Post paid.

## L.T. METAL RECTIFIERS

All full wave, bridge connected. Brand new.

| | | | |
|---|---|---|---|
| 12/18v.1.5A. | 3/9 | 24/36v. 6A. | 27/6 |
| 12/18v.2.5A. | 6/3 | 24/36v.15A. | 45/- |
| 12/18v. 4A. | 8/6 | 36/48v. 2A. | 19/6 |
| 12/18v. 6A. | 12/3 | 36/48v. 4A. | 29/6 |
| 12/18v. 10A. | 22/6 | 36/48v. 6A. | 32/6 |
| 12/18v. 15A. | 37/6 | 48/60v. 2A. | 21/- |
| 24/36v. 1A. | 7/3 | 48/60v.10A. | 82/6 |
| 24/36v. 2A. | 13/6 | | |

Please add postage.

## L.T. TRANSFORMERS

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

## FIELD TELEPHONES TYPE "L"

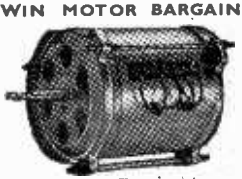
Generator bell ringing, two line connection. Supplied complete with batteries, ready for use, **69/6** per pair. Carriage 5/-.

## MINIATURE PANEL METERS

For 1¼in. dia. panel hole.

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

## TWIN MOTOR BARGAIN

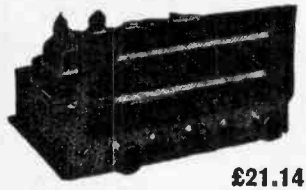


200/250 volt A.C. Twin concentric spindles operated independently. Either motor reversible. 1440 r.p.m. Brand New, Boxed. Only **12/6** each. P. & P. 2/6.

# C.W. SMITH & CO (RADIO) LIMITED

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

## ARMSTRONG AF208AM/FM RADIOGRAM CHASSIS



**£21.14.0**
(carriage free)

- FULL VHF BAND (87-108 Mc/s). MEDIUM BAND 187-570 m.
- 5 WATTS OUTPUT.
- 15 dB NEGATIVE FEEDBACK. 7 VALVES.
- 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. Write for free literature.

### New Boxed VALVES 90-day Guarantee

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|---|---|---|---|---|---|
| OZ4 | 5/- | 6K7G | 5/- | EB9F | 4/-) |
| 1R5 | 6/-) | 6K8G | 5/- | EBC41 | 8/-) |
| 1S5 | 6/-) | 6L6G | 8/- | EBC91 | 8/-) |
| 1T4 | 2/-) | 6N7M | 5/- | EBF89 | 9/-) |
| 2X2 | 3/-) | 6Q7G | 5/- | ECH42 | 9/-) |
| 3S4 | 7/-) | 6S8N7 | 5/- | ECH81 | 9/-) |
| 3V4 | 7/-) | 6V6G | 5/- | ECL80 | 9/-) |
| 3Q4 | 7/-) | 6X4 | 5/- | ECL82 | 10/-) |
| 5U4 | 6/-) | 6X5 | 6/- | EF85 | 6/-) |
| 5Y3 | 6/-) | 12AT7 | 6/- | EF89 | 8/-) |
| 5Z4 | 9/-) | 12AU7 | 6/- | EL33 | 5/-) |
| 6AC7 | 4/-) | 12AX7 | 7/- | EL84 | 7/-) |
| 6AM6 | 4/-) | 12BH7 | 7/- | EY51 | 9/-) |
| 6AT6 | 6/-) | 12K7 | 5/- | EY86 | 9/-) |
| 6BA6 | 7/-) | 12K8 | 14/- | EZ40 | 7/-) |
| 6BE6 | 5/-) | 12Q7 | 5/- | EZ80 | 7/-) |
| 6BW6 | 7/-) | 25Y5G | 9/- | EZ81 | 7/-) |
| 6C4 | 5/-) | 35L6 | 9/- | HABC801 | 10/-) |
| 6D6 | 5/-) | 35Z4 | 5/- | HVR2A | 5/-) |
| 6G6 | 4/-) | 954 | 2/- | KT33C | 8/-) |
| 6H6 | 3/-) | DAF96 | 8/- | KT76 | 8/-) |
| 6J5 | 5/-) | DF96 | 8/- | MU14 | 7/-) |
| 6J6 | 5/-) | DK96 | 8/- | PC86 | 8/-) |
| 6J7G | 6/-) | DL96 | 8/- | PCC84 | 7/-) |
| 6K8 | 6/-) | RAB C80 | 8/- | PCF80 | 8/-) |
| | | | | PCF82 | 8/-) |
| | | | | PCL82 | 10/- |
| | | | | PCL84 | 10/- |
| | | | | PL81 | 10/- |
| | | | | PL83 | 8/- |
| | | | | PY33 | 15/- |
| | | | | PY80 | 7/- |
| | | | | PY81 | 8/- |
| | | | | UBC41 | 8/- |
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| | | | | UBF89 | 9/- |
| | | | | UCH81 | 9/- |
| | | | | UCL82 | 10/- |
| | | | | UCL83 | 12/- |
| | | | | UF89 | 9/- |
| | | | | UL41 | 9/- |
| | | | | UY41 | 7/- |
| | | | | UY85 | 7/- |
| | | | | UU9 | 7/- |
| | | | | VR150 | 7/- |
| | | | | W81 | 6/- |

### NEW ELECTROLYTICS — FAMOUS MAKES

| TUBULAR | TUBULAR | CAN TYPES | |
|---|---|---|---|
| 1/350V | 2/- | 50/350V | 5/6 |
| 2/350V | 2/3 | 100/25V | 3/- |
| 4/450V | 2/3 | 250/25V | 3/- |
| 8/450V | 2/3 | 500/12V | 3/- |
| 16/450V | 3/- | 1,000/12V | 3/- |
| 32/450V | 3/9 | 5,000/6V | 5/- |
| 32/25V | 1/9 | 8+8/450V | 8/6 |
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| 50/25V | 2/- | 16+16/450V | 4/6 |
| 50/50V | 2/- | 32+32/350V | 4/6 |
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| | | 32+32/350V | 5/- |
| | | 32+32/450V | 6/- |
| | | 32+32+32/350V | 7/- |
| | | 50+50/350V | 7/- |
| | | 64+128/350V | 11/6 |
| | | 100+200/275V | 12/6 |

**TELESCOPIC CHROME AERIALS.** 18in. extending to 43in., 8/6 ea. 5in. to 32in., 7/6 ea.
**TRIPLEXERS** Bands I, II, III, 12/6. **COAX PLUG.** 1/- **LEAD SOCKET.** 2/-. **PANEL SOCKETS.** 1/-. **OUTLET BOXES** (Surface or flush), 4/- ea.
**BALANCED TWIN FEEDER** yd. 6d. 80 or 300 ohms. DITTO SCREENED per yd. 1/6. 80 ohms only. Wirewound Ext. Speaker Control, 10 Ω 3/-, 25 Ω 6/6.
**WIRE-WOUND POTS.** 3 WATT. Pre-set Min. TV Types. All values to 10 ohms to 25 K., 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K. to 2 meg., 3/-).
**WIRE-WOUND 6 WATT POTS.** Long spindle. Value, 50 ohms to 50 K., 6/6; 100 K., 7/6.
**PHILIPS TRIMMERS.** 6-10 pF., 3-30 pF., 1/-.
**TRIMMERS,** Ceramic. 30, 50, 70 pF., 9d.; 100 pF., 150 pF., 1/6; 250 pF., 1/6; 500 pF., 750 pF., 1/9. TV etc. **TRIMMER,** 1000 pF., with knobs, 2/-.
**RESISTORS.** Preferred values. 10 ohms to 10 meg., ½ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. High Stability. ½ w., 1%, 2/-. Preferred values 10 Ω to 10 meg. Ditto 5% 10 Ω to 22 meg., 9d.
**RESISTORS.** CR1, 3/6; CR2, 3/6; CR3, 1/6.

| | | |
|---|---|---|
| 5 watt | WIRE-WOUND RESISTORS 10 ohms—10,000 ohms | 1/3 |
| 10 watt | | 2/- |
| 15 watt | | 2/- |

12.5K to 47K 10 w. .. .. .. .. 3/-

### Volume Control

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

### 80 ohm CABLE COAX

Semi-air spaced ½in.
Stranded core **6d.yd.**
40 yds. 17/6
90 yds. 35/-
Ratings Quality
Air spaced **1/-yd.**
Mixed 626 lines.

| | |
|---|---|
| **MAINS TRANSFORMERS** 200/250 v. A.C. *Postage 2/- each transformer.* | |
| **STANDARD,** 250-0-250, 80 mA, 6.3 v. 3.5 a. tapped 4 v., 4 a. Rectifier, 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350 .. | 29/6 |
| **MINIATURE** 200 v. 20 mA, 6.3 v. 1 a. .. | 10/6 |
| MIDGET, 220 v. 45 mA, 6.3 v. 2 a. .. | 15/6 |
| **SMALL,** 220-0-220, 50 mA, 6.3 v. 2 a. .. | 17/6 |
| **STD.** 250-0-250, 65 mA, 6.3 v. 3.5 a. .. | 17/6 |
| **HEATER TRANS.** 6.3 v. 1½ amp. .. | 7/6 |
| Ditto, tapped 1.4, 2, 3, 4, 5, 6.3 v. .. | 8/6 |
| Ditto, sec. 6.3 v. 4 amp. .. .. | 10/6 |
| **GENERAL PURPOSE LOW VOLTAGE,** 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v. | 22/6 |
| **AUTO TRANSFORMER,** 150 w. .. | 22/6 |
| 0, 115, 200, 230, 250 v., 500 w. .. .. | 82/6 |
| **MULLARD "510" Mains Transformer** .. | 38/6 |
| **PARMEKO MAINS TRANSFORMER.** Made for special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA. L.T. 6.3 v. 1.8 amp. Size 4 x 3½ x 3 in. .. | 17/6 |

**INTERVALVE TRANSFORMERS.** 3:1 or 5:1, 9/-. **O.P. TRANSFORMERS.** Heavy Duty 50 mA 4/6. Multiratio. 7/6. Multiratio heavy duty push-pull, 10 w., 15/6. Miniature, 3S4, etc., 5/9.
10 w. O.P. matching trans. 3, 7, 15 Ω. 12/6.
**L.F. CHOKES** 15/10H., 60/65 mA, 5/-; 10H., 85 mA, 10/6; 10 H., 150 mA, 14/-.
**TINNED COPPER WIRE** 16 to 22 swg., ½lb., 3/-. **ENAMEL COPPER WIRE** 16-22, 2/9; 24-30, 3/6; 32-40, 4/6; D.C.C. 28, 34, 36 swg, 2oz. 3/6.

**L.F. TRANSFORMERS 7/6 pair**
465 K/s Slug Tuning Miniature Can, 2 x ½ x ½in. High Q and good bandwidth. Data sheets. Standard size Weyrad, 10/6 pair.

**FULL WAVE BRIDGE SELENIUM RECTIFIER:** 2, 6 or 12 v. 1½ amp., 5/9; 2 a., 11/3; 4 a., 17/6.
**CHARGER TRANSFORMERS.** Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6; 2 amps., 17/6; 4 amps., 22/6. Circuit included.
**4 AMP CAB BATTERY CHARGER** with amp. meter Leads, Fuse Case, etc., for 6 v. or 12 v., 69/9.
**AMMETER** 0 to 5 amp., 9/6.

### BOOKS list S.A.E.

| | |
|---|---|
| Boys' Book of Crystal Sets .. | 2/6 |
| "W.W." Radio Valve Data .. | 6/- |
| High Fidelity Speaker Enclosure .. | 5/- |
| Valve and TV Tube Equivalents .. | 9/6 |
| TV Fault Finding .. .. .. | 5/- |
| Mullard Amplifier Manual .. .. | 8/6 |
| Radio Valve Guide, Books 1, 2, 3, 4 or 5 .. .. | 5/- each |
| Transistor Superhet Receivers .. | 7/6 |
| Practical Radio Inside Out .. | 3/6 |
| Master Colour Code Chart .. | 3/6 |
| Transistor Controlled Models .. | 7/6 |
| Principles of Colour TV .. | 16/- |
| International Radio Stations .. | 2/6 |

### 4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

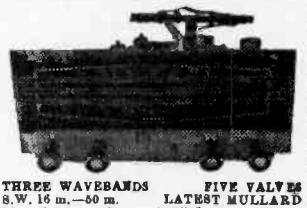
Size 3 x 1½ x ½.
A ready built miniature push-pull amplifier with Driver and output transformers, 4 transistors. Ideal for use with record players, intercoms, BABY ALARMS, etc. Complete with full instructions and circuit. Price **47/6** 9v. Batt. 2/3 2½in. Speaker 15/-.

### BAKER SELHURST LOUDSPEAKERS

12in. Baker 15w. Stalwart 3 or 15 ohms, 45-13,000 c.p.s. .. .. 90/-
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. .. ..£6.17.7
12in. Standard H.D. 20w. 40-14,500 c.p.s. .. £8.0.0
12in. De Luxe 15w. 25-17,000 c.p.s. ..£9.10.0
12in. Bass 25w. 20-18,000 c.p.s. .. £12.12.0
15in. Auditorium, 35w., Bass, 20 c.p.s. to 12 kc/s. Ideal Bass Guitar. £18.
Details and Enclosures, plans, S.A.E.

**LOUDSPEAKERS** P.M. 3 OHM. 2½, 3, 4, 5in. 7 x 4in., 15/6; 6½in. Rola, 16/6; 8in. Plessey, 17/6; 10 x 6in., 22/6; 10in. Rola, 30/-; 12in. R.A., 30/-; 13½ x 8in. Double Cone F.M.I., 35/-.
**STENTORIAN HF1012.** 10in. 3 to 15 ohms, 10w. 87/6; 8in. HF812. 72/-; **Tweeter** T350, 30/-; **Cross-over** CX3000, 30/-.

### 1963 RADIOGRAM CHASSIS



THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.—50 m. — LATEST MULLARD
M.W. 200 m.—550 m. — ECH81 EF89, EBC81,
L.W. 800 m.—2,000 m. — EL84, EZ80
12-month guarantee.
A.C. 200/250 v. 4-way Switch; Short-Medium, Long/Gram. Ferrite Aerial A.V.C. and Negative feedback, 3 ohm output, 5 watts. Glass dial, horizontal wording, size 13in. x 4in. Aligned and calibrated. Isolated Chassis, size 13½in. x 9in. high x 5½in. deep.
**£8.19.6** Carr. & Ins. 4/6.

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

**TWIN GANG TUNING CONDENSERS.** 365 pF, miniature 1in. x 1½in. x 1½in., 10/-; 500 pF Standard with trimmers, 9/-; midget, 7/6; with trimmers, 9/-; 500 pF slow motion tuning, standard or midget, 9/-. Transistor gang 208 + 176 pF with trimmers, 10/6.
**SMALL** 3 gang 500 pF, 17/-. **SINGLE** 365 pF, 7/6. **SINGLE** 10 pF, 25 pF, 50 pF, 75 pF, 100 pF, 150 pF, 5/6. Solid dielectric 100, 200, 500 pF, 2/6.
**CONDENSERS.** New stock. 0.001 mfd. 7 kV. T.C.C., 5/6; Ditto, 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25, 1/6; 0.5/350 v., 1/9; 0.1/350 v., 9d.; 0.1/2,000 v., 0.1/1,000 v., 1/9; 0.1 mfd, 2,000 volts, 3/6.
**CERAMIC CONDS.** 500 v. 0.3 pF to 0.01 mfd., 9d.
**SILVER MICA CONDENSERS, 10%** 5 pF to 500 pF, 9d.; 600 pF to 3,000 pF, 1/-. Close tolerance (+1 pF) 2.2 pF to 47 pF, 1/-. Ditto 1% to 50 pF to 815 pF, 1/-; 1,000 pF to 5,000 pF, 1/9.

**465 kc/s SIGNAL GENERATOR** Price 15/-. Uses B.F.O. Unit. ZA 30038 ready made with valve 1S5. **POCKET SIZE** 2½ x 4½ x 1in. One resistor to change, full instructions supplied. Battery 3/6 extra. 69V 1½V. Details S.A.E.

**WAVECHANGE SWITCHES**

| | |
|---|---|
| 2 p. 4-way 2 wafer long spindle .. | 6/6 |
| 2 p. 2-way, or 2 p. 6-way long spindle .. | 3/6 |
| 4 p. 2-way or 4 p. 3-way long spindle .. | 3/6 |
| 3 p. 4-way or 1 p. 12-way long spindle .. | 3/6 |

**Wavechange "MAKITS".** Wafers available; 1 p. 12 way, 2 p. 6 way, 3 p. 4 way, 4 p. 3 way, 6 p. 2 way, 1 wafer switch, 8/6. 2 wafer switch. 12/6; 3 wafer switch, 16/-; additional wafers up to 12, 3/6 each extra; **Toggle Switches,** s.p., 2/-; d.p., 3/6. d.p.d.t., 4/-. Min. Slide d.p.d.t., 3/6.

**CRYSTAL MIKE INSERTS, 6/6**
High output. Size 1¼in. dia. x 1in.
**ACOS MIC. 14.** insert 1¼in. dia. x ½in. 8/6
**ACOS 39-1 DE LUXE STICK MIKE** 35/-
**TSL QUALITY STICK MIKE**..... 25/-

**Valveholders.** EA50, 6d. B12A, CRT, 1/3. Engl. and Amer. 4, 5, and 7 pin, 1/-. MOULDED Mazda and int. oct., 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 1/9. Ceramic EF50, B7G, B8A, int. oct., 1/-. B7G, B9A cans, 1/- each. Valve plugs B7G, B9A, 2/3.

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

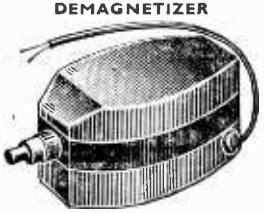
THE ORIGINAL

# RADIO COMPONENT

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

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

## THE "INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETIZER



200/250 v. A.C. **35/-** Leaflet S.A.E.

### AMERICAN "BRAND FIVE" PLASTIC RECORDING TAPE

| | | Spare Plastic Reels |
|---|---|---|
| Double Play | 7in. reel, 2,400ft. 42/-<br>5in. reel, 1,200ft. 25/- | |
| Famous Makes | | |
| Long Play | 7in. reel, 1,800ft. 22/6 | 3in. 1/6 |
| | 5½in. reel, 1,200ft. 17/6 | 4in. 2/- |
| | 5in. reel, 900ft. 15/- | 5in. 2/- |
| | | 5½in. 2/- |
| Standard | 7in. reel, 1,200ft. 17/6 | 7in. 2/6 |
| | 5in. reel, 600ft. 11/6 | |

**"EASISPLICE" Tape Splicer 5/-.**

**CRYSTAL SET BOOKLET.** 1/-.
**CRYSTAL DIODE** G.E.C., 2/-. **GEX34**, 4/-. **OA81**, 3/-.
**HIGH RESISTANCE PHONES.** 4,000 ohms. 15/- pr.
**MOVING COIL PHONES.** 100 ohms, 10/-.
**SWITCH CLEANER.** Fluid squirt spout, 4/6 tin.

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

First class components to make a 6 transistor 2 waveband superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, *with car aerial coil*, printed circuit, 8½in. x 2½in., but EXCLUDING Speaker and cabinet. Speakers, 35 ohms, 7 x 4in. 21/- 5in., 17/6, 3½in., 15/6. **£4.5.0**

**BULGIN PLUGS AND SOCKETS.** Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 6/6. "DOMINA" plugs, 2/6; sockets, 2/6.
**JACKS.** English open circuit, 2/6. Closed circuit, 4/3. Grundig type, 3-pin, 1/3. Grundig lead jack 3/6.
**JACK PLUGS.** English, 3/-; Screened, 4/-; Grundig, 3-pin 3/6; Phono Plugs, 1/-; Sockets, 6d.
**ALADDIN FORMERS** and cores, ½in., 8d.; ¾in., 10d. **0.8in. FORMERS** 5937 or 8 cans TV1 or 2, ¾in. sq. x 2½in., or ¾in. sq. x 1½ in., 2/- with cores.
**SLOW MOTION DRIVES.** 6:1, 4/3.
**SOLON IRON.** 25W, 200V or 230V. 24/-.
**ANTEX SUB-MIN. IRON.** 15W. 200 or 240V., 29/6.
**BENCH STAND** for above. 12/6. Spares in Stock.
1/16in. **Paxolin Panels.** 10 x 8in., 2/-.
**Miniature Contact Cooled Rectifiers.** 250V 50mA. 7/6; 250V 60mA. 8/6; 250V 85mA. 9/6; **Selenium Rect.**, 300V 85mA. 5/-.
**TV etc., Silicon Sub. Min. Rectifier,** 250V 450mA. 10/-, K3/25. 600V. 5mA. 5/-.
RM4, RM5, 14A100, 14A116 10/- each. FC31, 20/-
**Coils** Wearite "P" Type, 3/- each.
**Osmor Midget** "Q" type, adj. dust core, from 4/- each. All ranges. List S.A.E.
**Teletron D.W.R.** L. and Med. T.R.F. with reaction, 4/-. Med. wave D.R., 3/6.
**Ferrite Aerials,** M., 8/9; M. and L., 12/6.
**Osmor Ferrite Rod Aerials,** L. and M. for transistor circuits, 10/- each.
**Ferrite Rods,** 8 x ½in., 6 x ¾in., 6 x $^5/_{16}$ in. 3/-.
**H.F. Chokes,** 2/6. **Osmor QC1,** 6/9.
**T.R.F. Coils,** A/HF, 7/- pair; HAX. 3/-, Repanco DRR2, 4/6. DRX1, 2/6.
**Radio Screwdriver,** 5in., 6d. **Test Prods,** 2/9. **Neosid Trimming Tool,** 1/9.
**Neon Mains Tester Screwdriver.** 5/-.
**Multicore Solder,** 4d. yd., **Dispenser,** 2/6.

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

**JASON FM TUNER COIL SET 29/-.** H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s, detector transformer, heater choke. Circuit book using four 6AM6. 2/6.
**Complete Jason FMT1 Kit.** Jason chassis with calibrated dial, components and 4 valves, £6.5.0.
**Model FMT2** with new shelf cabinet, 5 valves, components and powerpack, **£10.**

**MAINS DROPPERS.** Midget adjustable sliders 0.3A, 1,000 ohms 5/-; 0.2A, 1,200 ohms, 5/-; 0.15A, 1,500 ohms, 5/-; 0.1A, 2,000 ohms, 5/-.
**MIKE TRANSFORMERS,** 50-1, 3/9.
**P.V.C. Covered Wire,** single or stranded, 2d yd. **Sleeving,** 1 or 2 mm., 2d.; 4 mm., 3d.; 6 mm., 5d. yd.
**SPEAKER-FRET.** Gold, Maroon or Green Cloth. 17 x 25in., 5/-; 25 x 35in., 10/-. Tygan, various colours 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples S.A.E. Expanded Metal, Gold, 12 x 12in., 6/- Panel mounting fuse holders, 2/-. Fuses 60mA –5A, 5d. Insulated side cutters, 8/6. Bib Stripper, 3/6.

### RADIO AND TELEVISION SPARES

**All leading makes, volume controls, etc., line output transformers, etc., B. V. A. valves (current and obsolete types). Send S.A.E. for quotation.**

## WEYRAD

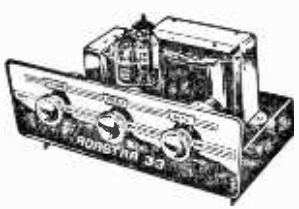
**COILS AND TRANSFORMERS FOR 2-WAVE TRANSISTOR SUPERHETS WITH PRINTED CIRCUIT AND FERRITE ROD AERIAL.**

| | |
|---|---|
| Long and Medium Wave Aerial—RA2W | |
| On 6in. rod, 208pF tuning, with car aerial coupling coil | 12/6 |
| Osc. Coil P50/1AC. 176 pF tuning | 5/4 |
| 1st and 2nd I.F. Trans.—P50/2CC. 470kc/s 11/16in. dia. by 1in. | 5/7 each |
| 3rd I.F. Trans.—P50/3CC. | 6/- |
| Spare Cores | 6d. each |
| Driver Transformer—LFDT4 | 9/6 |
| Wavechange Slide Switch d.p.d.t. | 3/6 |
| Printed Circuit—PCA1. Size 2¾ x 8¼in. Ready drilled and printed | 9/6 |
| Volume Control, 5K-DP | 4/6 |
| 35 ohm Speakers, 3¼in., 15/6; 5in., 7 x 4in., 21/-. | 17/6; |
| Tuning Gang with trimmers | 10/6 |
| 6 Mullard Transistors and diode | 42/6 |
| Constructor's Booklet | 2/- |
| 3 ohm O.P. Trans. O.P.T.1 | 10/6 |

**NEW MULLARD TRANSISTORS** OC71 6/-, OC72 7/6, OC81D 7/6, OC81 7/6, OC44 8/9, OC45 8/6, OC171 10/6, AF117 9/6.
**Sub Miniature Condensers.** 0.1 mFd. 30v.. 1/3. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100 mFd. 15 volt 2/6 ea. Transistor Holders 1/3.

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

## ADASTRA 3-3 AMPLIFIER 3 WATTS HIGH FIDELITY AT LOW COST



**READY BUILT, WIRED AND TESTED** A.C. only, 200-250 V. Valves ECL86 and EZ80. 3 ohms quality output. Mullard tone circuits. Controls: bass boost, treble and volume. Separate engraved front panel with de luxe finish. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. **Bargain Price £4.19.6.** Details S.A.E. post free
*"Performs agreeably well"* (The *Gramophone*)

## BUILD YOUR OWN RECORD PLAYER AND SAVE POUNDS!!

**4 Speed Autochange or Single Player units supplied with Brand New 2-tone Portable Cabinets 17 x 15 x 8¼in. de luxe Strong carrying handle, gilt finish clips and hinges. As used by Famous Make for 29gns. models. Ready cut-out motor board 14 x 13in. Front baffle with 7 x 4in. high flux loudspeaker and 3 watt 2 valve UY85, UCL82 2-stage amplifier ready built on metal chassis 12 x 3 x 2½in. Quality 3 ohm output transformer, low hum level circuit. Volume and Tone controls. 3-core safety mains lead. All items fit together perfectly. Special instructions enable assembly in 30 minutes, only 5 wires to join! 12-month written guarantee. Available separately or package deals as below.**

**AUTOCHANGER KITS COMPLETE** (as above)

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|---|---|---|
| B.S.R. Monarch .. .. | £11.10.0 | P.P. 5/6 |
| Collaro .. .. .. | £11.15.0 | P.P. 5/6 |

**SINGLE PLAYER KITS** Complete (as above)

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|---|---|---|
| E.M.I. Junior .. .. | £9.19.6 | P.P. 5/6 |
| E.M.I. auto stop/start .. | £11.5.0 | P.P. 5/6 |

**OR SEPARATELY**

| | | |
|---|---|---|
| Cabinet with cut out board to your choice | £3.9.6 | P.P. 3/6 |
| Amplifier with 7 x 4in. speaker | £3.17.6 | P.P. 2/6 |

**AUTOCHANGERS**

| | | |
|---|---|---|
| B.S.R. UA14 .. .. | £5.19.6 | P.P. 4/6 |
| B.S.R. UA16 .. .. | £6.17.6 | P.P. 4/6 |

**SINGLE PLAYERS**

| | | |
|---|---|---|
| E.M.I. auto stop/start .. | £5.10.0 | P.P. 4/6 |
| E.M.I. Junior .. .. | £3.7.6 | P.P. 3/6 |

**TRANSCRIPTION UNITS** Stereo/Mono

| | | |
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| Garrard 4HF .. .. | £16.10.0 | P.P. 5/- |
| Philips AG1016 .. .. | £12.5.0 | P.P. 5/- |

**BARGAIN**

| | | |
|---|---|---|
| B.S.R. Autochange UA12 Stereo/Mono .. .. | £7.10.0 | P.P. 4/6 |

Replacement sapphire styli available from 5/3. Replacement X-tals from 15/-; Stereo from 31/6.

**BARGAIN SINGLE PLAYER KIT 200/250 v. A.C.** (less cabinet)

**£5.15.0** Post 5/-

With 2-stage Amplifier; 3-watt; 2 valves, UCL82, UY85: High-flux 5in. speaker; 4-speed E.M.I. Turntable. 16, 33, 45, 78 r.p.m.; Crystal Pick-up for LP/STD. Records, 7in, 10in., 12in.; Cut out Mounting board 12½ x 9¼in.

**ARDENTE TRANSISTOR TRANSFORMERS**

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

**ARDENTE TRANSISTOR VOLUME CONTROLS**

| | |
|---|---|
| VC1545, 5K or 1 meg. with switch dia., .9 in., | 5/3 |
| DEAF AID EARPIECE, Xtal or magnetic, | 7/6 |
| SUB-MIN. JACK and PLUG, | 2/6 pair |

Panel mounting fuse-holders, 2/-.
Fuses, 60 mA to 5 A., 6d.

**MINIATURE PANEL METERS.**
Size 1½in. sq. Precision jewelled bearings, 2% accuracy, silvered dials, black numerals and fine pointers, zero adjustment screw on front of meter. 0-1 mA, 27/6; 0-5 mA, 27/6; 0-300 V., 27/6 ;0-50μa, 39/6; 0-500μa, 32/6. "S" Meter 35/-.

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*Telephone:* THO 1665
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# Practical Wireless

Vol. XXXIX No. 682 DECEMBER, 1963

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## Contents



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



## The Fascination of Short Waves

THIS month we have pleasure in presenting the second of our new series of blueprints. Continuing the theme of last month's beginner's short wave receiver and data chart, it features a versatile but simple short wave transmitter, suitable for the newly licensed amateur.

These two designs were selected because it was felt that, whatever fashions and trends come and go, interest in the short waves will always remain high and attract new followers.

The lure of short wave listening is as strong as ever, though it has changed in many ways throughout the years. One of its fascinations is the fact that something of interest is receivable at any hour of the day or night. Of the wide range of transmissions possible to pick up, even on simple equipment, for most newcomers the big attraction is the reception of broadcasting stations from all over the world.

A certain percentage of listeners, however, inevitably becomes drawn to the activity to be heard on the various wavebands allocated to amateur transmitters. And of those taking more than a casual or transient interest in these proceedings, a certain pattern of progress often emerges.

At first, the thrill of even receiving far distant amateur signals is sufficient, especially with the initial mystery of the amateur radio "language". But having become familiarised with the reporting codes, the "Q" abbreviations, etc., the keen newcomer gradually acquires the basic skills of short wave listening—what bands to use, when to listen, how to log certain parts of the world, etc. He also appreciates the principles and procedures of amateur operating and possibly starts to keep notes or a log book and to track down the "rarer" countries.

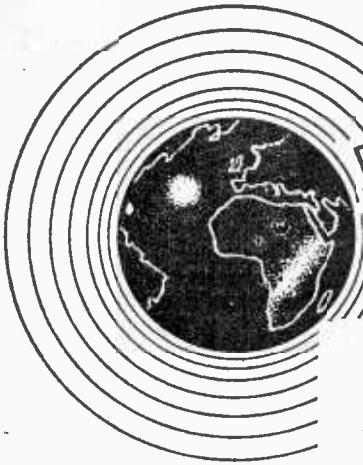
At this stage, some (though, unfortunately, far too few) enthusiasts decide to learn the morse code partly to conquer new frontiers and partly to give a considerably wider scope to their DX hunting.

A listener who has gone this far is almost certain to turn his mind to the possibility of getting on the air himself. Many listeners who cannot read morse think on these lines too. And it is here that the majority of enthusiasts are in need of guidance.

In this direction we cannot advocate too strongly the advantages of meeting other enthusiasts, particularly experienced amateurs, and the best way of doing this is to join the nearest local radio club. The prospective, and actual, licensed amateur will also derive much practical benefit from joining our National organisation, the Radio Society of Great Britain, without whom amateur radio facilities in this country would be less favourable than they are.

The short waves offer something for all tastes—listeners and transmitters and all variants thereof. One or both of our November and December blueprints, with their accompanying data, should appeal to most interests.

**Our next issue dated January will be published on December 6th**



# ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

## London-Bristol Telephone Link

LONDON and Bristol are to be connected by a microwave radio link which will provide 960 new long-distance telephone circuits between the two cities. The G.P.O.'s new 600ft. tower will be the London terminal point where transmissions will originate or be received.

Standard Telephones and Cables Ltd. has been awarded the contract to provide the equipment for the link, which will operate in the 4,000Mc/s band and which will consist of one "working" and one "standby" radio channel, with immediate automatic changeover in case of fault.

Radio waves between Bristol and London will cover the distance in a series of "hops" between a number of towers being built along the route which will receive and retransmit the signals in turn.

## *Pacific Telephone Cable Progress*

AT the time of going to press the Commonwealth telephone cable across the Pacific Ocean was less than 700 miles off being complete. All that remained at that point to be laid was a section south of Hawaii.

The cable-laying ship "Mercury", of Cable and Wireless Ltd., has the task of making the final part of the lay in the Central Pacific, which was to join the cable from a point 300 miles north of Hawaii, where H.M.T.S. "Monarch" had finished her part of the lay, to a point 700 miles south of Hawaii, to where the cable had been laid from Fiji.

## APPROACH RADARS ORDERED FOR R.A.F.

PRECISION approach radars (PAR) made by Standard Telephones and Cables Ltd. are already used extensively at airports in the U.K. and several countries overseas, and now a further 12 of the new model SLA-3C equipments are to be supplied to the R.A.F.

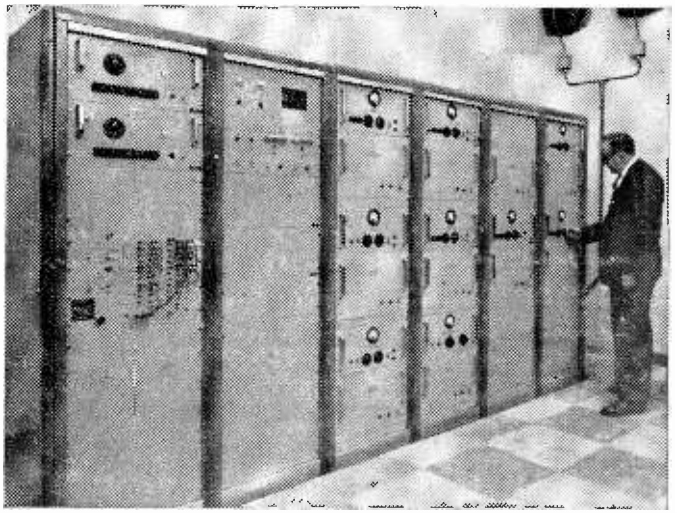
These radars are especially designed to monitor the high-speed, low-angle approaches of small fighter aircraft and this latest equipment produces more consistent and reliable echoes than earlier models. The displays on two 17in. monitor screens indicate the aircraft's position, elevation and distance from the airfield.

On the airfield itself is sited the main radar head. This is remotely controlled from the airfield control tower and may be rotated so that a number of runway approaches can be covered.

*An R.A.F. officer observing the display console of the SLA-3C approach radars*

# UNIQUE AUDIO SYSTEM FOR POWER STATION

THE installation of a comprehensive system of loudspeakers in the newly opened Rugeley power station introduces a technique of centralised control from a main control room rather than the localised on-the-spot control of the turbo-alternators which has been the practice in earlier stations.



*The 1800W audio amplifier suite in use at Rugeley power station*

The new system has been installed by Standard Telephones and Cables Ltd. and includes about 200 reflex loudspeakers which are placed at key positions on the operating floor and which broadcast instructions to operating personnel from the control room. Staff can reply through a number of microphone units in the area; these are also connected to the loudspeaker network to enable other floor personnel to hear both instruction and reply.

Considerable noise exists in the operating areas and so STC engineers used 12 15W amplifiers to feed the system. These amplifiers are housed in a special suite and provide 1,800W of audio amplification. Special microphones were also used where the high noise level would have made standard equipment unacceptable.

## U.K. SECTION OF IEEE FORMED

AS a result of the merger of the Institute of Radio Engineers (IRE) and the American Institute of Electrical Engineers (AIEE) to form the Institute of Electrical and Electronic Engineers the U.K. and Eire section of the IEEE has been duly established.

The IEEE is a "non-national" professional society of some 160,000 members organised in nine regions and with learned society activities designed to serve the expanding field of electrical and electronic engineering.

The U.K. section is part of the European region and its membership represents about half the total for that region. The section's aim is to achieve close co-operation with the IEEE, IRE and other professional bodies so that members of all these societies can benefit from the many hundreds of conferences and meetings which until now have remained practically exclusive to their own members. A more efficient exchange of matters relating to this field of engineering between the United States and the U.K. will also result from the section's activities.

The good relations enjoyed between the Institution of Electrical Engineers and both the AIEE and IRE has been extended to the IEEE, evidence of which is given in the provision made to the U.K. section by the IEEE of an official address and set of offices at the London headquarters of the IEEE.

## TRANSMITTERS FOR ROYAL NAVY

COMMUNICATION transmitters, type NT204, made by the Marconi Company Ltd., have already seen considerable service with the Royal Navy and now under a new order from the Admiralty the company is supplying more equipments.

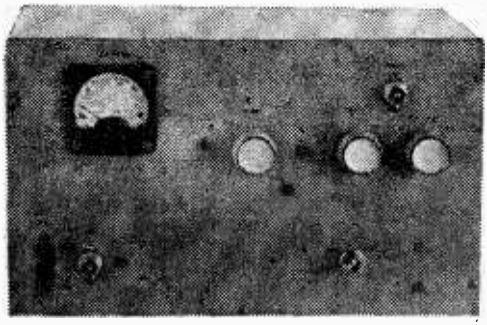
All the new equipment is for use on naval vessels, the compact design—made possible by the use of transistors and silicon rectifiers—making these 500W transmitters extremely suitable for shipboard operation.

### *INTERNATIONAL SYMPOSIUM*

THE British Institution of Radio Engineers is arranging an International Symposium on "Cold Cathode Tubes and Their Applications" which will be held in Cambridge from March 17-19, 1964.

### *RADIO COMPASS FOR LAUNCH*

FOR contestants in the off-shore power-boat race, recently held off the South Coast between Cowes and Torquay, a fast and accurate method of position fixing was vitally important as small navigational errors could cause loss of valuable time. And so this year the racing launch "Tranmontana"—last year's winner of the event—had fitted a Marconi automatic radio compass (type AD722). This is the same type of equipment that is used in many high-speed aircraft and on this occasion the equipment made use of the marine and aeronautical beacons situated along the Channel coast for a constant check on the launch's position.



# Beginner's 10watt TRANSMITTER

The circuit and wiring diagrams of this transmitter are illustrated on one side of the Blueprint given away free with this issue of ''Practical Wireless''

BY D. GIBSON (G3JDG)

EVERY year more and more people are becoming licensed to use transmitting equipment on the amateur bands. The number in England to date is around the 10.000 mark and is likely to go on increasing each year.

Unfortunately as the number of "hams" increases, the size or width of the bands on which transmission is permitted remains the same; indeed in some cases it has actually been reduced. This has inevitably led to very crowded bands with the grim outlook that they will become even more crowded as more licences are issued.

Back in the very early pioneering days the stability of a transmitter and the bandwidth of the receiver did not assume such paramount importance. If a c.w. note varied up or down even as much as a kc/s or so it did little harm since there was ample bandspace available and fewer stations, plus the wide bandwidth at the receiving end.

Nowadays the picture is very different. Frequency stability is imperative and often the only place to transmit may be a tiny gap between two other signals. Any drift at the transmitter will result in interference to one of the signals on either side, plus the fact that at the receiving end the receiver now has to sort out two signals—and has to retune each time the drift is evident.

A novice having just acquired his "ticket" is immediately faced with the problem of equipment. The receiver is often a commercial product but the transmitter is usually a home-built unit. Good designs for a suitable receiver have appeared from time to time in PRACTICAL WIRELESS as have circuits for transmitters. Unfortunately there appears to be so many different circuits with such widely differing values, etc., that the beginner, after reading many of them, becomes confused as to which design to build. Should there be a buffer stage, v.f.o. or crystal control? What type of output circuit and why for the same valve? Doe one designer specify a certain resistor as 33k while another has the value at 22kΩ? All thes questions arise and tend to confuse and cloud th issue.

The present circuit is a compromise (wha circuits aren't?). It has its limitations but it ha been designed so that the beginner may get th greatest value for cash outlay. First it is simple so simple one might say foolproof.

A large multiband rig usually has a v.f.c control to adjust, after which the anode curren may be checked. Next the meter has to b switched to read grid current of the powe amplifier and the grid tank circuit tuned up. Th drive control would then be adjusted (usually variable resistor in the screen supply of the drive valve), after which the meter is switched once mor to read p.a. anode current, and the p.a. resonate —not to mention the bandswitch or switches.

By contrast the circuit shown in Fig. 1 on th blueprint has only one meter, which is nc switched at all, and two tuning controls for us in conjunction with the meter. The third kno merely selects the desired band and once se requires no further adjustment.

The transmitter will work on four amateu bands:—1·8—2·0, 3·5—3·8, 7—7·1 and 14—14·35Mc/s with only two crystals if desired. I also has the advantage that a v.f.o. may b constructed later and plugged into the crysta socket and/or the unit may be used as a drive for a higher power p.a. stage perhaps containin valves like the 807 or the newer 6146. It also ha the advantage in that it is completely self contained with its own power supply unit an would, of course, serve as a very useful standb transmitter.

It might be as well to discuss the design and choice of circuit before moving on to the actual constructional side. This will enable the newcomer to appreciate some of the problems of selecting a suitable circuit.

## DESIGN CONSIDERATIONS

Fig. 7 depicts some of the possibilities for a small transmitter suitable for the l.f. bands. The combination of Fig. 7(a) shows a variable frequency oscillator with its own power supply unit. The v.f.o. is coupled directly to the aerial, which is undesirable since the v.f.o. should (for good stability) work into a constant load. The aerial does not prevent an unvarying load; it will vary with frequency and slight movements in the wind will be reflected back to the frequency determining circuits. Any harmonics generated by the v.f.o. will be taken directly to the aerial and this again is not a good practice.

Fig. 7(b) is identical to Fig. 7(a) except that the frequency is now controlled by a quartz crystal. Many might think that this is the answer, for if the crystal provides stability and will oscillate at only one frequency the varying load argument no longer exists, and this arrangement should be an ideal and very simple transmitter.

Unfortunately this is not true and the frequency stability of a crystal *can* vary—temperature is one factor. Where frequency stability is vital the crystal is kept in a crystal oven to ensure that the temperature is constant. Also, high output and stability do not go together. The aerial coupling might well prove tricky and there would probably be a tendency for the note to vary as it was keyed or, put another way, the note would chirp.

Ideally Fig. 7(c) would seem to fit our requirements. It has a crystal oscillator for stability, run at a low level, followed by a p.a. stage which fulfils two important functions—it amplifies the signal and its grid presents a more constant load to the c.o., effectively isolating it from the antenna.

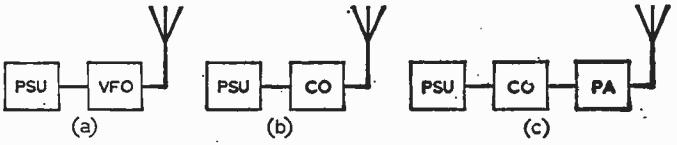



*Fig. 7: Three possible arrangements for a low power transmitter.*

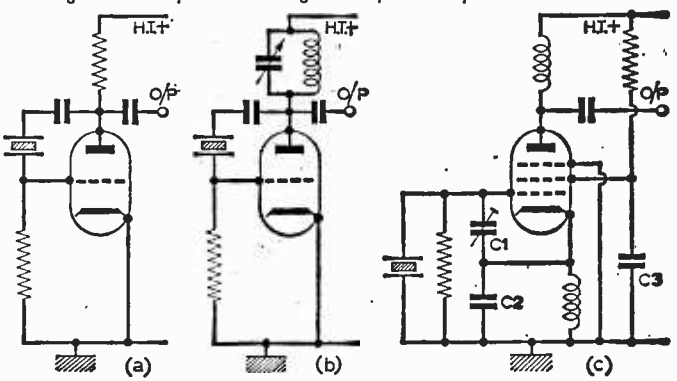



*Fig. 8: Crystal oscillator circuits.*

### C.O. Circuits

Having decided upon the basic structure the immediate problem was the design of a suitable c.o. and the first circuit considered is shown in Fig. 8(a). This is one of the simplest circuits for a crystal oscillator but turned out to be inadequate for present requirements. The anode voltage must be kept very low, otherwise there is a great danger that the crystal will heat and fracture. With low anode voltage there was sufficient drive from the fundamental frequency but insufficient output on harmonics. Since the second harmonic would be the only one required it would be possible to place a tuned circuit in the anode as in Fig. 8(b), but this would have meant the complication of two resonant circuits, one for 3·5Mc/s and one for 14Mc/s, plus switching, and although this arrangement is quite feasible it does present extra switching complications and was rejected for that reason.

Since the triode failed to produce the necessary output and as resonant anode circuits were decided against, the obvious choice was to use a tetrode or pentode and this arrangement is shown in Fig. 8(c). This circuit differs from the previous ones in several ways. First the crystal is now between grid and earth. The oscillatory circuit is set up between grid and cathode. Crystal excitation can be controlled by the values of C1 and C2, which form a capacity tap. If C1 is variable it can be adjusted for each crystal; however, it is possible to arrive at compromise values for C1 and C2 and so avoid the use of another variable.

The output is taken from the anode circuit and is electron coupled to the grid circuit via the inter-electrode capacitances of the valve. The screen is at earth potential as far as radio frequency is concerned, due to the low impedance path offered by C3. Greater output is available from this circuit, due to the higher gain of the pentode, together with higher anode voltages permissible, the screen being held at a lower potential. This arrangement proved to be satisfactory and a reasonable output was obtained on both fundamental and second harmonic.

### P.A. Arrangement

P.A. (power amplifier) stages can assume a wide variety of forms but the two factors most varied are (a) the means of obtaining bias and (b) the tank (anode) circuit.

Fig. 9(a) shows battery bias and a conventional parallel tuned circuit anode load. Both these methods were decided against. Battery bias required an odd battery floating about and is seldom used these days anyway. The type of anode load shown has the disadvantage that both

sides of the variable capacitor are at h.t. and this would involve constructional difficulties.

It would be possible to earth the anode tuning capacitor by the arrangement shown in Fig. 9(b) and this is a favourite with many constructors. However, if one adopts Fig. 9(b) there still remains the problem of feeding the aerial. Link coupling is fine but remember this is a multiband transmitter and what is right for 1·8Mc/s will be no good for 14Mc/s. The link turns will need to be varied and, probably, so will the position of the link up and down the coil. This link coupling problem also applies to Fig. 9(a).

A method of avoiding these difficulties is shown in Fig. 9(c). Here the aerial is tapped up and down the coil and a very precise match may be obtained in this way, L1 acting as a form of auto-transformer. However, any unwanted harmonics present in the anode will be fed directly to the aerial and there *will* be harmonics present. (Didn't we use a pentode c.o. in preference to a triode for the express purpose of greater harmonic output?)

Also, with a coil of some 40 turns there will be a great number of tapping points to ensure correct matching on four bands and a rather unwieldy switch needed for S1.

The final arrangement arrived at is shown in Fig. 9(d). It has a mixture of cathode bias and bias derived from grid drive. When drive is applied a voltage will be set up across R1, automatically biasing the grid. This type of bias also tends to be self-adjusting—the greater the drive the greater the bias.

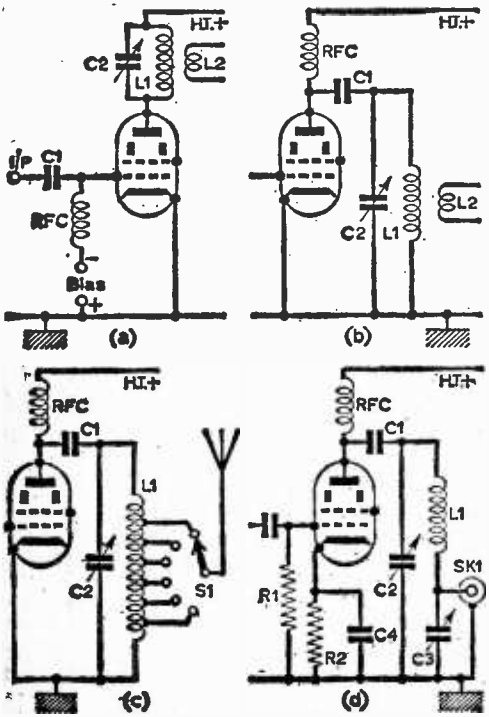



*Fig. 9: Various power amplifier stages.*

Since R1 does all this why do we also need cathode bias? R2 is included as a safety bias because in the absence of drive (i.e. when the key is up) there will be no bias on the p.a. valve and its anode current, with no bias to limit it, would immediately soar to such a value that the valve would enjoy a short life, although a bright one. R2 limits the anode current to a safe value. The value of R2 is calculated so that with no drive the p.a. is in Class A and, with the key down, in Class C.

### *Aerial Matching*

The output circuit is the familiar "Pi" coupler; it has two variables and is easy to tune. It saves a coil with many taps and at the same time will match a number of different aerials, although it is happiest feeding a low Z in the region of 80Ω. By fortunate coincidence this is just about the impedance of a centre-fed dipole.

One of the assets of a "Pi" tank is that it helps in the reduction of interference due to harmonics and is said to afford four times the protection than would be given with 9(a) and 9(b). This does not mean that if a "Pi" tank is used no harmonics will get through to the aerial, but it is a step in the right direction.

Choice of valves will depend largely on the output required. The transmitter was to be low power—not more than 15W, bearing in mind that for one of the bands (1·8—20Mc/s) only 10W is permitted anyway. The Brimar 5763 is a valve intended for r.f. use and has a maximum output of just 15W, so that running it around 10W allows it to "cruise along" comfortably.

For those who may consider that QRP (low power) doesn't stand much chance these days, especially competing with 100W stations, it is interesting to note that GW3AHN has worked some 300 different countries using only 25W. The difference between 25W and 15W at the receiving end is infinitesimal.

## *FINAL DESIGN*

The final circuit is that of Fig. 1 on the blueprint. It consists of a pentode crystal oscillator, followed by a beam tetrode power amplifier. The output circuit is the familiar "Pi" coupler and values are so chosen that it will resonate on any one of the four bands—1·8Mc/s—14Mc/s. On the two lower bands (1·8Mc/s and 3·5Mc/s) extra capacitance is switched in via the bandswitch S1. The same switch also selects the correct value of inductance for the band required.

### *The Power Amplifier*

A safety bias resistor of 150Ω is situated in the cathode lead of the p.a. in order to limit the anode current during no-drive periods and this resistor is bypassed to earth by C7. This combination gives approximately 7V bias, which is sufficient to limit the valve current to a safe value and corresponds to the optimum value (7·25V) for Class A operation.

The screen resistor R6 is merely to lower the h.t. voltage to 250V, which is the maximum voltage recommended by the valve makers. C8 is the normal screen bypass capacitor. The anode is fed via the meter and L3. The choke ensures that r.f. is kept out of the h.t. line and also out of the

meter. To further assist this the meter and L3 are decoupled to earth via C6.

C9 is a blocking capacitor to isolate VC1, VC2 and the coil L4 from the h.t. and to prevent the aerial being connected directly via L3 and L4 to h.t., a habit frowned on (particularly by the GPO) for reasons of safety.

The value of the grid resistor is chosen to provide around −60V bias under key down (i.e., drive applied) conditions. The correct value would really be slightly lower than would at first appear correct since some 7V bias is constantly applied through the action of the cathode resistor. However, in this instance the preferred value of 22kΩ was tried and proved satisfactory in every way.

C4 blocks the h.t. from the grid of V2 and also "passes" the r.f. signal on to its grid. It should be a good quality component since a capacitor which is not reliable in this position can cause a wealth of grief at a later date.

### The Oscillator

The r.f. choke anode load L2 in the anode of V1 again assists in preventing r.f. from getting into the h.t. line and is supported in this application by C3. The screen of V1 is fed via a potential divider formed by R2 and R3, the latter being decoupled to earth by C5. The value of R2 is chosen so as to keep the screen voltage down to a safe value and the potential divider arrangement helps to keep the screen volts a little more constant since current through the valve will vary greatly when the stage is keyed.

The regulation would be far superior if R3 had been of a lower value but the network would then draw far more current, requiring the use of high wattage resistors.

The oscillatory circuit proper is formed between grid and cathode of V1. The crystal X1 fixes the frequency with C1 and C2 forming a capacity tap across it. The 68kΩ resistor R1 is used to provide the means of developing sufficient bias and the r.f. choke L1 allows a d.c. return for the cathode while still allowing it to take up the correct r.f. potential from the tap formed by C1 and C2.

### R.F. Choke

It is very desirable that the three r.f. chokes be dissimilar. As will be appreciated, an r.f. choke is really a coil and possesses a certain inductance. Similar r.f. chokes will have similar inductance. This inductance, together with stray capacitance, which is always present, forms a tuned circuit which will be resonant at a particular frequency.

It is now very clear that if chokes are similar there is a very good chance that they will resonate at the same frequency and one will have, in effect, a tuned-plate/tuned-grid oscillator giving rise to spurious effects—a most undesirable affair, particularly in a transmitter which is radiating a signal.

### Keying

The place to key is always a debatable subject and a number of solutions to this problem are possible. The method shown is very common and is used in a great number of transmitters.

Many amateurs prefer to key in the cathode of the p.a., leaving the c.o. always running. This usually means that greater currents are presented across the key contacts themselves, tending to give rise to key clicks.

It appeared that a lower power stage would be more suitable to key, although the possibility of chirp when keying a c.o. would have to be considered. However, the circuit as shown has proved very satisfactory.

### Key Clicks

It may in some instances be necessary to place a small capacitor across the key lead if clicks become objectionable. If this is done the capacitor should be wired with the shortest possible leads directly across the contacts of the key itself. A value of 0·1μF is suggested as a starting point.

### Construction

The first step in construction is, of course, to obtain a suitable chassis and case. The items used here are supplied complete with front panel by Messrs. H. L. Smith (see components list), the front panel and case being already sprayed in a hammer finish.

The dimensions shown in Figs. 10 and 11 are for the particular components used in the original model and may vary slightly if other items are substituted. For instance, it may be that a 10H choke is either to hand or more easily obtainable than the 15H shown. Also, of course, different makes of 10H or 15H chokes may have the holes in the mounting lugs spaced differently and this should be borne in mind when drilling the chassis.

The safest practice is to collect all the components first before starting work with the drill. These can then be placed on the chassis in their appropriate positions and the desired places for the mounting holes can be marked exactly, thus eliminating any guesswork. Care should be exercised when mounting the valveholders to ensure that they are orientated in the correct positions.

The holders of V1 and V2 are so aligned as to provide the shortest possible lead between the anode of V1 and the grid of V2. The small shield between the c.o. and the p.a. stage may not be necessary. However, it is always a good plan to ensure no interaction between oscillator and amplifier as any feedback between the two stages would be disastrous.

The screen was made in approximately two minutes from a piece of tinplate cut with a pair of the XYL's scissors. Aluminium would doubtless be considered better and some may point out that where tinplate and chassis meet there will be a junction of dissimilar metals which may provide a thermo effect. However, no deleterious effects have been noted to date but those who have some aluminium to hand may prefer to use that metal. The tinplate is very cheap and can be obtained from most good ironmongers.

### Front Panel

The front panel is quite straightforward so far as construction and metalwork are concerned and readers are referred to Fig. 10. It is perhaps a little unusual to use a coaxial socket for the key instead of the more common jack plug and socket combination; however, with the coaxial plug

method it does mean that the key lead is shielded all the way from the key right into the rig itself. Also it's not a very brilliant practice to carefully shield and screen a transmitter only to radiate spurious signals from a key lead. The coaxial cable also affords a measure of protection from outside influences on the oscillatory circuit via the key lead itself. For those who would be happier with a jack plug and socket these may be substituted but the use of screen lead is strongly advised.

The crystal socket is a double one to take 10X and 10XJ types, both of which are obtainable on the surplus market. It is, of course, possible to put all the crystals inside the case and put a rotary switch on the front panel, thereby perhaps affording a more neat and compact layout.

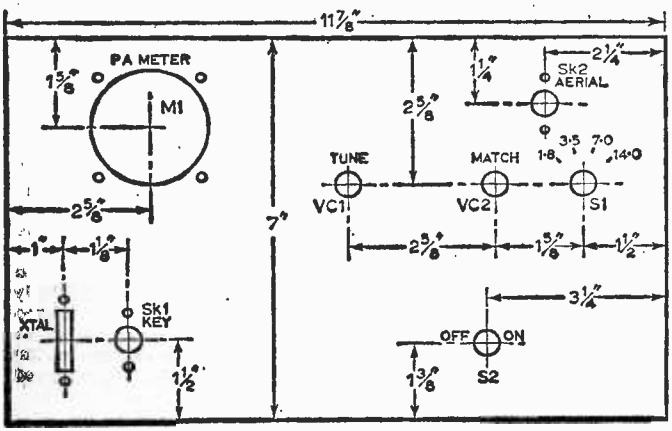



*Fig. 10: Details of the front panel.*

It should be remembered, however, that miniature valves run very hot and it was decided to use the plug-in method in order to keep crystals out of the case and out of any temperature change that must inevitably occur. This also facilitates the rapid exchange of crystals.

Although designed to work on fundamentals it is permissible to use only two crystals and still enjoy operation on four bands, V2 being made to act as a frequency doubler on 3·5 and 14Mc/s at slightly less efficiency.

### Wiring Up

The wiring up of a transmitter requires care if satisfactory results are to be obtained. All leads, particularly around the valve bases, should be as short and direct as possible. Pretty wiring with neat little bends and odd leads across to a tagboard are all very well but in a circuit which is to generate a stable signal it is only inviting trouble.

Note that no tagboards have been used at all and that all connections have been made right up to the valve pins themselves. The "leads" to the capacitors forming the capacity tap (C1 and C2) are less than ¼in. long! The components forming the grid circuit are kept well away from those of the anode circuit and the heater wiring is in twisted flex, the pin 4 of each valve being earthed at the valve base.

If these few commonsense rules are observed very little difficulty should be experienced.

Note that the position of the c.o. valveholder and key socket SK1 are positioned to practically eliminate any leads to L1, while L2 has a longer lead from the valve pin to allow it to be kept as far as possible from the L1. It is shielded from L3 by the tinplate screen and L3 is at right-angles to it, so no trouble should be experienced on this side.

The mains wiring to the on/off switch is twisted and tucked round the edge of the chassis purposely to keep it away from all other wiring.

### Choice of Crystals

A point to remember as regards choice of frequency on which to operate is that in general most bands are roughly divided into phone and c.w. portions. The tendency is for c.w. stations to use the l.f. portion and users of phone to occupy the h.f. portion. This should be borne in mind when selecting a crystal and is especially important if frequency doubling is envisaged.

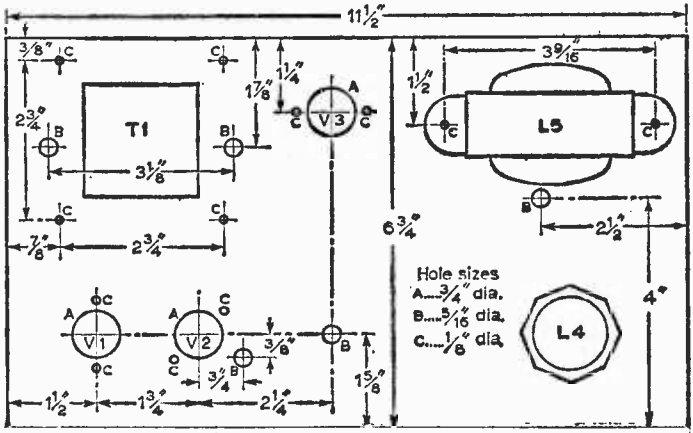



*Fig. 11: The layout of the chassis.*

### Tuning Up

Insert crystal, set S1 to appropriate band and depress the key. With a 240V 15W bulb connected to SK2 set VC2 to approximately mid position. Tune VC1 for a minimum dip—i.e., lowest reading on M1. The 15W bulb should now glow, indicating r.f. Rotate VC2 to bring the meter reading up to the desired input. The bulb should now

—continued on page 736

# transmitting aerials

## by G3JDG

*Figure numbers referred to in this article relate to illustrations given on the reverse side of the Blueprint.*

THE problem of a suitable aerial is one which confronts every amateur transmitting and receiving station. Unfortunately a well designed aerial which gives very satisfactory performance at one location often fails to duplicate the results when erected at another. This is most puzzling to some, since the exact dimensions are precisely the same in both cases.

It should be remembered that many things affect the performance of an aerial. Proximity to other objects is one example, especially if the objects are earthed or are metal (such as telephone wires, guttering etc). Height above ground is another factor which can affect performance, and even the nature of the soil itself can be a determining factor.

### *Half-wave Dipole*

The "basic" aerial can be considered as shown in Fig. 1 on the blueprint, and will be recognised by many as the conventional half-wave dipole. "Basic" because the performance and radiation patterns of nearly all antennas are given "with reference to" the dipole, and because the half-wave dipole has been with amateur radio since its pioneering days.

It has distinct advantages over its rivals and is well worthy of consideration. It bears the merit of simplicity. No stubs to tune, no complicated matching devices, and no tricky tuning procedures.

Construction? Take a piece of wire half a wavelength long at the transmitting frequency, cut it in half and connect a length of ordinary co-ax cable, and hoist it up as high as is practicable. All relevant data neded is given in Fig. 2.

It will be immediately obvious that very few people will have sufficient space to errect a dipole for 1·8Mc/s and many others will not even be able to manage one for 3·5Mc/s. However the 7Mc/s length will fit most gardens and the length of 14Mc/s will enable even the smallest space to be utilised.

It is permissible to tilt the aerial or bend it and so save further space. The polar diagram will not remain the same but this is not such a criterion where space is a vital factor. Fig. 3 on the blueprint gives two ideas along these lines.

### *Polar Diagrams*

A polar diagram is a pictorial representation of the radiation characteristics of an aerial. This merely means that if r.f. is being fed into an aerial the polar diagram will tell us in which direction it is being radiated. If the system radiates more in one direction than another it is said to be directional.

The polar diagram of a dipole is approximately that shown in Fig. 4. The line AB represents the aerial looking directly down from above. This polar diagram tells us that with this particular antenna there will be maximum radiation at right angles to the wire and minimum off the ends. Thus if it is desired to work certain countries in a particular direction, the aerial should be erected bearing this in mind.

The dipole has one great disadvantage: it will only function well on the band for which it is cut. There is one exception to this rule and that is the 7Mc/s dipole, which will also work quite well on 21Mc/s.

Against this disadvantage are the facts that it is easy to feed and it is "selective", as it will only work on one band and is in effect another tuned circuit. This extra selectivity is a decided asset as far as T.V.I. (interference with television reception) is concerned and also aids in reception on crowded bands.

### *Pi-coupler*

The Pi-coupler is famous for its ability to match various loads successfully. However it is usually designed to feed into a low impedance and the output or loading capacitor is rated accordingly. One way to ensure a low impedance is to select a single length of wire a quarter-wave long. Non-mathematicians refer immediately to Fig. 5 on the blueprint!

### *Single Wire*

As will be seen, the space requirements are much less than for the dipole, and for a limited space this type of aerial may prove the answer. Note that the length is measured right from the transmitter output terminal to the far end. Often a random length somewhere between the dimensions given will load up satisfactorily. If difficulty is experienced in loading such a wire it will often suffice to lengthen or shorten it by a few feet.

### *Vertical Aerial*

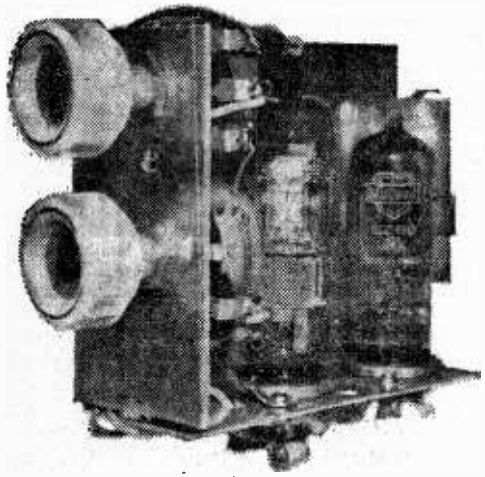
No examination of aerials would be complete without mention of the vertical type. This has distinct advantages over the others and is favoured by many Dx. enthusiasts.

Its first advantage is that it is omni-directional and a glance at the polar diagram in Fig. 6 will show that it radiates (and receives) equally well in all directions. Again the view of the aerial is from directly overhead.

Its second advantage is the one that makes it so attractive to amateurs: it radiates a great deal of the energy at low angles, which is an extremely desirable factor in Dx. work. It is possible to construct a multi-band vertical which will give a good

*—continued on page 731*

# MAKING A MODERN RECORD PLAYER



*by A. Sydenham*

NOW that ECL86 valves are easily obtainable it is possible to construct a useful portable record player for a reasonable sum. The ECL86 is a modern noval-based triode-pentode valve, the triode portion having an amplification factor of 100. The output pentode will deliver up to 4W of audio with an input of only 3·2V r.m.s. and because this is more than adequate for the use required, some losses due to tone control insertion can be afforded.

Record players are always in demand especially by the younger members of families and a well-built, safely constructed version makes an excellent gift and is usually well received if the case is of handsome appearance. Various portable cases are available to readers from time to time via advertisers announcements—as are complete kits—but before making a final decision to purchase it is wise to consider exactly what is being offered.

One of the first things to be decided is whether the proposed record player is to incorporate a single-play or autochange unit and although the former kind does allow cheaper results the latter type is generally preferable as up to ten records can often be loaded on at the start and so save the user the wearisome job of putting each one on separately. Modern autochangers are not over-complicated and do handle discs less clumsily than some ham-fisted humans!

## MAINS TRANSFORMERS

It will be discovered that a great many "kit" types employ the a.c./d.c. principle, no mains isolating transformer being fitted. This principle has always been frowned upon by this journal and rightly so, for danger to life can result unless great care is taken. Of course, deletion of the mains transformer saves space and weight but the financial saving is not so great as might at first be supposed, since from a constructor's angle the high capacitance and voltage capacitors required in transformerless versions are not inexpensive. At the present time a half wave "converter" type mains transformer capable of supplying up to 45mA can be purchased for less than fifteen shillings.

## A SUITABLE AMPLIFIER

Details of an excellent little amplifier for use with a portable record player are shown in Fig. 1 where two valves are used, one as a rectifier and the other as a 2-stage audio amplifier. Use of an indirectly heated valve instead of a metal rectifier is preferred because with the valve full h.t. is "delayed" (due to warm up time) and is not applied immediately to the amplifier proper.

At switch-on h.t. builds up steadily due to the rectifier action at pin 3 of V2. The h.t. is applied direct to V1 anode via the output transformer primary winding, whilst h.t. is applied to the remainder of the circuit via R4. The reservoir capacitor C6B and the smoothing capacitor C6A, are large enough to ensure silent running and there is no hum. These arrangements for h.t. supplies allow maximum output and at the same time permit use of a low wattage resistor for R4.

The fuse shown connected in the "earthy" lead of the mains transformer secondary winding is not absolutely essential and in any case may consist quite simply of a small 0·15A torch bulb.

The output circuit is quite conventional and fitment of the volume control VR2 in its grid circuit has been found most satisfactory.

## TONE CONTROL

Extensive tone controls and negative feedback circuits are rather superfluous in the type of construction under review, for the necessarily small loudspeaker housed in restricted surroundings sets a limit to bass response. A simple control of tone is all that is required and is best fitted at the input where amplitudes are comparatively low.

In Fig. 1 a portion of the output from V1A developed across VR2 is re-introduced to V1A grid via frequency conscious C1, and the response is varied as VR1 is operated. An alternative bass cut/boost arrangement is shown inset in the diagram and both have proved quite satisfactory in practice, either being a considerable improvement over the frequently encountered "top cut" devices fitted to output transformers.

The value of R*in* may be selected experimentally in conjunction with the type of crystal cartridge employed, but normally values in the range of 56kΩ-150kΩ will be suitable.

## CONSTRUCTION

Detailed plans cannot be given because cases vary so widely. Usually these amplifiers are built

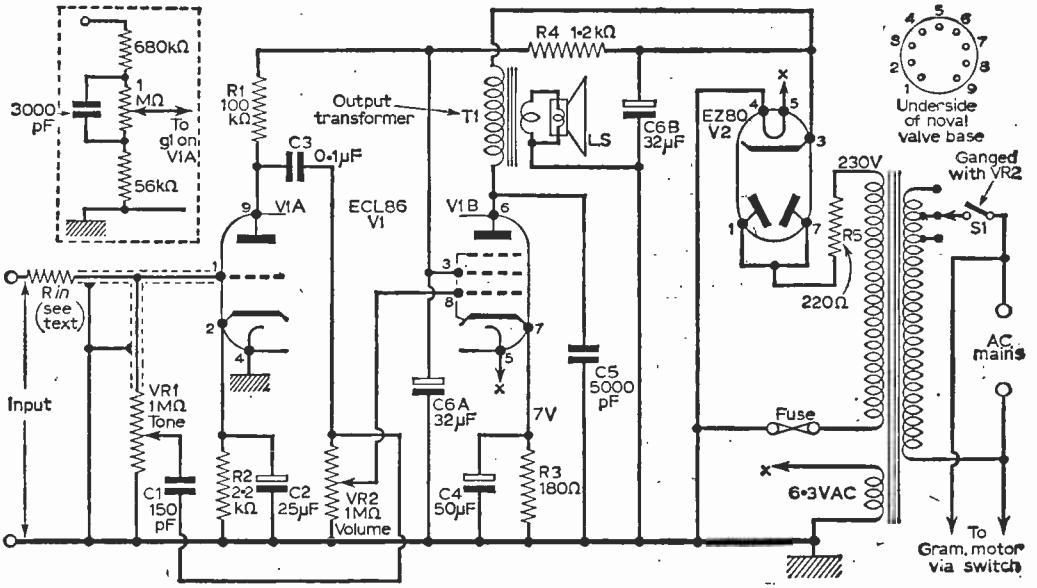



*Fig. 1: Complete ECL86 record player amplifier.*

on to the baffle board which carries the loudspeaker, and space is restricted.

A small rectangle of 18s.w.g. aluminium (say 8in x 5in.) is generally suitable as a chassis, it being bent about 1¼in. from one end into an "L". Both valveholders can normally be fitted to the narrowest portion and the two controls on the other whilst the mains transformer, output transformer and C6 can be affixed on the baffle board in the most convenient position.

A certain amount of ingenuity is often required and it is important to consider the locations of leads carrying mains voltages. These leads must never be left "floating" from their connections but must be securely anchored.

## WIRING

During wiring it is usually convenient to connect R4 directly between pins 3 of V1 and V2 together with the appropriate C6 section. Screened leads must be used at the input and a short length of thin coaxial cable connected from *Rin* and chassis to the tag strip found on the underside of the deck will be suitable. Screening must be connected to chassis at both ends. Supply leads from the deck motor are carefully connected to T2 and S1 as shown, assuming the motor to have its own on/off automatic switch. In this case leads for 230/250V a.c. working should be selected; any other leads should be tied off and insulated.

When the final setting up stage is reached the benefits of the mains isolating transformer will be appreciated, for it will be realized that no danger results from leaving control knob grub screws uncovered, etc.

A photograph of one amplifier constructed by the author is shown in the heading illustration. On this version the metal "chassis plate" required two bends because control knobs had to erupt from the carrying case at one side. When fitting any such chassis try and arrange for the valves to be operated upright.

If when a trial record is played the "top" response seems excessive, increase C5 in value; if overloading occurs at high volume settings increase the value of *Rin*. Should hum occur suspect the triode input circuit and leads to VR2. ■

### COMPONENTS LIST

**Resistors:**

| | | | |
|---|---|---|---|
| *Rin* | see text | R3 | 180Ω 1W |
| R1 | 100kΩ ½W | R4 | 1·2kΩ 1W |
| R2 | 2·2kΩ ½W | R5 | 220Ω 1W |

VR1 1MΩ potentiometer, linear (log. for inset circuit)
VR2 1MΩ potentiometer, log. with switch

**Capacitors:**

C1 150pF ceramic or mica
C2 25μF electrolytic 6V
C3 0·1μF paper 350V
C4 50μF electrolytic 25V
C5 5,000pF ceramic 500V
C6 32 x 32μF electrolytic 350V
(All electrolytics wire ended)

**Valves:**

V1 ECL86 V2 EZ80

**Transformers:**

T1 Output transformer: Primary 7000Ω; Secondary 3·75Ω or to suit loudspeaker
T2 Mains transformer: Tapped Primary. Secondaries: 0-230V at 45mA, 6·3V at 1·5A (Osmabet)

**Miscellaneous:**

Valveholders (2) Noval. Metal for chassis, etc.

# RADIOACTIVITY IN RAIN

*A description of experiments carried out using geiger counter equipment previously published in P.W.*

**By M. L. Michaelis**

IN the past years this magazine has published a number of articles dealing with Geiger-counters, to introduce our electronically-minded readers to this fascinating and topical field of "wireless experimenting" in the broadest sense. In particular, we published a simple digital counter with simple Geiger head in P.W. February-April 1962, and in more recent times we published a highly sensitive Geiger head for liquid samples (P.W. December 1962 and January 1963) followed by an advanced digital register for working with this unit (P.W. April-June 1963).

The articles just mentioned contained detailed information on some methods of preparing samples, and particularly on physical principles involved in these measurements and their methods of interpretation. In the meantime, detailed experience over a period of some two years has been obtained in operating the prototypes, and it is felt that a brief summary of the sources leading to successful signals with these units will be valuable to those readers who are working with equipment built to our designs in this field.

Much has been learnt by the authors in these directions since the units were originally built and published, and it is customary amongst the brotherhood of experimenters not to hide the information gained under a bushel! In passing, let it be said here that the designs as published have proved their reliability. All prototypes have been in extremely long periods of operation up to two years now, and the very few breakdowns experienced have been very trivial.

## OBTAINING SIGNALS FOR THE SIMPLE GEIGER HEAD

This unit, as shown on page 1108 of the April, 1962 issue of this magazine, used the Mullard MX146 Geiger tube, or preferably the companion type of greater sensitivity with a mica window to admit the radiation.

Measurements are made with this tube by holding a solid or liquid sample, whose radioactivity (atomic radiation emission) is to be determined, as close as possible to the Geiger tube, or window thereof if present. A suitable container such as a test tube can be employed for this purpose.

A point discovered by the author only after some period of usage of this arrangement is that very much improved sensitivity is obtained if a small screw-capped p.v.c. bottle of about 10cc. capacity is used as container (such as used by doctors, or used for specimens in biological experiments), and the sample contained in it is dry or nearly dry. An increase of effective sensitivity of up to 10 times was found compared to the use of liquid samples in test tubes, so that under some circumstances this arrangement gave signals, from samples on damp filter-papers in the p.v.c. bottles of comparable magnitudes to signals obtained with the inherently more sensitive liquid-sample Geige tube of the "Advanced Geiger Head" (started P.W. December, 1962).

It has thus been found, surprisingly, that the two types of head we have published are not the competitors originally imagined, but in fact are complementary, and that it is quite useful to have both of them to hand if one is embarking upon these experiments as an amateur in any great way.

The simple Geiger head, with the p.v.c. sample bottle, is useful for solid samples—particularly those contained on filter papers. The advanced Geiger head is useful for all detailed studies of liquid samples, where superior sensitivity is obtained because these can be filled directly into the Geiger tube involved.

## TYPICAL STUDY OF A RAINFALL

Bearing the above remarks in mind, and assuming both types of Geiger heads and associated digital counters have been built and are available as published, the following method of studying a typical rainfall has now been perfected and continually leads to most interesting results.

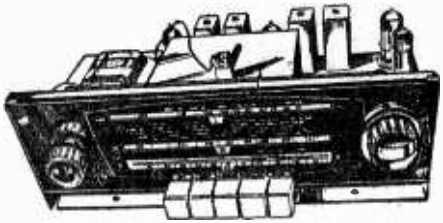
A small plastic bath tub of about two square feet area should be stood out in the open on the lawn or some other suitable position when rain is expected, and as soon as about a quart of water has been collected (which can be within half an hour or less if the rain is at all heavy), the rain water should be taken to the workshop and dealt with *quickly* as described below.

If necessary, experiments with weaker rainfall can be attempted from samples as small as a few spoonfuls. In fact, the radioactivity of initial or slow rainfall is often many times greater than that of heavy rainfall, so that the actual signals then obtained may not be much less than with large samples!

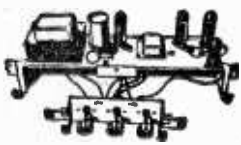
## FIRST IMMEDIATE MEASUREMENT

The first step of each routine examination of rainfall is to give the advanced Geiger head an *immediate* fill (some 8cc only needed), without any prior treatment, and set the Digital Register going

## BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £13.13.0 (Carriage Paid)



A.C. ONLY. Chassis size 15 x 6¾ x 5¼in. high. New manufacture. Dial 14¼ x 4in. in 2 colours, predominantly gold. Pick-up Ext. Speaker, Ae., E., and Dipole Sockets. Five push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested. O.P. Transformer. Tone Control. 1000-1900 M.: 200-500 M.: 88-98 Mc/s. Valves EZ80 rect.; ECH81, EF89, EABC80, EL84, ECC85. Negative feed-back circuit. Speaker and Cabinet to fit chassis (table model), 47/6 (post 5/-). 10 x 6in. ELLIPTICAL SPEAKER 25/- to purchasers of this chassis. **TERMS:** (Chassis) £3.10.0 down and 5 monthly payments of £2.4.0. Cheap Room Dipole for V.H.F., 12/6. Feeder 6d. per yard. Circuit diagram 2/6. **ALTERNATIVE DESIGN.** L.W. 1000-2000 M.: S.W. 17-50 M. (6-17 Mc/s): M.W. 200-550 M.: V.H.F. 87-100 Mc/s: Gram. position. Dial dark brown and gold. Otherwise similar to above chassis. Price £15.15.0 (carr. paid). **TERMS:** £3.10.0 down and 6 monthly payments of £2.4.0.



## PUSH-PULL AMPLIFIER £5.5.0

(6/- Carr.)

Brand new 200/240 A.C. mains. Bass, treble and vol. controls with valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 x 3½ x 3½in. With o.p. trans. for 2-3 ohm speaker. Front panel (normally screwed to chassis) may be removed and used as "flying panel". Stereo version 2 x 4 w., same price. Fixed panel. Tone & Vol. Controls.

## TAPE RECORDER AMPLIFIER

Type TR8. Fully built, high gain, low noise, printed circuit. Attractive grey and gold front panel 13 x 1½in. Height 5½in. overall. Front to back 5½in. Vol. and on/off tone, Mike, radio and ext. speaker jacks. Valves magic eye, ECC83, ECL82, EZ80. Mains trans. Ready to bolt to B.S.R. Deck. Complete with switch wafer wired. Our Price ONLY £6.15.0 (6/- Packing and Carr.). Also available for Collaro Deck at 5/- extra

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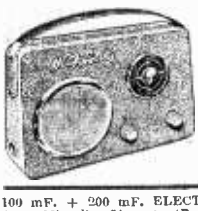
COMPLETE KIT FOR ONLY

**£5.17.6** (post 5/-)

500mW push-pull output. Ferrite rod aerial. Car aerial socket and coil. M.W. and L.W. full coverage. Operates on two 4.5v. cells. Printed circuit board 8½ x 2¼in. All holes drilled and component positions marked. Instructions 2/6 for 15p. (refunded on purchase of kit). Size 9 x 3¾ x 7in. 8 x 2¼in. P.M. high quality speaker. Attractive Vynair covered cabinet, two-tone. Two batteries 5/6 the pair (Ever Ready 126). Mullard transistors OC44, 2 x OC45, OC81D and 2 x OC81. Top grade Weymouth Radio coils and transformers. Alignment service if required 17/6 (inc. post). Write for list of prices. All parts supplied separately. Built in two hours.



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100 mF. + 200 mF. ELECTROLYTIC. New 275 v. (350 v. surge). 4in. x 1¾in. dia., 5/- each. (Post 1/-).
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PP9 Battery 3/9. Data and instructions separately 2/6. Refunded if you purchase the parcel.

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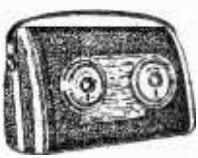
**PRINTED CIRCUIT.** 6in. x 2in. x 1½in. over transformers. Output for 3-ohm speaker. Suitable for microphone, record player, guitar and radio input., 9-12 volt battery required. Frequency range 100 cps. to 25 Kcps. Push/pull output single ended. Instruction sheet provided. Fully wired ready for use. Two types available. ½ watt output, 35/-, 1½ watts 41/-. P. & P. 2/6.

## THIS SUPERB SET for £9 (Carr. pd.)



6-transistor radio covered in sponge clean Duracour fabric, in latest two tone shades. M.W. and L.W. ferrite rod, provision for car aerial, 2-colour scale. With PP9 battery giving 300 hours use. Weighs under 4 lbs. With carrying handle. 12 x 7in. high x 4¼in. at base tapering to 2in. at top. Brand new, fully guaranteed. 3 push buttons.

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

## SPECIAL REDUCTIONS ON GRAMOPHONE AMPLIFIERS

**1½ watt type. Save 12/-.** With 5in. speaker. Baffle 12½ x 6in. 200-240 v. A.C. ECL82 and Rectifier. Tone and Volume. On/off switch. Two knobs. Ready to play. Useful for Stereo. 45/-, post 5/-.
**4 watt type. Save 20/-.** Valves UY85, UF80 and UL84. 200-240 v. A.C.. Covered baffle 13½ x 7¼in. (6½in. speaker), 3 front controls; bass, treble, on-off/vol. 54/-, post 5/-.
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Converts existing Radiogram to play stereo records. Chassis 6½ x 2½ x 4in. overall height. Mains and O.P. trans., Metal Rect., ECL82 valve and all screws, panels, etc. Moulded front escutcheon, fully built, brand new, only extras needed, speaker and stereo cartridge. Full instruction leaflet. Limited quantity at 39/6. (5/6 P. & P.)

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(1/- per tape, six or more post free).

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**AMPLION "Activette"** for charging dry batteries. Mains operated 200-250v. A.C. Size 4½ x 2½ x 1½in. with output socket and plug for 45v., 69v. and 90v. H.T. with 1.5v. L.T. Price ONLY 27/6.

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Mains input giving 6.3v. 2 amp. Size 2¾ x 2¾ x 1in. (2¼in. over winding). 5/6 ea. Less 10% for 12, or 20% for 50. P. & P. 2/- for 1 to 6, post free more than six.

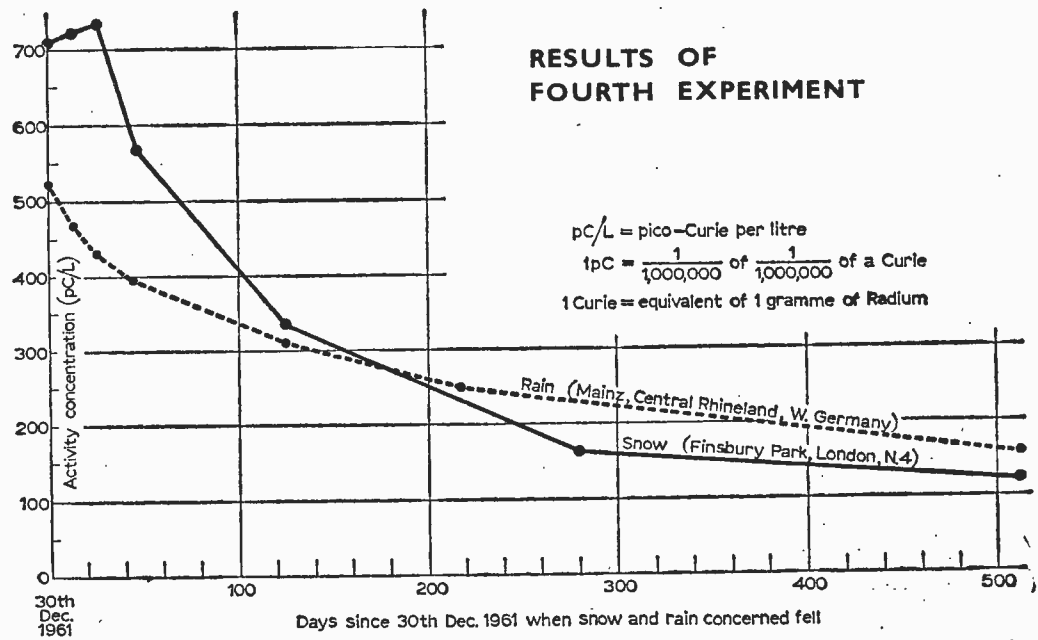



***Fig. 1: Actual results for radioactivity and its decay with time, for a pair of typical rain and snow samples.***

*Both samples are from rain/snow which fell at the same time on the same day, 30th December, 1961, but at different places. The* ***snow*** *(full line) fell in Finsbury Park, London. The* ***rain*** *fell at the same time in Mainz, central Rhineland, W. Germany, and its behaviour is shown by the dotted line.*

*About a pint of each sample was filtered, and the clear liquid boiled down to give a concentration of about 60 times. The two lines in the graph thus show the result of what was termed "Fourth Experiment" in the text.*

*The concentrated samples were measured immediately after natural Radium-Product activity (see text) had decayed away, and again at various intervals over the next 500 days, as shown by the dots on the graph-lines.*

*It is important to notice that both samples behaved virtually identically once they were more than about 120 days old. At times earlier than this, they differed widely; the Continental rain showed less initial activity than the British snow. The slight rise of activity over the first month or so, shown by the London snow, illustrates an effect repeatedly found on numerous occasions where rain or snow contained considerable proportions of really fresh debris from recent explosions. Such debris has not had time to reach equilibrium between the many types of atoms involved in the radioactive mixture, and this is generally evidenced by such initial increases of activity before the true decay sets in. The Continental rain from 30th December, 1961, clearly contained little fresh debris, but about the same amount of older debris as the London snow—because both showed practically identical activity once they were a few hundred days old.*

Provided one has the experiment running quickly enough after the rain has fallen, one generally obtains significant signals in all cases, sometimes even very large ones. What one is here measuring is the *natural* radium product activity washed out of the clouds and this can reach enormous intensities of up to 300 nanocurie per litre ("nano" is a thousandth part of a millionth of any unit. and one "Curie" is the radiation equivalent of a gramme of radium).

This is a natural phenomenon which has been present through all historical ages and has nothing to do with man-made devices. The surprising fact is that it can reach intensities of up to 100 times the levels of atomic bomb fallouts which. if prolonged, are considered dangerous! The great difference is the short life involved, which can be followed in this first experiment.

The most common behaviour is that the observed signal halves itself every 50 minutes for two or three hours and then suddenly vanishes. Science does not yet know too much about these effects except their existence, so that useful pioneer work, as in the days of early transatlantic short-wave transmissions by keen amateurs, is here still possible in studying the behaviour of these natural radium signals at various locations and for various weather conditions.

As the radium traces involved originate from the rocks (not necessarily entirely locally, as winds have a great effect), the geology of the immediate and more distant surroundings has an important influence on them.

The advanced Geiger head gives a "background" count from cosmic radiation, etc., of some 40 counts per minute. This must be subtracted from the total registered: the remainder is the actual "signal" from whatever sample one is testing. The sensitivity of the advanced Geiger head is such that a concentration of some 3·5 nano-

curie per litre of fill-liquid gives one *signal*-count per minute.

As the natural radium-product signals can have initial amplitudes up to 300 nanocurie (though this is rare) per litre, *huge* counts can sometimes be observed when the untreated rain is filled into the head quickly enough—especially after summer thunderstorms which sometimes seem to enhance these effects. Normal values observed seem to lie between 30 and 60 nanocurie per litre, giving initial signals of 10 to 20 counts per minute, i.e. the total count is 50 to 60 per minute.

One should, after starting such an experiment as quickly as possible after the rain has fallen, read-off the digital counter on the register initially every 10 minutes and, after an hour, every 20 or 30 minutes.

The average counts per minute are then determined for each of these periods, the known background count subtracted, and the remaining signal counts per minute plotted on a graph against the "age" of the rainwater since it fell. Such a measurement should be carried out as long as anything still "happens", i.e. until the signal count per minute no longer reduces. This will take at least an hour, and may take up to five hours. Each graph should be marked with all details of weather, time of day and year, amount of rain, how long it did not rain previously, and any other factors one may notice and may think as possibly useful for a later attempt to study general trends shown in a large collection of such graphs from many rains over several years.

If the signal count does not fall back to the known background count at the end of this experiment, but stays put at some higher value, still present after many hours, then the remaining signal represents a very high contamination from atomic bombs and should be subtracted from all signals plotted on the graph for the natural radium-product studies.

Such atomic-bomb contaminations giving significant signals even in this first experiment on untreated rain are becoming more frequent, but are nevertheless no real cause for serious alarm. As already said, initial portions of slow rain tend to be more contaminated, very especially if much sulphurous industrial smoke is present, which seems to act as a "magnet" to debris from fresh atomic explosions. Under such conditions, atomic bomb debris signals larger than the huge natural radium-product signals have occasionally been noted with this apparatus, leading to remarkably high total counting rates exceeding 100 per minute at the start of this first experiment.

## SECOND EXPERIMENT

Whilst the first experiment to determine the natural radium-product content is running, one can at the same time set about treating the main bulk of the collected rainwater. This should be filtered through an ordinary filter paper obtainable from a chemists. A small suction pump operating off the water-tap is here useful; a suitable set of apparatus is also obtainable at a chemists.

The filter paper should then be drained, rolled-up, and inserted into one of the 10cc p.v.c. bottles for standing in front of the simple Geiger head. The latter has a background count of some 20 to 25 pulses per minute, and the sensitivity in this present arrangement can be as high as one signal count for only 0·4 nanocurie total activity collected on the filter paper. Thus very considerable amounts of the natural radium-product activity in the bulk of the water can here be registered, and it is an interesting study to note the relative proportions indicated on the two Geiger counters now running simultaneously.

Alternatively, the filter paper can be washed immediately in some 16cc of dilute nitric acid, and the clear liquid, which now contains the filtered-off natural radium activity (and other activity) in a state of concentration so many times greater as the original as the amount of nitric acid used was less than the original bulk of water, can be substituted into the advanced Geiger head.

As the original bulk of water is about a quart, and about 16cc of acid are used, a concentration factor of about 80 can be reached. The filter paper typically catches 25% of the total activity, as roughly 25% is generally lodged on the largest dust particles of the air, and so the final effective signal increase can be around 20 times. This means that, if the rain happened to contain good natural radium-product signals, this just described method of concentration can reach counting-rates of hundreds per minute with the advanced Geiger head, i.e., drive the digital register almost to the limit of its counting rate.

A detailed study of the decay of these signals, until they vanish after a few hours, is thus very easy. The counting rate is often so huge that the register can be read off every 5 minutes or less, giving a very accurate graph with closely-spaced points.

## THIRD EXPERIMENT

When the huge natural radium signals have vanished after a few hours in the last experiment, the counting rate in the advanced Geiger head will generally remain some 10 to 50 per minute above the background, for weeks, months or years. This is that part of the atomic-bomb debris in the original rain which was attached to large dust particles of the air and was thus held-back on the filter and subsequently dissolved by acid.

The known sensitivity of the advanced Geiger head (some 3·5 nanocurie per litre of fill-liquid for one signal count per minute) should be divided by the effective concentration factor of the process and multiplied by the number of signal pulses observed per minute, to get the actual content per litre of original rain for this part of the debris.

## FOURTH EXPERIMENT

The clear filtered rainwater after preparation for experiment number two above should now be concentrated by boiling and subsequent acidification, as described in the published article on the simple Geiger head and digital counter.

Measurements can then be made in the advanced Geiger head, and thus the portion of atomic bomb debris not attached to dust, i.e., which passed the filter paper, determined. It will often be found to be about equal to that attached to the dust and measured in experiment three; it is generally somewhat more, if anything.

It is interesting to keep the liquid samples from experiments three and four in small p.v.c. bottles, for repeated measurements after weeks, months or even years. The dust in the air seems to scavenge

preferentially new products from recent atomic explosions which are still decaying rapidly, so that after recent test explosions in the northern hemisphere one often finds that the dust portion noted in experiment three is much greater than, and decays more rapidly than, the dissolved portion measured in experiment four, for one and the same rainfall.

In general, of course, both portions decay the more rapidly the more recent the responsible atomic explosions. Intensities may halve in a month or two if explosions took place within the last three months, otherwise it may take a year or more before the signal-count of the samples halves

—continued on page 762

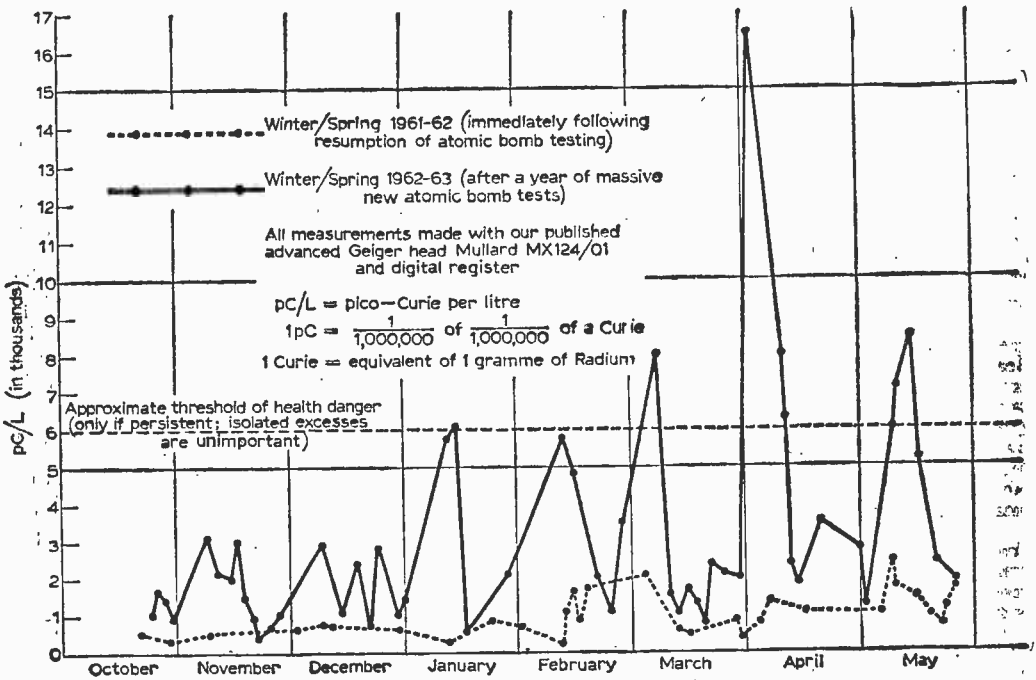



***Fig. 2: Initial amounts of Atomic-bomb-fallout Radioactivity.***

*This graph shows very enlightening results obtained at Mainz, central Rhineland, W. Germany, where a station using equipment we have published has been operating for two years at this very typical Continental location.*

*Each dot represents rain or snow which fell at the named station and was examined. The date scale along the bottom of the graph shows the date of fall in each case. The vertical scale of the graph represents the initial atomic-bomb-radioactivity found in each case, according to the details of "Fourth Experiment" in the text, after having allowed a few hours to elapse since the rain/snow fell, to permit all Radium-Product signals to decay away.*

*The dotted-line curve shows measurements for winter/spring 1961/2, immediately after resumption of atomic testing in the autumn of 1961. The full-line curve is for the same seasons one year later, i.e. 1962/3, after a year of massive atomic-bomb testing in the meantime.*

*These two comparative curves show the resulting increase of radioactivity in rain and snow, from the numerous test explosions of 1962, most clearly. Equally clearly do they show the relative* **uselessness** *of isolated measurements of individual rains or snows in this connection. Only the systematic measurement and plot of all—or nearly all—rains and snows can give a true picture, because variations are so great that isolated readings can, if taken alone, be very misleading.*

*The* **tremendous** *peak in early April, 1963, was reported by all official stations and the Press, although few stated the true extent. The meteorological network reported the epicentre of this massive "breakthrough" to have been in Switzerland and the Austrian Alps. The station at Mainz for which the graph here was compiled is situated fairly close to this area.*

*Such "breakthroughs" result from a sudden start of downward flow of large air masses out of the stratosphere, down into the weather regions. This happens every spring, and marks the real start of spring. Due to the tremendous violence of many of last year's atomic tests, much of the debris was hurled into the stratosphere, where it remained until the spring "breakthrough" next took place. The same effect is apparent from mid-February to mid-March the year before (dotted curve).*

*At the same time as the huge radioactivity peaks in early April 1963 were taking place, unusually fine reception conditions for Band IV television transmissions were noted at the same station. These coincided with the start and finish of the radioactivity peak. It is unlikely that the radioactivity itself promoted fine u.h.f. reception, but rather the stream of downward-flowing stratospheric air.*

***These measurements were all carried out with the Advanced Geiger Head and Digital Register, as published in Practical Wireless (Dec. 1962 - June 1963).***

Good soldering can mean the difference between success or failure of home-constructed gear. Knowing how to make properly soldered joints saves time, trouble and wasted effort.

# SOLDERING

By HENRY MAXWELL

IT is perhaps ironic that the most important tool in the radio enthusiast's kit is also the most neglected. Badly soldered joints account for a great percentage of the constructor's frustrations. The intermittent fault that results from a lack of the right heat, in the right place, for the right length of time wastes more of a professional engineer's hours than a hundred total breakdowns. Part of the trouble is undoubtedly an incomplete knowledge of the art of soldering.

Yes, ART. It is not enough to hold a warmed-up lump of copper on a clumsily wrapped bundle of wires, apply resin and tin and hope for the best. Even the best intentions of modern manufacturers, who provide us with heat-controlled irons and carefully balanced resin-cored solders, can come unstuck if we take their products for granted and work in the sort of careless rapture that leads to wasted time. The following notes are an attempt to show that there is more to the subject of solders and soldering than may at first be apparent.

## THE ESSENCE OF SOLDERING

To begin with, what are we trying to do when we join a couple of wires? First it is necessary to destroy the high resistance oxide film on the outer surface of each conductor, then to let the solder run quickly on to the prepared surface so that it forms what is in effect a fused outer coating. This jointing should be as strong as the basic conductor. Next, the flux which performed the original cleaning operation has to evaporate and, finally, the solder must cool at a rate that allows it to set hard and firm. All this requires a correct temperature sequence which is easier to understand if we take a look at the physical make-up of solder.

## RESIN-CORED SOLDERS

Modern solders are fusible alloys, many of which are made with self-contained fluxes for special purposes. It may be interesting to note that the resin-cored solder we use for general purposes comes in two or three grades and several sizes, but this represents only a minute part of a very wide range of solders marketed by the leading companies for the making of all manner of joints.

For radio work we need a combination of tin and lead in the proportions 40:60 or 60:40. This ratio is not just a matter of convenience. It is determined by the melting points of both the metals and—equally important—the "plastic range" when the alloy is neither solid nor liquid. Too great a plastic range means that the cooling down period is protracted and, usually, the amount of heat required for correct fusing of the metals is greater. These two things add to the danger of the dry joint. Too small a plastic range means that transition from liquid to solid on cooling would be too rapid and a fractured bond would result.

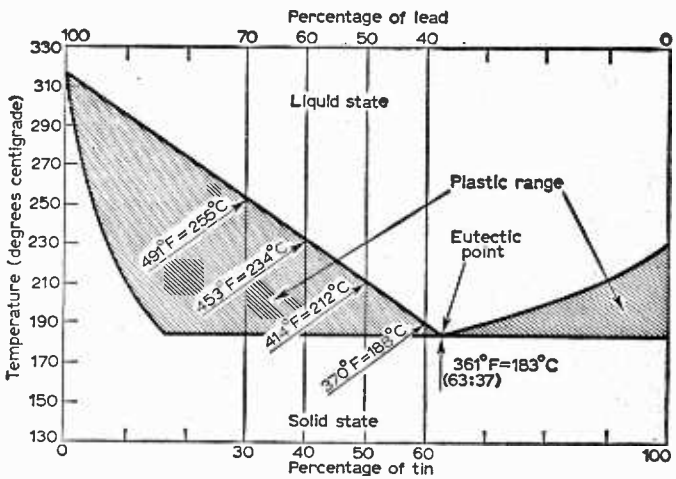



*Fig. 1: This shows the various melting and solidifying temperatures for several alloys of tin and lead.*

## MELTING AND SOLIDIFYING TEMPERATURES

Fig. 1 has been prepared from data supplied by Ersin Multicore Solders Ltd. and shows the various melting and solidifying temperatures for several alloys of tin and lead as used by the radio industry. Special solders with small traces of antimony, bismuth, cadmium and silver are also available.

It can be seen that the "ideal" proportion of tin

to lead is 63 parts to 37. This gives a direct melting point of 183 deg. C. But if an alloy of these proportions was used, as soon as the soldering iron was taken from the joint the solder would solidify and the slightest movement of the wires would result in crystallisation of the alloy and a high resistance joint.

## EFFECT OF EXCESSIVE HEAT

A similar effect is produced by the application of too great a heat—or even the correct heat for too long a period. For example, the recommended bit temperature of a soldering iron is above the normal melting point of the solder. A bit temperature of 476 deg. F is adequate for use with 50/50 solder, the melting temperature of which is 414 deg. F. It would cause the flux to wet the joint efficiently and, if the heat was not applied longer than necessary to make the solder melt, the volatilising point of the flux would not be reached before the solder had flowed over the prepared surface.

But suppose the areas of metal to be joined were larger than our specimen "two wires"—as, for instance, joining a screening plate to chassis. Then the iron would have to be applied for a longer period to enable the metal to attain sufficient heat to melt the solder, at which condition the spot heat at the point of the bit could well be too great, causing the flux to volatilise and prevent an even bonding.

Design of resin-cored solder has to take into account this flux volatilisation temperature—at 550 deg. F approximately 7 per cent of the flux volatilises in the Multicore 40/60 range. Reference to Fig. 1 shows that this has a melting point of 453 deg. F, returning to the base temperature of 461 deg. F before solidifying. Thus an iron of lower bit temperature can be used, and if a larger bit and higher wattage iron is employed on the "chassis joint" jobs the heat is more evenly distributed, the flux wets the joint, solder spreads evenly and cools at a rate that prevents crystallisation.

## SUITABLE BIT SIZE

If we try to use one of the smaller irons—which may well have a bit temperature of more than 600 deg. F—the heat will be concentrated at the point of the bit and rapidly dissipated through the metal of the joint and an uneven job will result.

Conversely, the use of a large iron on a small joint can have the effect of spreading the heat where it is not wanted—up the wires to the nearby components, for example, even if a heat shunt is used. For better-class work an alloy of the proportions 60/40 should be used in conjunction with a small iron bit. Although the actual bit temperature of the iron may be higher, the application of this heat for a shorter length of time produces a better joint.

As an example, the bit temperature of the Oryx 10W soldering iron, Type M1, which has a $\frac{5}{32}$in. diameter bit, is 670 deg. F, but as the 60/40 solder has a plastic range of only 9 deg. F a much quicker job can be done, with less risk of spreading the heat, yet with a reasonable cooling margin to allow the solder to set.

## THREE ESSENTIAL REQUIREMENTS

From the foregoing three things become apparent. First, the flux must be allowed to run on to the prepared surface and do its chemical job of destroying the oxide film that the atmosphere forms on the metal of the working surface, and the applied heat should not be so great as to cause it to volatilise before is has done this job. Conclusion: do not apply the resin-cored solder to the iron bit but heat the joint just sufficiently for the solder to run, at which temperature the flux will have wetted the joint.

Secondly, applied heat must be correct. There is no advantage in a larger and hotter iron and no time saved by rushing a job if the solder has not completely melted.

Thirdly, the correct solder should be used for the job. To demonstrate this more clearly see Fig. 2, which is a table of "Contact Angles" given by Enthoven Solders Ltd. The contact angle is that formed by the edge of a blob of solder dropped on a surface of a specific metal and is an indication of the effectiveness of the joint. Note that the lower the angle the greater the solder "spread" and the better the jointing properties. (This shows clearly the misleading appearance of those bulbous joints that are

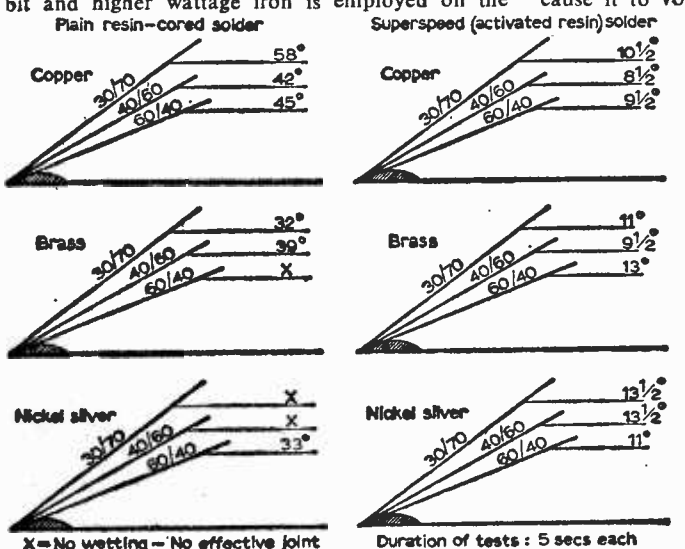



*Fig. 2: A table of "Contact Angles".*

made with an iron wrongly applied.) Note also that the angles differ widely for different materials and for different solder alloys and that the incorporation of specially prepared flux lessens the contact angle drastically. This enables much quicker work, with less residual heat.

### SOLDERING ALUMINIUM

Much heartbreak has been caused among the radio fraternity by the reluctance of aluminium to take solder. The reason for this is the high thermal conductivity of the metal, which prevents retention of the correct heat at the spot where it is required, allied to the chemical property which causes a prepared surface to oxidise before flux can wet the joint. Thus apparently good aluminium joints may actually be no more than solder shells with a high resistance contact beneath.

To overcome this it is necessary to have a higher heat source than normal, plus an alloy of tin and zinc, aided by special non-hygroscopic flux. Special aluminium solders have been developed, but it is necessary to use a very hot iron, to work rapidly and to prevent heat dissipation. It may be advisable, too, when the job has been completed, to coat the joint with a lacquer

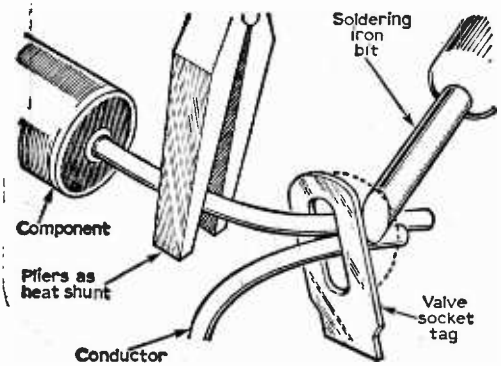



*Fig. 3: A convenient method for connecting lead-out wires to valve-base pins.*

to exclude air, for aluminium surfaces that have had the outer skin removed tend to corrode more rapidly than usual.

### MECHANICAL JOINTS

From a purely practical point of view there are several observations worth making. The argument used to run: make a good mechanical joint and then the minimum of soldering is needed. But any constructor who has been faced with the problem of "unwrapping" a tangle of soldered wires to remove a faulty component will know that a more convenient method may be as shown in Fig. 3. Here we have two components connecting to a valve base pin. The lead-out wires are inserted in the slot with sufficient overlap to allow the solder, shown dotted in the final joint, to cover the working surface. The iron is applied to the body of the work, a pair of pliers forms a heat

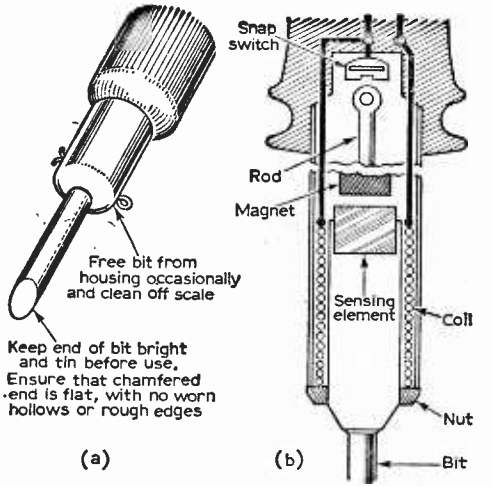



*Fig. 4a: The iron bit should be kept well shaped, as shown here.*

*Fig. 4b: Cut-down view of a Weller magnetic temperature controlled iron.*

shunt to protect the capacitor and the solder is applied to the work, not the iron. Take care not to move the work while the solder cools.

The next rule, often quoted, is "keep your bit bright". The main reason for this is to conserve efficiency, as the scale on the outside of a bit robs the job of heat. But equally important is to keep the bit well shaped, as shown in Fig. 4(a). The working blade of the bit is a chamfered surface which allows the iron to be applied at a convenient angle, as well as getting the best area of copper into play. Tinning the bit, by running clean solder on to it and wiping off the excess, enables a quicker job to be done.

### CLEANLINESS IS ESSENTIAL

Clean work, in fact, makes for greater efficiency. The little bits of foreign matter not only prevent even flow of the solder but, by transferring to the bit, accelerate the wear of the iron. This is partly the reason for the development of such materials as the Savbit alloys made by Messrs. Ersin.

In this type of solder is incorporated a small proportion of the same metal as the iron bit, which helps control the absorption of impurity. Adding copper to the alloy is said to result in a 98 per cent improvement in soldering iron bit wear. The technique was discovered when a special alloy for soldering silver-plated ceramics was being developed ten years ago. To prevent absorption of the precious silver during the soldering process it was found necessary to add as much as a 2 per cent silver content to the solder. The useful by-product of reduced bit wear was realised by Messrs. Ersin and has resulted in their popular line of Savbit Solders.

Further to this, the practice of using existing solder to remake a joint is to be deprecated. From the above it should be apparent that this robs the joint of its necessary wetting agent. Solder is cheap enough and a reel of the convenient

multi-cored solder should be in every constructor's kit. Bits and pieces of old solder dredged from the depths of the toolbox are false economy in the end.

### REPAIRS TO PRINTED CIRCUITS

Making soldered joints in printed circuits is a special technique. It is not proposed to enter here into the many and interesting methods of mass-

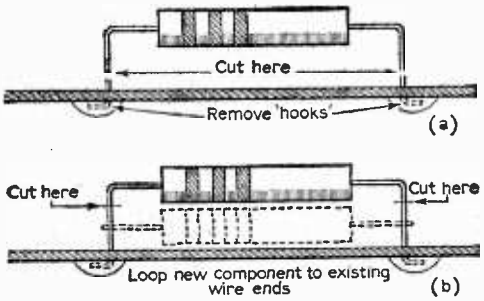



*Fig. 5a and b: How components are soldered on to printed circuit boards.*

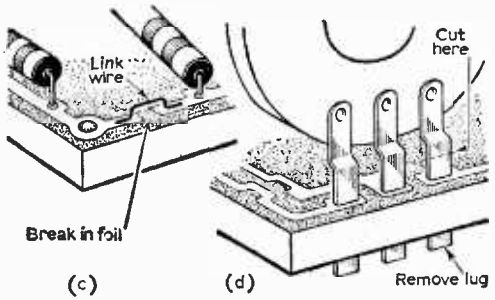



*Fig. 5c: Bridging a crack in printed circuit "wiring". Fig. 5d: Removing a tagged component from a printed circuit board.*

producing soldered panels. But repair procedures should be touched upon to complete the purpose of this article.

In the first place printed circuits are generally coated with protective lacquer. This should be scraped away from the vicinity to be soldered to prevent infiltration of the flux. And, ideally, the finished joint should again be coated with varnish, but perhaps this is a counsel of perfection.

Because of the methods by which components are anchored it may be more efficient to cut the lead wires above the panel when removing, for example, resistors, as in Fig. 5(a), then take the remaining hook of wire from the other side of the panel. Alternatively the existing leads could be left in circuit, the new component prepared by cutting and bending its leads and a simple "top-chassis" joint made, as in Fig. 5(b).

When working on printed circuits avoid excess heat on the panel, which might result in a raising of the thin film of conductor from the laminate, and always keep the solder to a minimum, avoiding its spreading with the consequent risk of short-circuits.

A thin crack in a printed circuit can be caused by flexing of the panel and is one of the hardest faults to trace. When the hairline crack is found a bridge of solder may be run across it, first scraping the lacquer away. However, it is sometimes necessary to make a longer bridge, especially if the panel is burned. Then a length of tinned wire may be fitted, as in Fig. 5(c). Avoid excess length and always trim wires exactly to shape. A little extra care in preparation can save a great deal of worry later.

When removing tagged components brush off the excess solder with a paintbrush, removing it entirely as it cools and crystallises, and move the component gently as the solder cools to loosen the joint. Do this with each tag in turn and, with patience, the component may be removed intact. But if it is going to be replaced it is better to cut the tags above the panel, as in Fig. 5(d), and remove the lug ends from below, leaving clean apertures for the fixing of new components.

### RANGE OF IRONS

In this, as in all soldering, the secret is the application of the correct heat for just long enough. To enable one to obtain this end manufacturers have produced such a wide range of soldering irons that it would be invidious to single any particular types out for mention. Sufficient only to say that the day of the "poker in the fire" should now be no more than a memory. A good iron is a good investment; indeed, one soldering iron is hardly enough, for the small tool for handy work in confined spaces will not be of great use in making chassis connections, where a heavier wattage and larger bit are necessary.

The soldering iron or solder gun is the radio constructor's most important tool. The author hopes that the foregoing notes—basic though they may be—have helped readers to avoid taking solders and soldering for granted. ■

## THE "PRACTICAL WIRELESS" FILM SHOW

*The "Practical Wireless" Film Show which is held annually and to which readers of P.W. are invited, is to be held, as before, at Caxton Hall, Westminster. The date of the Show, which is arranged in collaboration with Mullard Limited, is the 31st January, 1964.*

*The programme will appeal to all readers of "Practical Wireless" and of especial interest will be the illustrated talk on colour, 625-line and u.h.f. television, which will form the first part of the programme. After a break for refreshments, the programme will continue with a film entitled "Ultrasonics".*

***Tickets may be obtained free on request from these offices. A stamped addressed envelope must be enclosed with all applications for tickets.***

# A Recording Level Meter

★ ——— by G. D. Howat

SOME time ago, the author constructed a recording level meter for his tape recorder, from a published design. Unfortunately the unit, as described, had a rather serious snag. When connected to the tape recorder, at the same point as the magic eye, the meter at once showed almost full deflection, even in the absence of any input signal. (By full deflection, of course, is meant full modulation of the recording amplifier.) The presence of an input signal had barely any additional effect on the meter.

After a certain amount of trouble, the fault was traced, and at first appeared almost insurmountable. All tape recorders include in them a bias oscillator, the output of which is mixed with the recorded signal before it is fed to the record head. This is done quite simply, as is shown in Fig. 1. The full deflection of the recording-level meter was due to the bias oscillation passing through the resistor R and into the meter circuits. The meter is unable to tell the difference between a genuine input signal, and the bias, and thus in effect calls the bias a "signal".

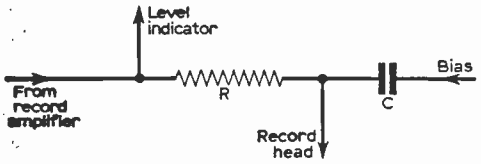



*Fig. 1: The bias voltage and recorded signal are mixed and fed to the record head.*

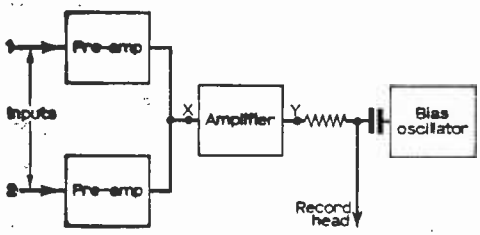



*Fig. 2: General block diagram of a recording amplifier.*

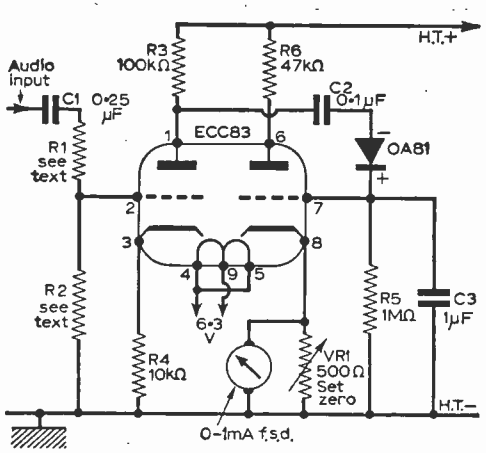



*Fig. 3: The recording level meter circuit as used by the author*

### Possible Alternatives

There are various ways of overcoming this problem. One method would be to cut out the bias supply while adjusting the record gain controls. This is highly inconvenient as hardly any tape recorders have such a bias switch. Another way is to introduce some forms of filter in the input to the meter which does not allow the bias to pass. This is also a somewhat difficult operation. The most obvious cure is to connect the input to the meter at some point in the amplifier before the bias is applied.

The general block diagram of a recording amplifier is shown in Fig 2. When the level meter is connected to point Y, the snags already explained arise. However, connecting the meter at point X overcomes this problem, as there is no bias at this point. Unfortunately there is then a new problem. The original recording-level meter described was not sensitive enough for connection at this earlier point in the amplifier, it needed at least 12V input signal.

### Revised Circuit

As most tape recorders have a similar circuit to that of the author's, both these problems may occur in them and it was this factor that led to the improved circuit for a level-meter. The original circuit used on ECC83; one half strapped as a diode, the output of which was connected via a one second RC network to the grid of the second half. The audio signal, thus rectified and smoothed, caused variations in the anode and cathode current which was measured by a milliammeter.

The revised circuit which needs only a few extra components, uses one half of the ECC83 as a voltage amplifier, an external crystal diode, and the second half of the ECC83 connected as before. The circuit is shown in Fig. 3, and is largely self-explanatory. The audio input is fed via R1 and R2 to the grid of one half of the valve. The amplified voltage is fed via an OA81 diode to the grid of the second half of this valve. The 1MΩ resistor and 1µF capacitor in parallel form the 1 second time

constant which prevents the meter from following the audio signal too closely. The meter is shunted by a 500Ω set-zero variable resistor, VR1.

The resistors R1 and R2 form a potential divider which sets the sensitivity of the unit. The sum of R1 plus R2 must not be less than 1MΩ otherwise the input to the recording amplifier will be reduced.

### *Assembly of Components*

The entire unit can be built up on a tagboard quite easily. A suitable layout is shown in Fig. 4.

The power requirements for the unit are 6·3V at 0·3A and a few mA of the h.t. supply. The recorder will almost certainly be able to provide this without difficulty.

### *Calibration*

In the absence of a signal the meter will read full scale, this reading decreasing as the recording level is raised. It is therefore recommended that the meter be mounted upside down, and the scale redrawn, or a new one fitted, to read 0 to 10 (left to right). That portion of the scale from 7 to 10 should be coloured in red.

The procedure for initially setting up the meter is as follows. Adjust VR1 so that the meter pointer coincides with the new zero position, apply a continuous tone signal to the recorder input and

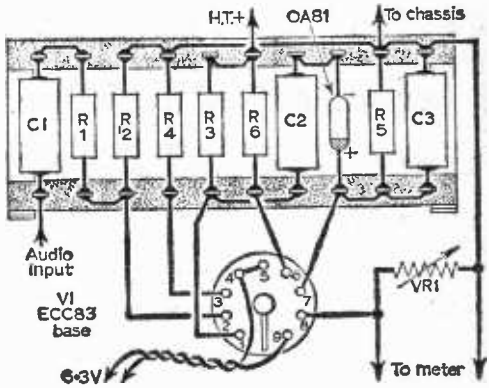



*Fig. 4 Wiring diagram of the circuit of Fig. 3.*

advance the recording level control on the instrument until correct level is indicated by the magic eye. Now adjust the values of R1 and R2 until the meter reads 7 on the scale. The total value of R1 and R2 must not be less than 1MΩ.

In normal use any reading in the red portion of the scale will indicate over modulation and the input to the recorder should then be reduced. ■

# A Neon Voltmeter

*A Novel Pocket-size Test Instrument—by L. E. Crockford*

THIS simple and cheap little voltmeter is small enough to fit into the pocket and virtually unbreakable, yet it can be used to measure anode and screen voltages etc. in valve receivers and amplifiers with a fair degree of accuracy.

It consists essentially of a small neon bulb and a potentiometer: see Fig. 1. The neon requires about 80V to strike. If the voltage to be measured is applied across the potentiometer and the slider moved up from the bottom end a point is reached at which the neon just strikes. Then the unknown voltage can be calculated from:

$$Vx = Vs\left(\frac{Ra}{R}\right) \text{ volts.}$$

where Vx is the unknown voltage and Vs is the neon striking voltage.

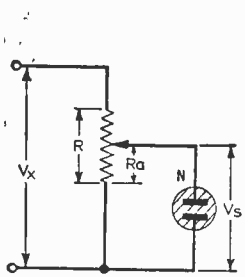



*Fig. 1 (left): A circuit illustrating the principle of the instrument.*

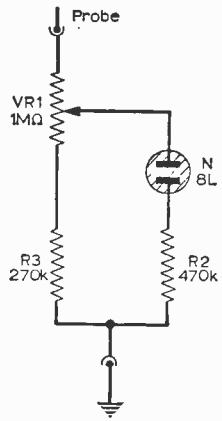



*Fig. 2 (right): The simple circuit of the voltmeter.*

It will be seen that the potentiometer can be calibrated in terms of voltage and also that the lowest voltage that can be measured is the neon striking voltage. This varies from one bulb to another but is constant for any given sample. Two samples of the HIVAC 8L have been tested: the striking voltage of one was 72V; the other 76V.

The maximum voltage than can be measured is limited by the voltage rating of the potentiometer. This is 500V for most makes but a safe and useful maximum is considered to be 350V. The resistor R3 in Fig. 2 is of such a value that with 350V applied the neon will strike with the slider of VR1 near the bottom end. Hence the range 80-350V is covered by the full range of the potentiometer.

If an edge control knob is fitted to VR1, of about 2in. in diameter, then the scale length will be 4½in. which compares favourably with most pocket voltmeters.

It was found that although the recommended burning current for the HIVAC 8L is from 450 to 650$\mu$A, it would still give a reasonable glow with only 40$\mu$A. The burning current is limited to this value by the resistor R2. As the resistance of VR1 and R3 is 1·27MΩ the maximum current that can be drawn by the meter, when measuring 350V, is 275+40$\mu$A, providing that the slider is not moved beyond the point at which the neon strikes. (If this is done the burning current increases.)

For most measurements, say of around 250V, the current drain is about 250$\mu$A so that the meter does not have too great a disturbing effect on the circuit being tested.

### *Construction*

Fig. 3 shows the form of construction used by the author; though readers may have their own and better ideas.

The potentiometer is fixed to an aluminium bracket which is bolted to the base of a small wooden box. It must be fixed firmly in the bracket, using the locating tag or pip, so that its body can

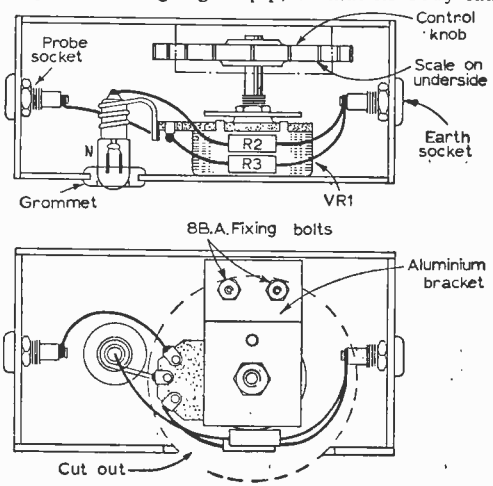



*Fig. 3: Two views of the form of construction used by the author.*

not turn otherwise the calibration will be altered. It is also fitted off centre so that one edge of the control knob may project through a cut out in the side of the box.

A convenient bulb holder can be made by wrapping 18 s.w.g. tinned copper wire in a spiral around the screw thread of the bulb, one end of the wire being soldered to the centre terminal of the potentiometer, the other cut close to the bulb. R3 is soldered to the base cap of the bulb. The bulb is held tightly in a rubber grommet in the base of the box, through which the anode and cathode pins of the bulb can be viewed.

A banana socket is fitted to each end of the box; one to receive the flexible earth or chassis connection, the other for the probe. The probe consists simply of a length of stiff wire soldered into a banana plug, sleeved with systoflex or rubber sleeving and sharpened to a point.

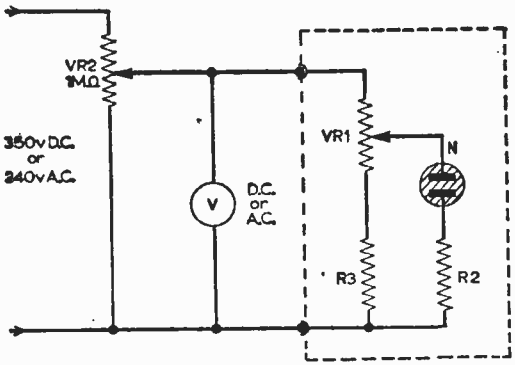



*Fig. 4: The circuit arrangement necessary for calibrating the instrument.*

A scale is made by glueing a circular strip of white card to the underside of the control knob near the rim, an inked-in scribe line on the side of the box below the cut out acting as a pointer.

The knob should be a good fit on the shaft; if there is any play or backlash it should be put right by applying a little glue such as Araldite to the shaft before fitting the knob.

### *Calibration*

The calibration is best done using a d.c. voltage source of at least 350V and a good d.c. voltmeter (see Fig. 4).

The procedure is:

(a) Start with the sliders of VR1 and VR2 both at their lower ends.

(b) Raise the slider of VR2 until the meter reads 350V and raise the slider of VR1 very slowly until the neon strikes. Mark the scale opposite the pointer as "350".

NOTE: If the neon is already glowing with VR1 turned right down, (indicating that the neon being used has a low striking voltage) change R3 to 220kΩ.

(c) Reduce the voltage from VR2 to 340V and find the new point on VR1 at which the neon strikes marking this on the scale with a short line.

Repeat at 10V intervals, but writing the voltage value at each 50V interval.

When the calibration is complete apply a coat or two of clear varnish to the scale.

### COMPONENTS LIST

| | |
|---|---|
| VR1 | 1MΩ potentiometer, log. |
| R2 | 470kΩ ½W |
| R3 | 270kΩ ½W (or 220k—see text) |
| N | Neon (Hivac 8L) |

Two banana or wander sockets and matching plugs. Crocodile clip. Rubber grommet. Suitable box. Control knob.

If a d.c. voltage is not readily available th meter can be calibrated using the 240V main supply as an input and substituting an a.c. volt meter. A correction factor must be applied how ever as the neon strikes on peak values and th a.c. voltmeter will indicate r.m.s. values.

The procedure is the same as before except tha the reading of the a.c. voltmeter must be multiplie by 1·414 to obtain the peak value, e.g., 240V o meter × 1·414=340V peak: this is the firs calibration point.

While on this subject it should be mentione that if the neon voltmeter is being used to measur a.c. voltages the scale reading must be multiplie by 0·707 (7/10ths is good enough) to obtain r.m. value.

It will be immediately apparent when a.c. vol ages are being applied since both pins in the bul will glow whereas with d.c. only one, depending o polarity, glows.

It will also be noticed when using this met that there is an apparent backlash in the neo that is, having turned up the potentiometer t strike the neon it will remain alight for a sho distance as the potentiometer is turned down agai This is because the voltage necessary to sustain th neon discharge is 20V less than the striking voltag It is important therefore that the voltmeter shou be used in such a way that the reading is taken the point where the neon strikes and not at th point where it fails to sustain, i.e. the contr knob should always be returned to the 350V en after taking a reading, and when making a ne reading it should be turned slowly up from th end.

## TRANSMITTING AERIALS

—continued from page 7

match on three bands. It should be remember that this type of aerial requires a good earth, ev more so than some other types.

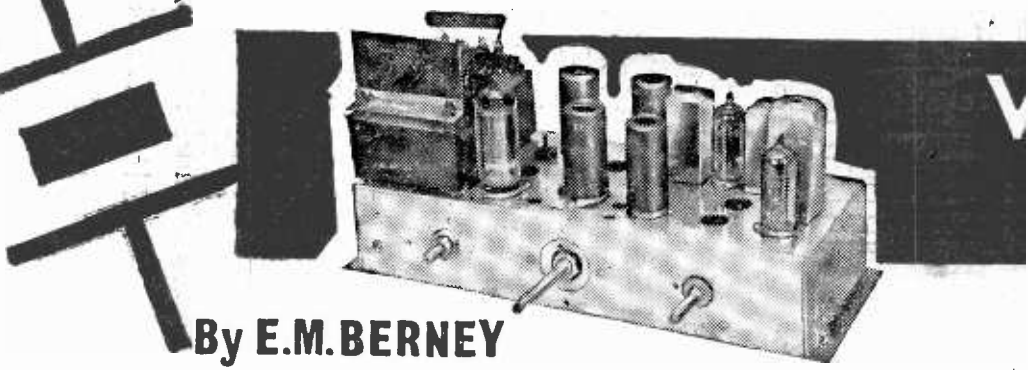
Those wishing to try this system are referred Fig. 7 for details.

The actual aerial may consist of any metal r or pole insulated from earth. This pole can serve dual purpose of acting as an aerial and also as support for another aerial. The coil should wound with as thick a wire as possible and shou be either self-supporting or wound on a ceram former.

The last obvious advantage of this type system is that it requires practically no space all. The loading coil acts as a form of auto-tra former. It is adjusted to resonate at the requir frequency, and T2 is adjusted to give a good mat to the co-ax feed line.

The earth lead should be as short as possil and of a substantial gauge wire such as 7/029.

# CRYSTAL CONTROLLED



By E.M.BERNEY

ONE of the problems in the design of any superheterodyne receiver is stability of the local oscillator. Easy to achieve at normal broadcast frequencies, this is much more difficult at v.h.f. where temperature variations have a greater effect upon the oscillator valve and its associated components.

The resulting variations of frequency can be balanced out fairly accurately by making use of capacitors having negative temperature co-efficients or they can be made self-cancelling by an automatic frequency control circuit; they can also be prevented from occurring at all, as is done in this tuner, by including in the oscillator circuit quartz crystals cut to resonate at the required frequency. The sole disadvantage of this is the cost of the crystals.

The tuner here described has a high gain and will perform satisfactorily in fringe or difficult reception areas as well as in the more favourable situations. The cost of the crystals has been offset by reducing other components to the minimum needed for proper performance and by using valves which are available very cheaply—the eight required can be bought new, ex-equipment, for about £1.

### R.F. STAGE

Referring to Fig. 1, the valve V1, a high gain pentode, amplifies the signal received at the dipole aerial.

The inductance L1 is tuned very broadly by means of its dust core to the lowest of the three frequencies to be received; no separate tuning capacitance is necessary, the input capacitance of the valve being sufficient for this purpose.

Bias is provided by the resistor R2, bypassed in the usual manner, and automatic gain control is applied to the grid through the 100kΩ resistor R1. The anode load is the inductance L2, which is slug tuned to the highest frequency to be received, and the amplified signal is transferred to the grid of the mixer valve V4 via the capacitor C5.

Note that all decoupling in this stage is to cathode and thence to chassis, also that the anode circuit is decoupled additionally to the cathode of V4. The stage has a very satisfactory gain and additionally isolates the aerial from the local oscillator, thus preventing the radiation of harmonics.

### OSCILLATOR

This needs a rather detailed explanation. The crystals XL1, 2 and 3, one for each of the transmissions to be received, are cut to resonate on the fifth mechanical overtone so that they work directly at operating frequency. They do not, however, take control readily and positively in the manner of the ordinary crystal, having instead to be urged gently into action by a regenerative circuit tuned fairly accurately to the operating frequency. If too much drive is supplied the tuned circuit will itself take charge and will behave as though the crystals were absent, while with too little drive the circuit will fail to oscillate.

Several single valve oscillator circuits were tried but though they could be made to perform satisfactorily they were considered too critical for reliable reproduction having regard to the minor differences which are bound to occur as between one constructor and another. The two-valve cathode coupled circuit shown in Fig. 1 was, on the other hand, found to be quite well behaved and reasonably tolerant of minor differences in physical form. The critical components were found to be the cathode resistors R5 and R7 and the values required here largely governed the choice of valves.

The first of the pair, V2, is a grounded grid triode, EC91, and has in its anode circuit the inductance L3, tuned basically by the 22pF capacitor C9 connected across it; the switch S1 introduces the additional capacitance needed to receive each of the programmes.

The anode of V2 is coupled to the grid of V3. This is a triode-connected pentode, EF91, whose output, taken from the cathode, passes via the switch S1a, through the appropriate crystal, back to the cathode of V2. The capacitor C8 blocks off d.c. from the switch S1 and the two 10pF trimmers TC1, TC2.

As might be expected with a rather delicately balanced circuit it is necessary to ensure that the arrangements for introducing the oscillator frequency into the mixer valve do not load the oscillator unduly. The simple method shown in Fig. 1 is quite satisfactory provided C10 is kept small and the mixer grid resistor is fairly high. If, however, the tuning of L2 approaches within about 4Mc/s of oscillator frequency, energy will be absorbed progressively as it approaches until

# H.F.-F.M. UNER

eventually the oscillator will fail. This situation could arise, exceptionally in the case of the Wenvoe transmissions if L2 were tuned to the Light Programme (89·9Mc/s) and L3 to 86·1Mc/s (96·8—10·7) for reception of the Third Programme, but if the alignment instructions are followed it will not arise at all.

### ACCURACY OF CONTROL

Overtone crystals in sets of three are cut to a close tolerance on the nominal frequency with a closer tolerance on their differences. Of those supplied for the prototype the greatest difference from nominal frequency was 1kc/s and the greatest difference between any two units was 720c/s. The maximum possible tuning error with accurate alignment is thus very small indeed.

### MIXER STAGE

The valve V4 accepts at its grid the signal and oscillator frequencies and combines them additively to produce in the anode circuit the difference frequency of 10·7Mc/s. This is extracted by the transformer IFT1 and passed on for further amplification. The stage exhibits the high conversion conductance which is characteristic of circuits employing separate oscillator and mixer valves.

### I.F. AMPLIFIER

Two more pentodes, V5 and V6, are employed in successive stages for amplification at the intermediate frequency. The first is a straightforward amplifier carrying in its anode circuit the second i.f. transformer, while the second is operated as a saturated limiter with low anode and screen voltages.

Signals arriving at the grid of V6 are amplified up to a predetermined limit only and interference

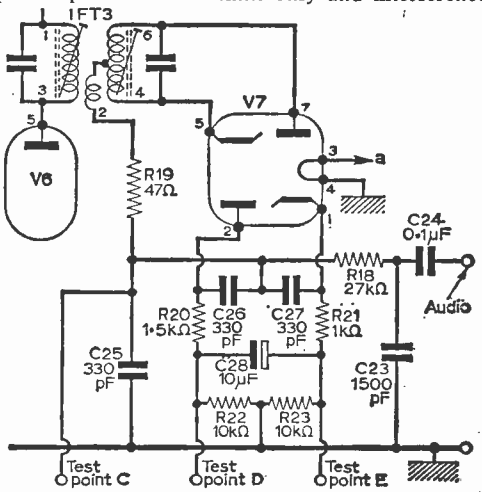



*Fig. 2: The alternative ratio detector stage.*

is thus excluded from the output. The network R13/C18 in the grid circuit generates bias and a negative voltage appears at the grid which, by reducing the current through the valve to a very low value, assists the limiting action. This bias voltage is also used for automatic gain control, being applied for this purpose to the grid of V1. It is inadvisable to apply a.g.c. to the mixer or i.f. stages because of the change of valve input

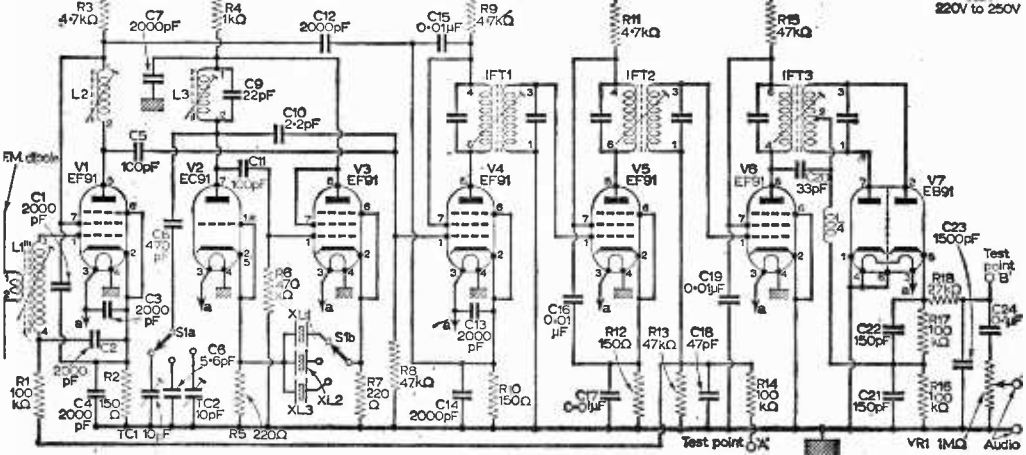



*Fig. 1: The circuit of the tuner which includes Foster-Seeley phase discriminator.*

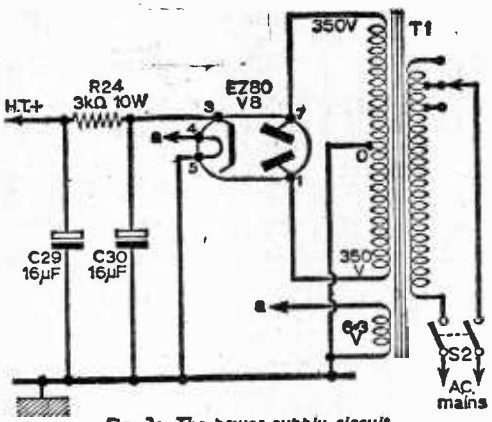



*Fig. 3: The power supply circuit.*

primary winding of the discriminator transformer producing at the ends of the secondary two voltages 180 deg. out of phase. A centre tap on the secondary is capacitively coupled to the valve anode and so assumes a voltage 90 deg. out of phase with the two induced voltages. When the transformer is properly aligned and the i.f. signal is at 10·7Mc/s the diodes connected to the secondary conduct equally and the output across their load, R16 and R17, is zero; when the signal moves away from the quiescent frequency—i.e. when modulation is present—the voltage on one diode rises, while on the other it falls. There is thus an output across the load resistors corresponding to the modulation. This output is passed through the filter R18/C23 to remove the emphasis of the higher frequencies (which was introduced at the transmitter) and is then available for delivery to an audio amplifier. The choke L1 prevents entry of the intermediate frequency into

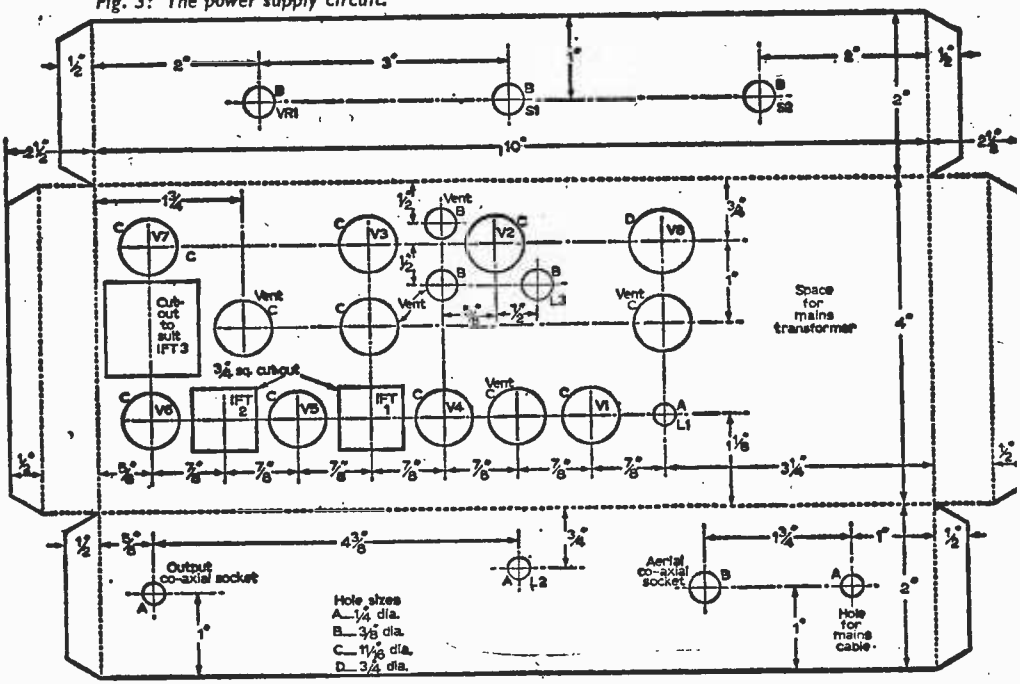



*Fig. 4: Drilling details of the chassis.*

capacitance which occurs with variations of control voltage. This effect is of no importance in the case of V1 where the grid circuit is very broadly tuned.

## DEMODULATION AND DE-EMPHASIS

The detector stage is not, in this tuner, called upon to produce a d.c. voltage for gain control or for the operation of a tuning indicator, therefore a discriminator circuit of the Foster-Seeley type can be employed. The Foster-Seeley discriminator yields rather less distortion at maximum deviation than the more familiar ratio detector and is to be preferred on this account.

The i.f. signal at V6 anode is applied to the

the audio portion of the circuit. The 1MΩ volume control VR1 will be required only if, as in the prototype, volume is to be controlled from the tuner rather than from the associated audio amplifier.

## MODIFICATIONS

The Foster-Seeley phase discriminator is not unresponsive to changes of amplitude, and the tuner relies upon V6 to suppress interference. This it will do most efficiently so long as a sufficiently large signal is received at the grid. Since the gain is high, this condition will usually be met, but if the tuner is used in a poor reception area, the

additional noise rejection properties of the ratio detector will be an advantage. The circuit of Fig. 2 gives very good rejection and may be substituted directly for the discriminator circuit of Fig. 1.

Automatic gain control is a considerable advantage in areas where the signal strength is subject to large fluctuation. If, however, the greatest gain is required for weak signals, it may be better to remove it and return R1 to earth at V1 base. The core of IFT2 secondary will need slight readjustment if the a.g.c. connection is removed after the tuner has been aligned.

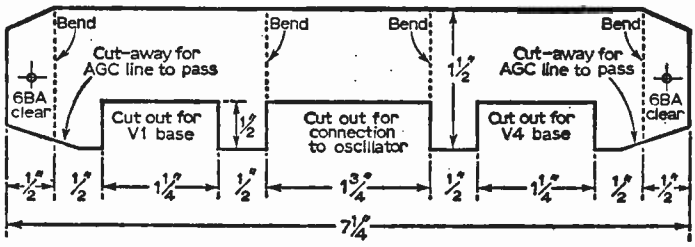



*Fig. 5: Dimensions of the underchassis screen.*

### POWER SUPPLY

The tuner requires a supply of 45mA h.t. at about 230V, and 2·7 amp at 6·3V a.c. for the heaters. This is provided in the prototype by a double wound mains transformer and valve rectifier, EZ80. Smoothing is by resistor, R24 in conjunction with the two 16μF electrolytic capacitors as shown in Fig. 3. The value of the resistor will need adjustment to produce the correct h.t. line voltage, depending upon the output of the transformer-rectifier combination employed. The prototype uses a 350-0-350V transformer, which was to hand, but a 250V transformer will be quite satisfactory if R24 is reduced to about 2kΩ, 5 watts.

This part of the tuner is not critical, and any arrangement which produces the correct currents and voltages will serve. If half-wave rectification is used, the smoothing capacitors should be doubled.

### CONSTRUCTION

The tuner is constructed with the power pack on a chassis of 16s.w.g. aluminium, 10in. x 4in. x 2in. as shown in Fig. 4. Though the crystals are capable of accurate control over a wide range of conditions, it is prudent to limit the temperature rise to reasonable proportions, and special attention has been given to ventilation by providing a number of vents in the deck of the chassis.

Valves V1, V4 should have ceramic bases and

## COMPONENTS LIST

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 100kΩ | R13 | 47kΩ |
| R2 | 150Ω | R14 | 100kΩ |
| R3 | 4·7kΩ ½W | R15 | 47kΩ 1W |
| R4 | 1kΩ | R16 | 100kΩ } matched |
| R5 | 220Ω | R17 | 100kΩ } matched |
| R6 | 470kΩ | R18 | 27kΩ |
| R7 | 220Ω | R19 | 47Ω |
| R8 | 47kΩ | R20 | 1·5kΩ } 5% |
| R9 | 4·7kΩ ½W | R21 | 1kΩ } 5% |
| R10 | 150Ω | R22 | 10kΩ } matched |
| R11 | 4·7kΩ ½W | R23 | 10kΩ } matched |
| R12 | 150Ω | R24 | 3kΩ 10W |

All 10%, ¼W unless otherwise stated
*R16 and R17 for discriminator only*
*R19 to R23 for ratio detector only*

VR1 1MΩ potentiometer log.

**Capacitors:**

| | |
|---|---|
| C1 | 0·002μF tubular ceramic |
| C2 | 0·002μF disc ceramic |
| C3 | 0·002μF disc ceramic |
| C4 | 0·002μF disc ceramic |
| C5 | 100pF tubular ceramic |
| C6 | 5·6pF tubular ceramic or mica |
| C7 | 0·002μF tubular ceramic |
| C8 | 470pF disc ceramic |
| C9 | 22pF tubular ceramic or mica |
| C10 | 2·2pF tubular ceramic |
| C11 | 100pF tubular ceramic |
| C12 | 0·002μF tubular ceramic |
| C13 | 0·002μF disc ceramic |
| C14 | 0·002μF disc ceramic |
| C15 | 0·01μF ceramic or paper |
| C16 | 0·01μF ceramic or paper |
| C17 | 0·01μF ceramic |
| C18 | 47pF mica |
| C19 | 0.01μF ceramic or paper |
| C20 | 33pF ceramic or mica |
| C21 | 150pF mica |
| C22 | 150pF mica |
| C23 | 1,500pF tubular ceramic |
| C24 | 0·1μF paper |
| C25 | 330pF tubular ceramic |
| C26 | 330pF tubular ceramic |
| C27 | 330pF tubular ceramic |
| C28 | 10μF electrolytic, 50V working, wire ended |
| C29 | 16μF electrolytic |
| C30 | 16μF electrolytic |

All 500V working unless otherwise stated
*C20, 21 and 22 for discriminator only*
*C25, 26, 27 and 28 for ratio detector only*

TC1, 2 10pF air-spaced concentric trimmer

**Inductors:**

| | | |
|---|---|---|
| L1 | Aerial coil, r.f. stage | (see text and Fig. 6 for details) |
| L2 | Anode coil, r.f. stage | (see text and Fig. 6 for details) |
| L3 | Oscillator coil | (see text and Fig. 6 for details) |
| L4 | R.F. choke (see text) | |
| IFT1, 2 | I.F. transformer, 10.7Mc/s | (Denco, Eddystone or Jason) |
| *IFT3 | Phase discriminator transformer | (Denco, Eddystone or Jason) |
| *IFT3 | Ratio detector transformer | (Denco, Eddystone or Jason) |

* as required

T1 Mains transformer. Tapped primary. Secondaries 350-0-350V 50mA; 6·3V 3A

**Crystals:**

XL1, 2, 3 Single wire-ended crystals, or multiple unit (STC). Refer to table for frequencies

**Switches:**

S1 2-pole 3-way wafer switch
S2 D.P.S.T. toggle switch

**Valves:** V1-V7 EF91 V8 EZ80

screens should be fitted. No screening was found necessary below the chassis, but experiments showed that minor alterations in the physical form of the r.f. and mixer stages could introduce slight regeneration. The constructor is therefore recommended to fit screens across the bases of V1 and V4 to separate the input circuits from the output.

These screens may conveniently be made as one unit to the measurements given in Fig. 5 and secured by two 6 BA bolts to the rear runner of the chassis. The layout is critical and the constructor who does not wish to experiment should follow it exactly.

### COILS

Coils L1 and L2 are wound on ⅜in. polystyrene formers having ¼in. dust cores. Details are given in Fig. 6.

The grid winding for L1 is 3½ turns of 20s.w.g. tinned copper wire, spaced one wire diameter. The aerial coupling winding is one complete turn of 22 gauge enamelled wire positioned as shown in Fig. 6.

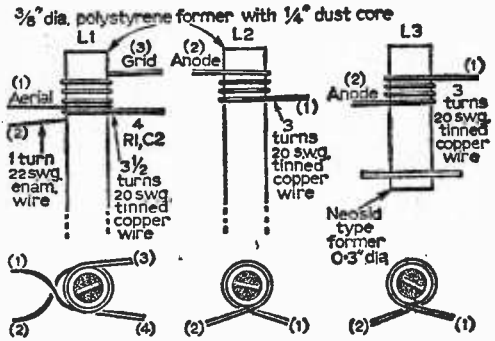



*Fig. 6: Winding details of the coils.*

For L2, three turns of 20 gauge wire, spaced one wire diameter, are needed.

The oscillator coil, L3, is critical; it should have 3 turns of 20 gauge tinned copper wire on a Neosid type former 0·3in. diameter, and having a core coded black.

All the windings should be a good tight fit on the formers and should be secured in position with polystyrene cement.

**TABLE 1**

Crystal frequencies for local oscillator operating at 10·7 Mc/s below the signal frequency.

| BBC Transmitters | Oscillator Frequencies (Mc/s) | | |
|---|---|---|---|
| | LIGHT | THIRD | HOME |
| Wrotham | 78·4 | 80·6 | 82·8 |
| Peterborough, Divis and Thrumster | 79·4 | 81·6 | 83·8 |
| Rosemarkie and Llanddona | 78·9 | 81·1 | 83·3 |
| North Hessary Tor | 77·4 | 79·6 | 81·8 |
| Sutton Coldfield | 77·6 | 79·8 | 82·0 |
| Pontop Pike and Rowridge | 77·8 | 80·0 | 82·2 |
| Meldrum and Blaen Plwyf | 78·0 | 80·2 | 82·4 |
| Holme Moss and Orkney | 78·6 | 80·8 | 83·0 |
| Douglas | 77·7 | 79·9 | 82·1 |
| Kirk O'Shotts | 79·2 | 81·4 | 83·6 |
| Llangollen | 78·2 | 80·4 | 82·6 |
| Norwich | 79·0 | 81·2 | 83·4 |
| Les Platons (C.I.) | 80·4 | 84·05 | 86·4 |
| Oxford | 78·8 | 81·0 | 83·2 |
| Dover | 79·3 | 81·7 | 83·7 |
| Wenvoe | 79·25 | 86·1 | 81·425 |

### CRYSTALS

Crystals can be had from several sources, either as multiple units of three in a B7G glass envelope, or as single wire-ended units in transistor type cans; the latter were preferred for the prototype since they can be wired directly into circuit with short connections. The multiple units are available in combinations to suit most, though not all, reception areas, while the single units can be had to order for any desired frequencies. The frequencies required to receive the three BBC programmes in various parts of the country are set out in Table 1.

The order in which the crystals are connected to the switch S2 is a matter of convenience only but it must be arranged that the highest frequency unit is brought into circuit at the same time as the fixed tuning capacitor C6.

TO BE CONTINUED

## Beginner's TRANSMITTER

—continued from page 712

glow much brighter. The loading of the prototype was 35mA, which corresponds to an input of approximately 10W.

The transmitter may now be keyed and the note tuned in on the station receiver to check on the purity of the tone and freedom from key clicks, etc.

When the tests have been carried out and it is evident that everything is functioning as it should the transmitter is ready to go on the air. Disconnect the 15W bulb and plug in the aerial. Proceed to load up as for the dummy load and the rig is all set for its first QSO.

### Operating Drill

One of the best ways of starting with a QRP rig is to listen first. If the station receiver is tuned to the crystal frequency a watch can then be kept for any station calling "CQ".

Remember that after a station has called CQ he will be listening carefully for a reply around that frequency and is more likely to hear you. If your crystal frequency is very quiet and no signals can be heard (most unlikely with today's crowded bands) then a "CQ" call may be tried.

It is best when working low power not to call CQ for too long a period. A three-by-three is sufficient—i.e., "CQ CQ CQ de G3XYZ G3XYZ G3XYZ" repeated three times, followed by AR and a period of careful listening. Listen carefully on the frequency, note the dial reading and then try up and down the band on either side. It may be that your CQ is being answered by another crystal controlled station whose crystal frequency is higher or lower than your own.

# Simple Resistance Measurements

BY G. A. W. PARTRIDGE

*Accurate and reliable methods of measuring resistance values*

THERE are times when the value of resistors have to be determined fairly accurately. The various ways of doing this are well known. The colour code system and a large variety of test instruments on the market from simple ohmmeters to expensive bridge instruments are for this purpose. However, colour codes fade and even ohmmeters become unreliable.

The methods described here are very simple but unfortunately they are more often than not applied too roughly for much practical value. A little more time spent on these tests is well worth it.

## Low Values of Ohms

It is sometimes necessary to measure a low resistance of only a few ohms, such as the type used to reduce a 12 volt supply to 6 volts. Such problems usually arise on low voltage heater supplies.

Fig. 1 shows how the ammeter and voltmeter method is used. A suitable battery, ammeter, and

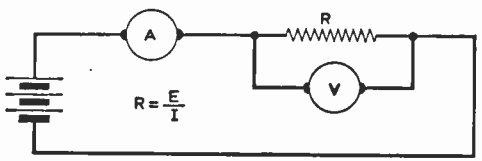



*Fig. 1: Measuring low resistances using the ammeter and voltmeter method.*

voltmeter are chosen. The battery must be large enough to maintain a steady current through the resistor without overloading it, but at the same time giving at least half-scale deflection on both instruments. The value of the resistor will be equal to the voltage divided by the current. The voltmeter must have a high internal resistance. For example if a resistor of 1Ω was being tested, and the voltmeter had a resistance as low as 100Ω, the error would be 0·01Ω assuming that both meter readings are accurate. It is, of course, essential that good quality instruments are used when a fairly high degree of accuracy is desired.

## Kilohm Range

Resistors in the kilohm range can also be measured in much the same way, using a milliammeter and a very high resistance voltmeter, or preferably an electronic voltmeter. However, if such apparatus is not available a good moving coil instrument will do providing the following formula is used:

$$R = \frac{(E/I)\,Rv}{Rv-(E/I)}$$

where R = value of the unknown resistor
E = voltmeter reading
I = current in amperes
Rv = voltmeter internal resistance.

For example, during a resistor test the voltmeter read 100 and the milliammeter 10. The voltmeter resistance was 100,000Ω. What is the value of R? (Fig. 1).

$$R = \frac{(E/I)\,Rv}{Rv-(E/I)}$$

$$= \frac{(100/100\text{th})\ 100{,}000}{100{,}000-(100/100\text{th})}$$

$$= \frac{10{,}000\times 100{,}000}{100{,}000-10{,}000}$$

$$= \frac{1{,}000{,}000{,}000}{90{,}000}$$

$$= 11{,}111\Omega.$$

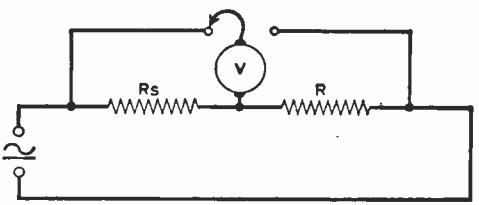



*Fig. 2: Method for measuring high resistances.*

## Megohm Range

Resistors in the megohm region can be measured in the same way, but high voltages are required in order to give a suitable deflection on the microammeter. Fig. 2 illustrates a more suitable arrangement which enables voltages as low as 240 or less to operate the circuit. Rs is a resistor which has a known value. R is the unknown resistor. If the circuit is non-inductive a.c. can be used.

The voltmeter should have a resistance of about 10,000Ω per volt or more. In this test Rs was 500,000Ω and the applied voltage 240.

First, the voltmeter was connected across Rs and the reading was 50V. It is now connected across R and reads 100V.

$$R = \frac{\text{Rs x voltage across R}}{\text{voltage across Rs}}$$

$$= \frac{500{,}000 \times 100}{50}$$

$$= 1{,}000{,}000\Omega.$$

The resistor Rs should be about the same as the unknown R so that the voltmeter reading will be on the same range, thus reducing error. All connections must be as tight as possible and the current steady while the readings are taken. Excessive heating must also be avoided.

### METER RESISTANCE MEASUREMENTS

There are times when it is necessary to know the internal resistance of a milliammeter or voltmeter, especially the former, when it is desired to extend the instrument range. An instrument may read, say, from 0 to 100mA, and it is desired to extend its range to 1A. The resistance of the necessary shunt is calculated from:

$$\frac{\text{Internal resistance of meter}}{\text{Multiplying factor} - 1}$$

It will be seen that it is necessary to know the internal resistance of the meter. The multiplying factor in this case is 10 because 1A is 10 times greater than 100mA.

Some instruments have their internal resistances marked on them or it is mentioned in an accompanying leaflet, but there are many cases where such information is not available.

The resistance of a voltmeter is usually given in *ohms per volt*, which is called the sensitivity. Therefore if a voltmeter is marked at 1,000Ω per volt and reads from 0 to 100V, its total resistance is 1,000 x 100=100,000Ω. Here again, this information may be unknown, and will therefore have to be measured if the range is to be increased.

Four methods of finding the internal resistance of an instrument are described here. It must be pointed out that good tight connections, especially when measuring small resistances, are most important. Extra resistance caused by a bad connection can lead to serious errors.

#### The Ohmmeter Method

The first described is the ohmmeter method which is the simplest. The resistance of a milliammeter is measured with a low reading ohm-

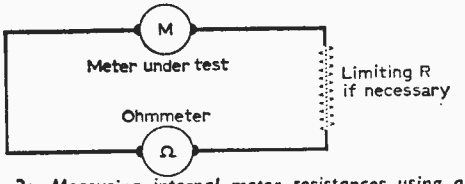



*Fig. 3: Measuring internal meter resistances using an ohmmeter.*

meter in just the same way as any other resistance (Fig. 3). A Wheatstone bridge or any other suitable measuring device can be used if available. The success of the test is, of course, largely dependent upon the accuracy of the resistance measuring instrument. If the milliammeter needle goes beyond full scale deflection, it is advisable to reduce the test current by adding a small known resistor (Fig, 3) to the circuit, and then deduct its value from the ohmmeter reading which will give the milliammeter resistance.

Much the same idea applies when testing a voltmeter except that a higher reading ohmmeter may be required and no limiting resistor will be necessary. (Here again a Wheatstone bridge or any other resistance measuring instrument can be used.)

#### The Ammeter and Voltmeter Method

The ammeter and voltmeter method is illustrated in Fig. 4. It is more suitable for measuring the internal resistance of voltmeters than milliammeters. Note that the voltmeter under test measures its own test voltage so its accuracy must be taken

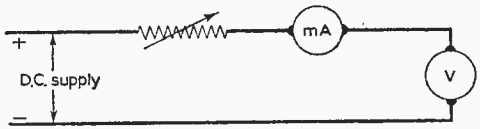



*Fig. 4: The ammeter and voltmeter method of measuring the internal resistance of voltmeters.*

into consideration. A suitable d.c. supply, usually derived from batteries, is adjusted by a rheostat until full scale deflection takes place on the voltmeter. The internal resistance is calculated by dividing the voltage by the current in amperes.

For example:

The voltmeter has a full scale deflection of 10V. After adjusting it to read this voltage the current is found to be 1mA. What is the internal resistance?

$$Rm = \frac{E}{I}$$

$$= \frac{10}{1/1{,}000}$$

$$= 10{,}000\Omega.$$

Therefore the sensitivity is 10,000÷10, which is 1,000 ohms per volt.

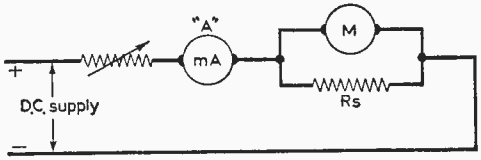



*Fig. 5: The resistance comparison method.*

#### The Resistance Comparison Method

The resistance comparison method (Fig. 5) can be applied to milliammeters and voltmeters. The standard resistor Rs must be as accurate as possible and about the same value as the unknown internal resistance of the instrument under test. Rs is connected in circuit first and the rheostat adjusted until a suitable deflection is indicated on the milliammeter A. Now the meter under test

—continued on page 745

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# The Progressive PORTABLE

*This receiver is built in successive stages, each new stage adding to the performance of the set and culminating in a six-transistor, two-waveband portable.*

CONTINUED FROM PAGE 669 OF THE NOVEMBER ISSUE

**By R. F. Graham**

A SINGLE transistor, in a Class A output stage and used with a sensitive loudspeaker, will give good loudspeaker volume. Volume is naturally not so great as when two transistors are employed in a Class B or push-pull stage but is nevertheless adequate for ordinary listening.

A suitable output stage, using an OC72, is shown in Fig. 4. The frequency changer (Tr1), intermediate frequency amplifier (Tr2), and OC71 audio amplifier Tr3 are already present. The extra components needed are thus 8$\mu$F and 50$\mu$F capacitors, 39Ω, 2·2kΩ, 2·7kΩ and 12kΩ resistors, OC72 transistor, output transformer and loudspeaker.

Assuming that the push-pull output stage will eventually be made, a matched pair of OC72's should be obtained. The output transformer can also be that intended for the push-pull stage, the whole primary being connected, and the centre tap being unused for the present.

The loudspeaker is bolted behind the aperture provided, and the Perspex panel will act as a baffle, so that reproduction is good, even with the set out of its cabinet.

The output transformer T1 is mounted just above the plywood base, the same side as the volume control—that is, in the same position as for the complete 6 transistor receiver. The transformer listed has two lugs. These pass through slots made by drilling two or three small holes closely side by side. The lugs are then twisted, to secure the transformer.

If the receiver has already been used with phones, in the way described, no trimming or other adjustments will be needed. (The headphones were connected in place of the 2·7kΩ R10 resistor in Fig. 4.)

A meter may be included in one battery lead, to test working, and it should read approximately 10mA, with a 7½V supply. Current will remain fairly steady, irrespective of volume, and this is usual with a Class A stage. The actual current depends on exact resistor values and the transistor, and anything between about 15mA and 25mA may be encountered. The second OC72 may be tried in the circuit, if desired, and should give similar results.

The steady drain of about 20mA is easily within the capacity of the round cell type of 7½V battery (e.g. AD38), and this kind of battery is preferred to miniature layer type battery. When the Class B stage is fitted, very much greater volume will be obtainable, and current consumption will be smaller, except at maximum volume.

### *Second I.F. Amplifier*

It is convenient to add the second intermediate frequency amplifier next. The receiver will then have five transistors, and will give a very good performance, with much increased sensitivity to weak signals.

In the new circuit, the 5kΩ potentiometer VR1 acts as an audio volume control, no longer controlling the sensitivity of the i.f. amplifier, as in the simpler circuit. Wiring is also slightly changed, to obtain some measure of automatic volume control. This a.v.c. voltage is applied to the first i.f.

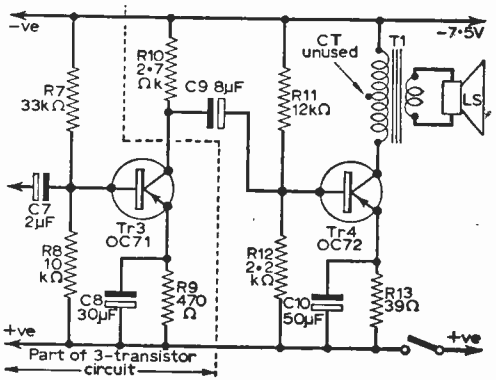
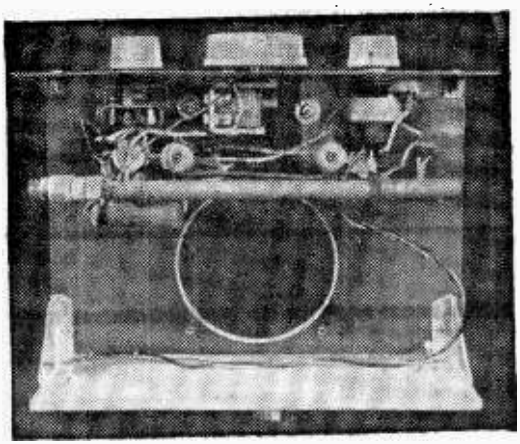



*Fig. 4: Class A output stage with R-C coupling.*

amplifier, through the 8·2kΩ resistor in Fig. 5, the voltage being provided by the diode. Automatic volume control helps to prevent overloading on powerful local stations, and to some extent reduces the effect of fading, or changes in volume, experienced with some transmissions.

The frequency changer, as already made and adjusted, remains untouched. The a.f. amplifier and output stage are also unchanged. The new wiring is thus confined to that part of the receiver shown in Fig. 5.

The new transistor is Tr5 and the third i.f. transformer is inserted in position. As the first i.f. stage transistor Tr2 originally fed the diode



*A view of the receiver in an advanced stage of construction.*

detector stage, this lead and the old volume control connections, have to be removed. The extra i.f. stage (Tr5, IFT3) is then wired up according to the circuit in Fig. 5. The arrangement of components and wiring should be as in the finished receiver wiring diagrams.

With the new stage added, current consumption (as shown by the meter in one battery lead) will be only very slightly increased, the increase being roughly 1mA. If the meter shows a heavy current, switch off at once and check wiring.

The extra intermediate frequency transformer (IFT3) is adjusted by engaging its core with the insulated tool described and slowly rotating this for best volume. Slight readjustment of IFT1 and IFT2 will also be necessary for peak performance. If a signal generator is available the IFT's can be aligned at 470kc/s. If not, adjustments are made in the way already described for the simplified receiver.

The increase in sensitivity should be very marked, and many more stations should be heard, at adequate volume. The volume control will give a smooth adjustment of volume, from zero to maximum (fully clockwise) as it no longer controls sensitivity, as in the simpler circuit.

During subsequent additions, such as providing for Long Wave reception, and converting to a push-pull output stage, no changes at all will be made to the intermediate frequency amplifier. It is thus worth checking that this part of the set is operating well.

If alignment is correct, each i.f. transformer core can be "tuned" to a setting which gives best volume, and no core will be in an extreme position, either right in, or very far out.

Aligning at some frequency a little removed from 470kc/s has virtually no effect on sensitivity, and may be expected, if a signal generator is not available. Final adjustments should always be made with a weak signal. That is, set volume control at maximum, and find a weak station, or rotate the receiver to reduce signal pick-up by the aerial rod.

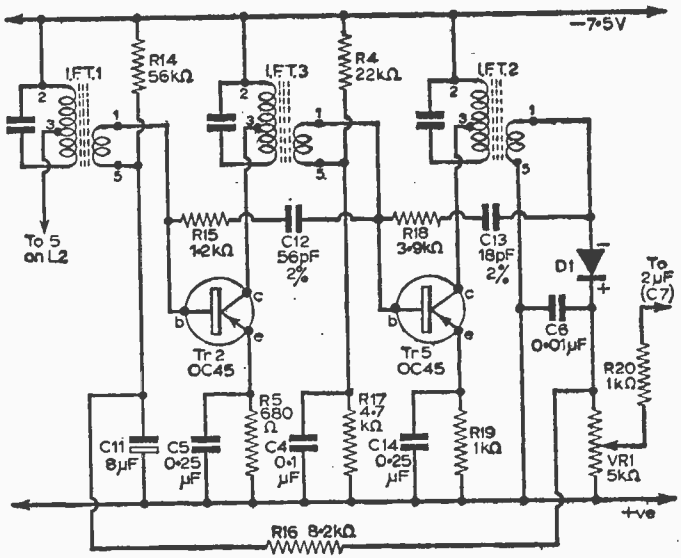



*Fig. 5: The modified i.f. amplifier with additional stage (Tr5).*

**SUMMARY OF REQUIREMENTS FOR SECOND AND THIRD STAGES**

**Class A Output Stage (Fig. 4)**
Resistors: R10-R13
Capacitors: C9-C10
Transistors: Tr4
Transformers: T1

**Second I.F. Stage (Fig. 5)**
Resistors: R14-R19
Capacitors: C11-C14
Transistors: Tr5
Transformer: IFT3

### The Cabinet

An attractive cabinet of very simple design ca be made quite easily, as shown in Fig. 6. Th cabinet is in the form of a case with handle an open top, so that the receiver can be placed in i complete with battery, and as a working unit.

The actual receiver is 3in. x 8¼in. x 6¼in. Th cabinet is 6¼in. deep inside, so that the receive panel is slightly sunk. This dimension is no critical. The cabinet must, however, just clear th receiver, and is thus about 3 1/16in. x 8 3/16in., inside It is equally satisfactory to make the cabinet 3in x 8¼in., if the receiver is just enough under thes dimensions to give clearance.

The bottom, two sides, and back are cut, an glasspapered smooth, if necessary. For th dimensions given, sides and bottom must be c

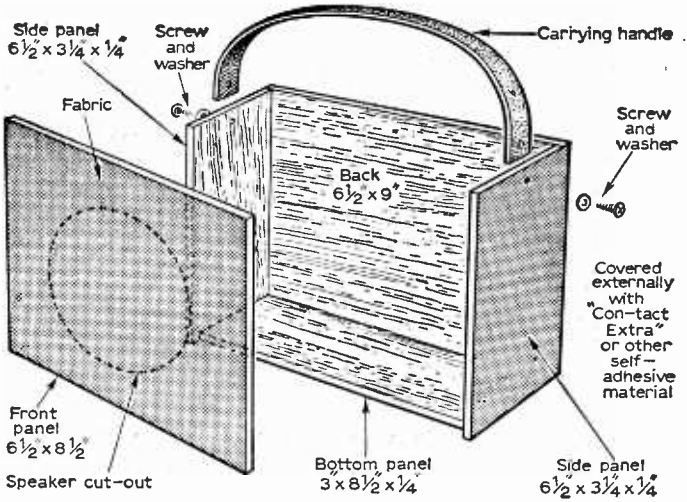



*Fig. 6: Construction details of the cabinet.*

¼in. thick wood. The back is of smooth hardboard. After these parts have been checked for accuracy, meeting surfaces are glued, and they are secured together with panel pins. This makes a box 6¼in. x 8½in. x 3¼in. inside dimensions.

When the glue is dry, edges and corners are smoothed with glasspaper on a block. Pin heads should be flush, or should be levelled with a file.

This part of the cabinet is then covered entirely on the outside with a single piece of self-adhesive material, as used in kitchens, etc. The wood should be free from dust. Begin by placing the back of the cabinet near the centre of the material. Smooth out to avoid wrinkles. Each side can then be done, cutting with scissors at the corners. Finally, the bottom is covered. The material laps right over the edges of the wood and hardboard, and should be large enough to extend for an inch or so inside.

The, front is cut from 3-ply with a 4½in. diameter hole. A strong silk, cloth, or similar material is stretched over this board, and overlaps all edges, again extending somewhat on the inside surface, where it is glued. The material can be held taut with pins until the glue is dry. A metal fret is not recommended.

The covered front piece should be a tight fit in the cabinet, and meeting surfaces are smeared with adhesive, before it is inserted. In the cabinet illustrated, the cabinet was covered with a mottled red adhesive material, with a yellow cloth front.

A carrying handle is made from any strong, flexible material, and is held by two screws. Washers are placed under the screw heads.

The finished cabinet has a modern, pleasing appearance, and is intended to take the receiver immediately. It can then be carried and used as wanted. The colours used can be according to choice. If ready-planed wood, of the required width and thickness, is purchased, the whole cabinet can be made very readily, and with few woodworking tools or skill.

TO BE CONCLUDED

## Simple Resistance Measurements

*—continued from page 738*

is substituted for Rs and the deflection on milliammeter A again noted, the rheostat setting remaining the same.

The internal resistance of the meter is:

$$\frac{\text{Standard resistance} \times \text{current through meter under test}}{\text{Current through standard resistor.}}$$

For example, the current taken by the meter under test was 100mA, and the standard resistor passed 50mA, its value was 10Ω. What is the internal resistance of the meter?

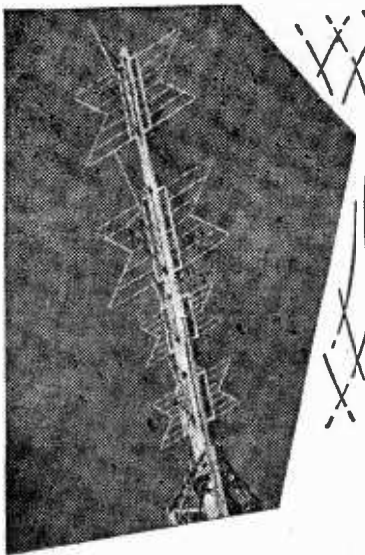
$$= \frac{10 \times 100}{50}$$

$$= 20\Omega$$

The accuracy of the standard resistor is most important here, so a reliable standard must be chosen.

The more sensitive the instrument the greater its internal resistance. A milliammeter may have an internal resistance of several ohms as compared to an ammeter, which would be be less than one ohm.

**Next Month—Inductance Measurements**



# On Your Wavelength

By THERMION

THESE are significant times in the history of wireless communication. Extensive research into materials and components with accompanying advances in circuit techniques have resulted from man's determination to explore space.

So then, as we stand on the threshold of a new era in telecommunications, perhaps it would be a good thing to ponder over some of the ways wireless (or radio) communication is at present employed in our everyday affairs: perhaps we can think of further applications that would be of benefit to the general public. Many of you will have your own ideas on this subject, and I will confine myself to giving one illustration of this kind.

### *Radio Telephones and the Railways*

Many important services such as police, fire, ambulance, and air-sea rescue, and also various commercial undertakings, make use of v.h.f. radio telephone networks to maintain contact between vehicles and fixed control centres. On the other hand one can think of other organisations still relying on time honoured methods of communication, although radio has obvious advantages to offer.

The railways, for example, seem reluctant to make any widespread use of radio. This is no doubt explained, to some extent at least, by the excellent system of line communication and visual signalling that has been built up over the years for operational purposes. But what of the passengers? When setting out on a long journey by train, one has to accept complete isolation from the rest of the community for the duration. True, we know that in a real emergency the guard can throw a message out onto a station platform as the train thunders past, but is this good enough in the day of the communications satellite?

There would seem to be no technical obstacle to the use of two-way radio on modern trains. Surely at least a start could be made by providing a radio link with signal boxes along the line. On certain long distance trains a further development would be justified in the provision of a radio link with the public telephone service for the benefit of passengers wishing to make private calls. After all this same facility is now available (in certain parts of the country) to private motorists. I do hope that the G.P.O. (currently engaged on a sales campaign to boost the use of the telephone) is prodding British Railways in this connection.

### *Vulnerable Police Radio*

While writing on the subject of v.h.f. radio telephones, another example of lack of technical enterprise by the powers that be comes to mind.

You may recall a short while ago that during investigations into a large scale robbery the police imposed a ban on the use of their radio telephone network. It is incredible that such a body as the police should at any time find it necessary to deprive themselves of a very convenient and flexible method of communication, and have instead to make recourse to line systems with their dependence on fixed installations. The reason (as stated publicly) for this self-imposed embargo was that criminals are known to monitor the police radio. This is not surprising; what is surprising, however, is the failure to use a scrambling system to render the signals unintelligible when received by an unauthorised person.

Speech scrambling devices have long been employed on official telephone line circuits and also on transatlantic radio telephone services. The G.P.O. takes care to protect the conversations of private individuals from etheric eavesdroppers, but the same protection cannot apparently be given to an important service such as the police.

A few years ago one could have been told that the very size of the equipment necessary to 'scramble' ruled out the possibility of its incorporation into a mobile station. This cannot be true in the age of semiconductors, subminiaturisation and satellites!

### *T.T. Solution*

I must thank all who wrote to me about the little problem entitled 'Tape Teaser'.

For those unfamiliar with the technique employed in the Language Laboratory and who may still be puzzled, I must explain that the answer lies in the use of a two-track recording system with special head and amplifier switching arrangements. One track is controlled by a preset type switch (inaccessible to the student). The tutor first records on this track and then sets this switch to play. The equipment is now ready for student use.

The second track is under the control of the student who can record and replay in the normal manner. Output from the tutor's track is fed continuously into the headphones, and when the student switches to replay he hears in addition the output from his own track.

# capacitor tester

## A QUICK CHECK INSTRUMENT

*By L. Sheldon*

CONSIDERABLE damage can be done to expensive components by a "leaky" capacitor and this simple test unit was evolved primarily in order to eliminate this particular hazard. Construction is based on the very versatile characteristics of small neon lamps, which are also cheap and very reliable.

Referring to Fig. 1 it will be observed that there are three distinct sections to the tester, two being for capacitor tests, while the third section performs as an audio oscillator, and although quite limited in use has been found very handy as a simple l.f. generator when testing audio amplifiers. If not required, this third section can be deleted without any adverse effect on the remainder of the unit.

The neon lamps, although not critical, may need a certain amount of experimenting with for best results. The neon lamps used in the prototype were the small indication type for N1 and N3, both having the internal resistor removed. For N2 a similar type can be used, but it was found that a somewhat larger type was in fact more suitable and gave a more critical indication when used as a calibrated unit as described later. Whatever type is employed it is essential that an internal resistor is incorporated in N2. The voltages obtained with a 1,000Ω/V meter were 140V d.c. across C2 and 260V d.c. across C4.

The functions of the various stages of the capacitor tester are described as follows, beginning with Test Section A for paper and mica dielectric capacitors.

### *D.C. Leakage Test*

Set switch S1 to position 3 and switch S2 to position 1.

A good capacitor connected to test terminals A will give a short single flash indicating that it has been charged, after which the neon will remain dark. The intensity of the flash will depend on the size of the capacitor and will not be easily discerned with small values. If flashes recur at intervals of a few seconds to a minute or more this indicates leakage, but the component under test may be used in some circuitry which is not hypercritical. A continuous glow proves the capacitor to be useless.

### *A.C. Internal Open-circuit Test*

Set switch S1 to position 3 and switch S2 to position 1.

Connect capacitor to terminals A. When a.c. flows through the capacitor under test the neon will strike and remain alight. By slowly reducing VR1 a point will be reached where the neon is extinguished.

This position in the switching sequences also allows calibration to be made for a limited range of capacitors. Apply a good capacitor of known

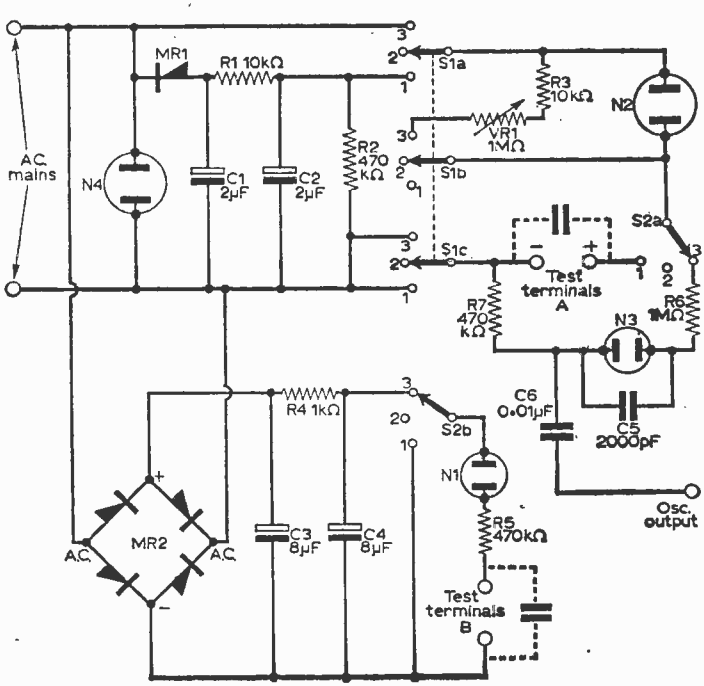



*Fig. 1: The circuit of the tester. One section of the circuit can be used as a simple l.f. generator.*

## CAPACITOR TESTER

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 10kΩ 1W | R5 | 470kΩ ½W |
| R2 | 470kΩ 1W | R6 | 1MΩ ¼W |
| R3 | 10kΩ ½W | R7 | 470kΩ ¼W |
| R4 | 1kΩ 1W | | |
| VR1 | 1MΩ linear potentiometer | | |

**Capacitors:**

| | |
|---|---|
| C1, C2 | 2μF electrolytic 350V |
| C3, C4 | 8μF electrolytic 350V |
| C5 | 0·002μF paper |
| C6 | 0·01μF paper |

**Metal Rectifiers:**

| | |
|---|---|
| MR1 | 250V 30mA surplus type |
| MR2 | FC124 contact cooled |

**Neon Tubes:**

| | |
|---|---|
| N1, N3 | Small mains indicator type—less internal resistor |
| N2 | M.B.C. mains type *with* internal resistor |
| N4 | Small mains indicator type—*with* internal resistor |

**Switches:**

| | |
|---|---|
| S1 | 3-pole, 3-way wafer switch |
| S2 | 2-pole, 3-way wafer switch |

**Miscellaneous:**

Four terminals (Belling Lee), three instrument type knobs, four crocodile clips, one mains plug.

value to test terminals A and rotate VR1. When the neon is extinguished note position of VR1. Calibrate a chart from different sizes of capacitors ranging from 0·1μF to 0·001μF. Fig. 2 shows the scale obtained with the prototype model.

With the 0·1μF capacitor under test the current when the lamp is extinguished is approximately 6mA, this largely passing through VR1, and it is advisable to terminate this part of the test as soon as possible. The resistor R3 limits the current through VR1 and a value of 10kΩ allows the instrument to read up to 0·1μF. A lower value for R3 would enable the range to be extended to higher values of capacitance but would increase the risk of VR1 burning out.

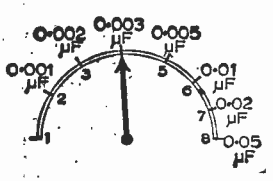



*Fig. 2: The scale calibration of the prototype instrument.*

### *Electrolytic Tests*

Set switch S2 to position 3 and switch S1 to position 2.

Although this is not claimed to be the complete answer to testing electrolytics the unit will give indication which is sufficient to give confidence in using the chosen electrolytic capacitor.

It will be observed that MR2 gives a rectified d.c. output of slightly over 260V, and when the capacitor to be tested is applied to the test terminals B the neon N1 will most likely glow continuously. If the electrolytic is a good one, after a short period the neon will begin to flash at short intervals. These intervals will become more prolonged according to the length of time the test is continued.

It will also be found that an electrolytic capacitor which has been out of use for some time can be sufficiently "re-formed" by leaving it in circuit for upwards of an hour. If after this period of time the neon glows continuously instead of giving intermittent flashes the capacitor should be discarded.

In view of the higher capacities encountered with the electrolytic capacitors, once a test has been completed the accumulated charge must be removed by placing S2 in position 1 and S1 in position 2.

### *The Oscillator Section*

Set switch S1 to position 1 and switch S2 to position 3.

The neon N3 will glow steadily and generate an audio note which can be heard in the loudspeaker when the test prod is in contact with the grid of the output stage in the radio receiver or amplifier undergoing test. This signal is also suitable for tracing faults when applied to earlier stages in audio amplifiers and it can be used for energising "bridge" circuits.

The component values given are subject to experiment if different audio frequency outputs are required. Variation in the value of C5 particularly affects the pitch of the audio note.

A suitable test prod was made from a discarded inhaler case. This was drilled at one end to take a 4B.A. screw which acted as the prod. C6 was fitted inside this case, the lead being soldered to the head of the screw before the latter was passed through from the inside of the case. Finally the screw was bolted in position with a 4B.A. nut.

### *Construction*

The capacitor tester was built on to a chassis measuring 6in. x 4in. x 1in. and this was fitted into a case having the following dimensions: 7½in. x 5in. x 5in.

Layout of components is not important and therefore details of construction are not given. It is worth mentioning, however, that each neon should be located as near as possible to the selector switch that controls its function.

The author included a further neon N4 as safety device, connected in the mains input to give warning when the whole unit was switched on. This neon has an internal series resistance and is fitted with a red cover lens. ■

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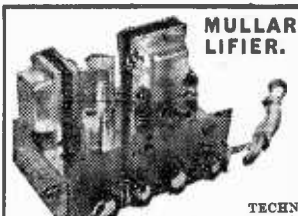

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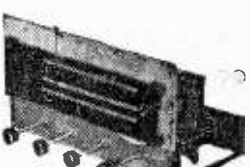
## 7 VALVE AM/FM RADIOGRAM CHASSIS



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# A Miniature MAINS RECEIVER

**A simple 3-valve 2-waveband set**

By C. J. Lee

THIS miniature mains receiver performs very well and receives several stations on both long and medium waves. Two coils are employed and each is brought into circuit independently at the turn of the wavechange switch S1. Also incorporated in this set is a telescopic aerial, but it should be noted that a somewhat longer external aerial may be required in some districts.

To give the finished set an attractive appearance, it is mounted in a small fabric-covered cabinet. This makes for one complete unit, and as it only weighs a few pounds and measures but 7½in. x 5in. x 5½in. the set can easily be transferred from one place to another without any difficulty.

### Components

As the majority of the parts are not critical, the cost of the receiver can be kept to the absolute minimum. In the author's case, most of the parts were obtained from the "spares box". However, to keep it in the "miniature" class, it is necessary to employ two "midget" type components; these being the mains transformer (T2) and the loudspeaker.

Suitable mains transformers can be obtained from advertisers in P.W. quite cheaply. In the prototype receiver, the mains transformer measured 2½in. x 2½in. x 2½in., and supplied 250V-0-250V 60mA and 6·3V 2A. It should be noted that the space available on the chassis to mount this component is very limited, and so a bulky kind of component cannot be accommodated.

The other "midget" component is the loudspeaker, and the space available in the cabinet allows room to install a 2½in. diameter unit. Very good results are obtainable, however, with such a small unit.

If the constructor has a larger loudspeaker to hand, he could of course, construct a similar cabinet to that which accommodates this set, and install it so that it could be connected to the output transformer (T1) via flexible leads.

### Tuning Arrangements

For tuning purposes, a 500pF variable capacitor is employed (VC1). It is not necessary to fit a reduction drive, but a fairly large knob is recommended to facilitate more accurate tuning.

A 500kΩ potentiometer (VR1) is used as the volume control, and this also incorporates the mains off/on switch (S2).

Two coils are required and these are of the aerial type, each consisting of an aerial coupling coil, and a grid coil, the latter being tuned by the variable capacitor VC1.

Either of the coils is brought into circuit by the wavechange switch S1.

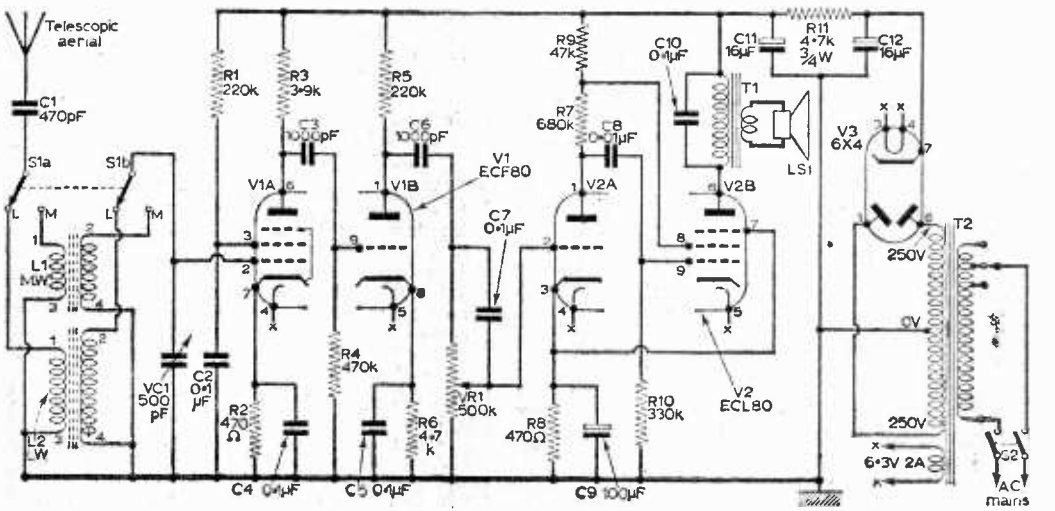


*Fig. 1: The complete circuit.*

### The Valve Functions

The theoretical circuit is given in Fig. 1. It is based on two triode-pentodes, and a small valve rectifier is used to provide h.t. current.

The first valve V1 is an ECF80. This performs the dual function of signal detector (V1a) and voltage amplifier (V1b), using the pentode and triode sections respectively.

The second valve is an ECL80. The triode section acts as voltage amplifier and the pentode section as the output stage. The a.f. signal is fed from the anode of the triode section of V1, via C6 and the volume control VR1 to the control grid of the triode section of V2.

A small B7G based rectifier, type 6X4, supplies adequate h.t. power for the set.

### Power Supply

The midget mains transformer should supply 250V centre-tapped at 60mA, and 6·3V at 2A for the valve heaters. For smoothing, a 16+16μF double electrolytic capacitor is employed, and the outer foil, usually marked with a red dot is connected to the cathode, pin 7, of the rectifier. The two capacitors are strapped with a 4·7kΩ 1W smoothing resistor smoothing choke, with a saving R11. This saves employing an l.f. in cost, space and weight.

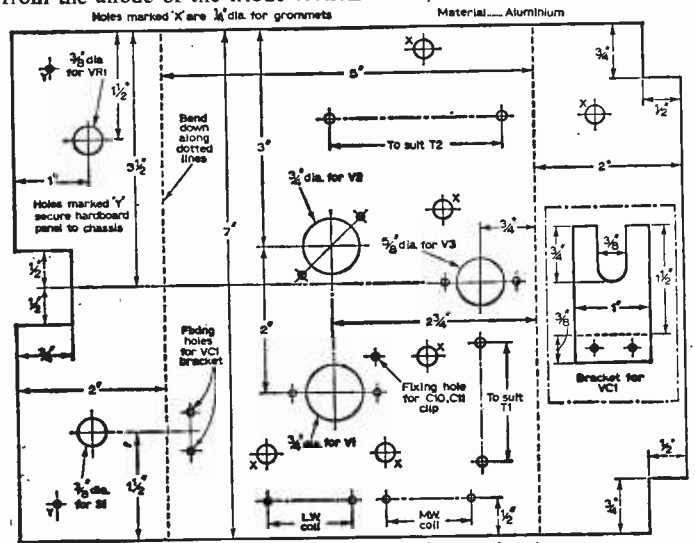


*Fig. 2: Chassis dimensions and drilling details.*

### Construction

The whole set is constructed on a metal chassis formed from a 9in. x 7in. sheet of aluminium. Details of how to prepare this chassis may be found in Fig. 2. The drilling operations should be conducted carefully, and any rough edges filed down. It will be seen in Fig. 2 that there are six holes marked "X". These holes permit the passage of wires from the top to the underside of the chassis. They are ¼in. diameter and each is fitted with a rubber grommet to prevent the sharp metal piercing the insulation on the wires.

Two ⅜in. diameter holes are drilled in the front panel to accommodate the wavechange and volume controls.

## COMPONENTS LIST

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 220kΩ | R7 | 680kΩ |
| R2 | 470Ω | R8 | 470Ω |
| R3 | 3·9kΩ | R9 | 47kΩ |
| R4 | 470kΩ | R10 | 330kΩ |
| R5 | 220kΩ | R11 | 4·7kΩ 1W |
| R6 | 4·7kΩ | | |

All ±10%, ½W carbon, except where otherwise stated.

VR1 500k potentiometer with d.p. switch (S2)

**Capacitors:**

C1 470pF mica
C2 0·1μF paper 350V
C3 0·001μF paper 350V
C4 0·1μF paper 350V
C5 0·1μF paper 350V
C6 0·001μF paper 350V
C7 0·1μF paper 350V
C8 0·01μF paper 350V
C9 100μF electrolytic 25V
C10 0·1μF paper 350V
C11 16μF } dual electrolytic 350V
C12 16μF }
VC1 500pF solid dielectric tuner

**Inductors:**

L1 M.W. coil with aerial coil (Teletron HFA5 or similar type)
L2 L.W. coil with aerial coil (Teletron HFA1 or similar type)
T1 Pentode output transformer: primary 7500Ω approx.; secondary 3Ω or to suit loudspeaker
T2 Miniature mains transformer with tapped primary. Secondaries: 250-0-250V 60mA; 6·3V 2A

**Switches:**

S1 2-pole, 2-way rotary switch
S2 D.P.S.T. toggle switch (see VR1)

**Valves:**

V1 ECF80 V2 ECL80 V3 6X4

**Miscellaneous:**

P.M. loudspeaker unit, 2½in. dia., 3Ω speech coil. Two B9A valveholders, one B7G valveholder. Telescopic aerial (3ft. 6in.) complete with mounting clips. Two small knobs and one large knob. Tuning dial. Sheet of aluminium for chassis 9in. x 7in., plus piece for bracket. Piece of hardboard 7½in. x 5in.

Material for cabinet:

Three pieces ¼in. plywood 7½in. x 5in.
Two pieces ¼in. plywood 4½in. x 5in.
About 4ft. of ½in. x ½in. for glue blocks.
Covering fabric 24in. x 24in.
Four rubber feet. Small handle. Screws, glue.

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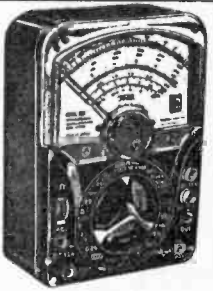

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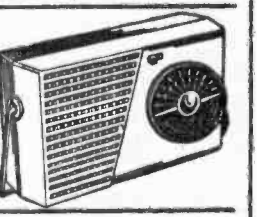

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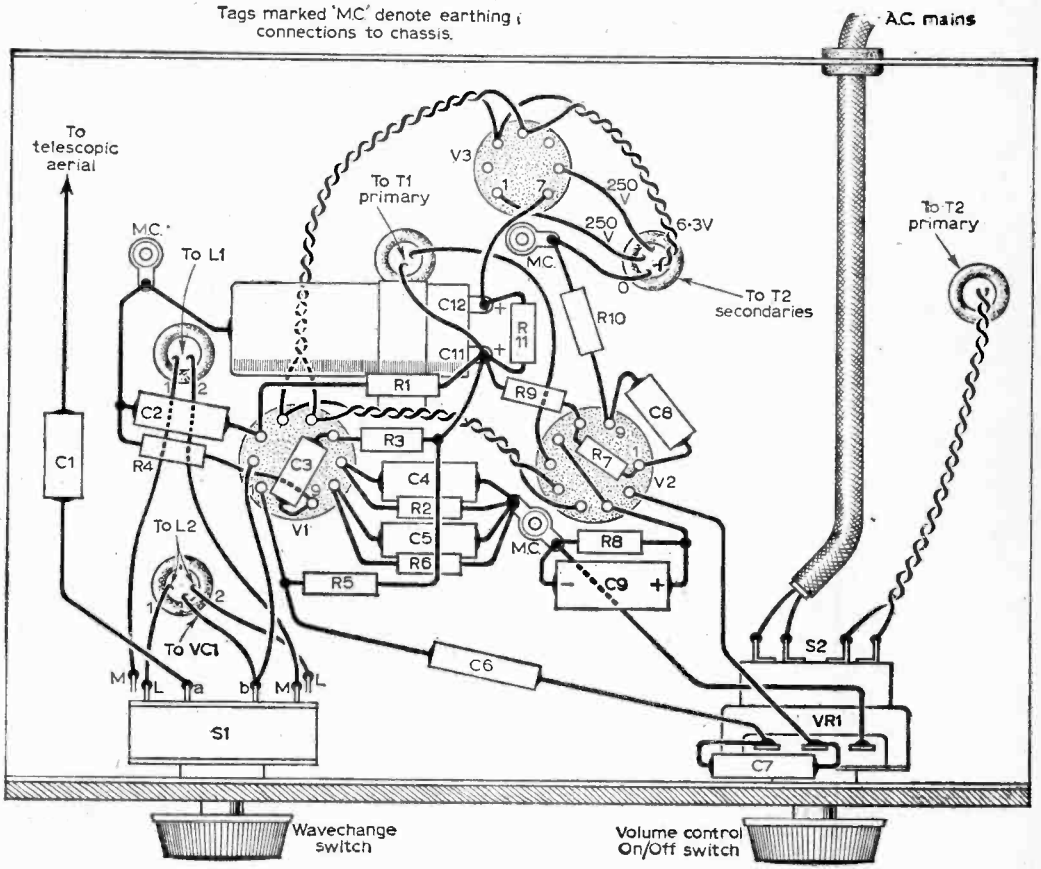



*Fig. 3: The underchassis wiring diagram.*

In the right-hand part of this diagram, details are given of the small aluminium bracket designed to take the tuning capacitor, VC1. This bracket is secured on to the top of the chassis by two bolts passing through two holes marked "a". It is possible to adjust the height of the tuning capacitor to line up with the hole drilled in the front panel (see later), but it is important to see that the plates do not short to chassis.

When these operations are complete, proceed by bolting the mains and output transformers in position, as shown in the diagrams. The coils, valveholders, tuning capacitor, volume control, wavechange switch and smoothing capacitor should then be mounted.

### *Wiring Up*

The valve heater circuit should be wired up first. Take a pair of twisted leads from the 6·3V winding on the mains transformer to pins 4 and 5 of V1 and V2 and pins 3 and 4 of V3. The underchassis wiring can then be carried out with reference to Fig. 3. Any leads which run from the underside to the top of the chassis should pass via the grommetted holes.

When this has been carefully carried out, the top chassis wiring may be dealt with. Reference to Fig. 4 will give complete wiring details, and it will be seen that this operation consists mainly of wiring up the mains transformer and coils. It is important to see that those leads carrying h.t. are carefully insulated from the chassis.

### *The Front Panel*

The front panel for the receiver is made from a piece of hardboard and measures 7½in. x 5in. The method of preparation may be seen in Fig. 5.

Three holes, each of ⅜in. diameter have to be drilled to take the wavechange, volume and tuning spindles. A cutout 2in. x 1½in. has also to be made for the loudspeaker. This panel is covered with fabric, but this should not be done at this stage.

The panel should be fixed to the front of the metal chassis with two countersunk bolts; the positions are indicated in Fig. 5.

When this has been done, remove the hardboard panel, but leave the two countersunk screws in position. Presuming the loudspeaker cut-out has been made, and the three ⅜in. diameter holes drilled, the loudspeaker can be mounted on the

panel, using four countersunk screws.

Now remove the loudspeaker but as before, leave the four bolts in position. The front panel can now be covered with a suitable fabric. As will be seen, when this has been done, the heads of the bolts are no longer visible, thus giving a neater appearance.

The panel can now be bolted once more on to the chassis and the bolts tightened accordingly. The loudspeaker and a small piece of fret can also be put in position.

The receiver is now finished and can be set aside temporarily.

### Constructing the Cabinet

Five pieces of ¼in. plywood make up the cabinet. The top and bottom pieces measure 7½in. x 5in., and the two sides 5in. x 4½in. The back piece is the same size as the hardboard front panel that is 7½in. x 5in., and all five pieces form a neat cabinet measuring only 7½in. x 5in. x 5¼in.

Small glue blocks are used to reinforce construction, and are put in position using a fairly strong glue and a few panel pins, which hold the blocks in position while the glue sets.

The cabinet should be sanded when it has been made to remove any rough edges. It can then be covered in the same way as the front panel with an attractive material.

The telescopic aerial should then be fixed to the cabinet, and a short length of flex attached to it. This has later to be connected when the receiver is inserted into its cabinet. The handle and four rubber feet can also be screwed in position in their appropriate positions.

### Operation

It only remains now to test the receiver before putting it into its cabinet.

Connect a suitable mains lead to the set, and a good aerial (not necessarily the telescopic one), and turn the wavechange switch to the medium-wave position. Switch the set on and allow it to "warm up" for a few seconds. A faint hum should be heard from the loudspeaker if all is well, but if none can be heard of if there are intermittent crackles, check the circuit for dry joints.

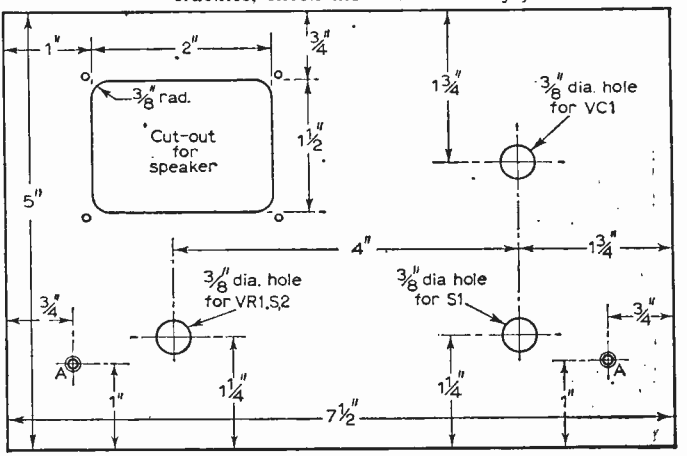



*Fig. 5: Details of the front panel.*

However, assuming all is well, turn up the volume control about half way and tune in a local station. If a printed dial has been fitted, it may be found that the station being received does not correspond to the pointer reading on the dial. This can be cured by adjusting the medium wave coil core, but it should be remembered that the position of this core also influences selectivity.

position of this core also influences selectivity.

This operation should be repeated if the same problem occurs on long waves, only in this case the long wave coil core should be adjusted.

When satisfied with the performance of the receiver, connect up the loose lead from the telescopic aerial to S1a. The aerial capacitor C1 should be soldered in circuit between this lead and the switch.

Pass the mains lead through the hole in the back of the cabinet and insert the receiver into the cabinet. Finally, three screws should be used to secure the set in its cabinet; these screw into the three glue blocks in the front of the cabinet.

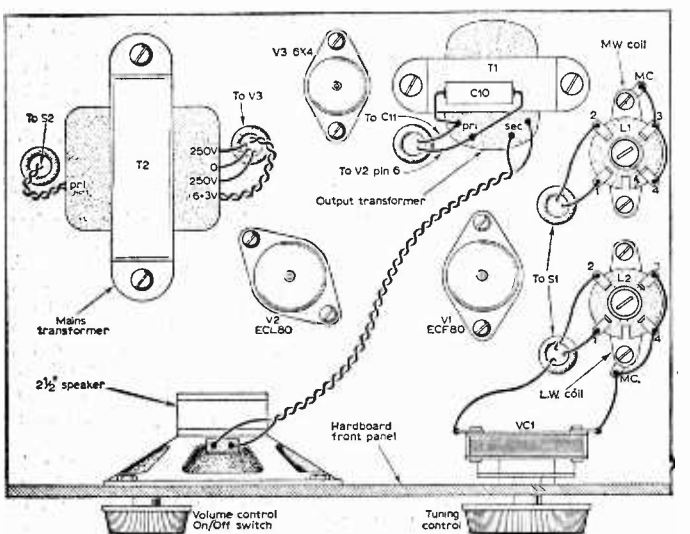



*Fig. 4: The above-chassis layout diagram.*

# A Sensitive THERMOSTAT

By P. Rowe

*A simple, but effective constant temperature device*

THIS simple circuit was designed to enable the temperature of an incubator to be kept constant, the ordinary bi-metallic type of thermostat being considered too insensitive for this particular application. The thermostat has been operated with complete success over the temperature range 15-70 deg. C.

### Accuracy

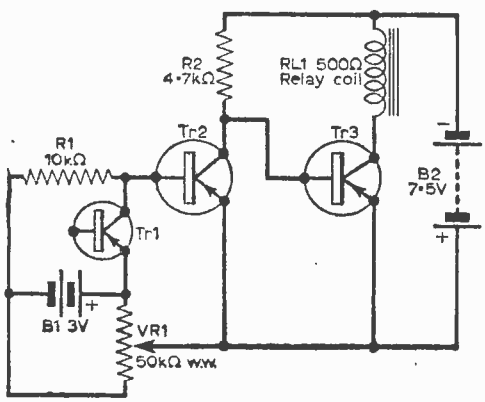
The accuracy of the prototype was such that when a 40W bulb was used as a heating element in the incubator no discernible change in temperature was observed on a thermometer. This suggests an accuracy of higher than ±0·1 deg. C.

*Fig. 1: This bridge circuit illustrates the principle of the thermostat.*

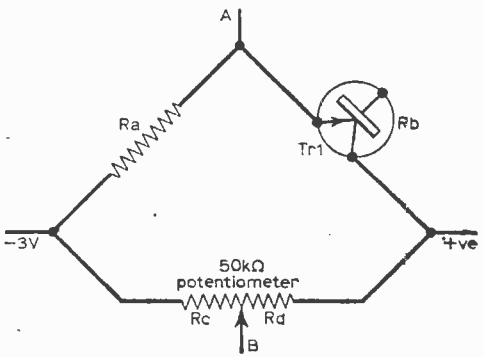
### Circuit

The heat sensitive component in this circuit is a transistor. The collector-emitter resistance of a transistor decreases with a rise in temperature and use is made of this property in the design to be described.

The transistor is placed in a bridge circuit as shown in Fig. 1. When the ratio Ra/Rb=Rc/Rd then no p.d. is observed between the points A and B. The ratio Rc/Rd is altered by the potentiometer VR1 and the ratio Ra/Rb is altered by a rise in temperature of the sensing transistor.




When the temperature of the sensing transistor Tr1 rises, the base of Tr2 becomes negative, consequently the collector current rises, causing the negative voltage applied to the base of Tr3 to fall. The resultant fall in the collector current of Tr3 causes the relay RL1 to de-energise, so breaking the circuit to the heater.




### Transistors

Tr1 should be a metal encapsuled type, preferably painted black so as to respond rapidly to a rise in temperature. Glass encapsuled types may take too long to respond to a temperature rise to suit many applications.

All three transistors used in the prototype were surplus types but, as the characteristics of surplus types vary, suitable Mullard types are suggested.

An increase in temperature of Tr3 due to ordinary temperature fluctuations causes only a very slight rise in the total collector current, but a rise in temperature of Tr2 will cause a fall in the collector current in Tr3 which is many times larger due to the gain of the latter. This effect is minimised by reducing the gain of Tr3 to a minimum without a subsequent loss in sensitivity. A suitable transistor for Tr3 would be an OC70 with a gain of 30.

*Fig. 2: The actual circuit of the thermostat.*

The gain of Tr2 only affects the sensitivity of the apparatus and not its susceptibility to fluctuations in room temperature. This transistor is selected to have as large a gain as possible and the OC75, which has a gain of 90, is suitable here.

The prototype amplifier had a d.c. gain of 3,300, and using an OC75 with an OC70 gives a gain of 2,700. If a MAT101 is used for Tr2 the current gain can be as high as 7,500, with a consequent doubling of sensitivity, but this may necessitate the use of high stability resistors. The potentiometer VR1 should in any case be a large diameter wire-wound component.

**COMPONENTS LIST**

| | |
|---|---|
| R1 | 10kΩ ½W |
| R2 | 4·7kΩ ½W |
| VR1 | 50kΩ wire-wound potentiometer |
| RL1 | Type 3000 relay. 500Ω coil |
| Tr1 | (see text) |
| Tr2 | OC75 |
| Tr3 | OC70 |
| B1 | 3V battery |
| B2 | 7·5V battery |

### *Relay*

The relay used was a P.O. type 3,000 with a coil resistance of 500Ω. Only one set of contacts was used on the original relay, but no great loss in sensitivity should occur if two sets are used.

For heating coils of more than 100W, a heavy duty secondary relay must be used. A capacitor of about 0·02μF should be connected across the relay contacts to reduce sparking and interference.

### *Setting Up*

When the thermostat was used with an incubator the potentiometer was rotated until the bulb became illuminated and was then rotated in the same direction to the end of the track. When the required temperature was reached, as indicated on a thermometer, the potentiometer setting was slowly backed off until the bulb was *just* extinguished. The incubator then maintained the required temperature. ■

## Radioactivity in Rain

*—continued from page 721*

itself, i.e. half of the unstable atoms contained have disintegrated.

It is seen that, if one has the patience to carry out these experiments systematically and relate them to man-made and weather effects, a wealth of fascinating information can be obtained.

In general, such work places a rather heavy burden on individual experimenters, but it would be an ideal job for a radio club or school to run in teamwork, with an operator "on watch" at all times possible!

### DRY FALLOUT OF ATOMIC-BOMB DEBRIS

Apart from debris washed down with rain and snow, there is a continuous deposition of radioactive dust during fine weather. Recent rates can reach values as high as 0·1 nanocurie per square yard per hour, as measured by the author with apparatus published in this magazine.

Since we require about 0·05 nanocurie in the fill of the advanced Geiger head to get one signal count per minute, and can observe 10 signal counts per minute with ease, it is very easy to get observable signals from dry fallout with this apparatus.

The same small p.v.c. bath tub, if left standing in the open air for a day or two in fine weather, and then swilled out with one or two spoonfuls of dilute nitric acid, generally gives quite strong signal counts when this swill liquid is filled into the advanced Geiger head. Indeed, signals are often so good that it is well worth while storing the resulting samples in small bottles to observe the rate of decay of this activity over the months following, and compare it with the rate of decay of activity from rainfalls of the same period.

### VOLATILE DEBRIS

A final interesting experiment is to add the results of experiments three and four and compare this with the remaining signal in experiment one after the natural radium has all gone.

One often finds that the remainder in experiment one is much larger than the sum of the measurements from experiments two and three. The difference can be due to two things: (a) "Volatile" activity i.e., that due to easily evaporated substances such as active isotopes of iodine or rare gases, which escape during the boiling for experiment four, and (b) lumps of activity which are enclosed in inert particles which even acid fails to break open (so-called "hot particles"), which thus remain lodged on the filter-paper even after this has been washed in nitric acid for experiment three.

Such "hot-particles" are easily measured by returning the filter paper once more to the p.v.c. bottle in front of the simple Geiger head, after washing in nitric acid. Each signal-count then *still* obtained represents about 0·5 nanocurie of "hot-particle" activity on the filter paper, and one can immediately relate this to the concentration in the original rainwater because one knows the amount of water filtered. Knowing now the hot-particle contribution, if any, the remaining difference must be the volatile contribution which escaped during boiling, which we have thus succeeded in measuring indirectly—there being no convenient direct method for measuring this.

This has now given all information at present gathered by the author in operating the Geiger counter equipment published in this journal, for studying rainfall.

Levels in foodstuffs, river water, drinking water, etc., are generally too small to observe, so that rainfall remains the major object of interest for studying with this apparatus we have designed for you.

The Editor will always be interested to hear of any striking effects any reader may notice with his apparatus and which he cannot explain in terms of the discussion given in this article. ■


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

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

## WARNING

SIR,—I read with the utmost concern, the letter headed 'Permanent Valve Identification' from J. H. Turner which appeared in the November issue. The chemicals referred to are not only dangerous to handle, but their reactive products are extremely toxic and should they come into contact with the skin, most serious consequences will result!

If any of your readers have tried using these chemicals and have allowed any of the products to come into contact with their skin, they should see their doctor *immediately*, as hydrogen fluoride can rot the skin under the outer epidermis.—J. G. RANSOME B.Sc. (Barnet, Hertfordshire)

### SATISFIED CUSTOMER

SIR,—In a recent issue of P.W. I made use of your "sell or loan" service on the Letters page. Since then I have received no fewer than 25 replies to my request for copies of P.W. (one reply came from South Africa!). All of these came from thoughtful enthusiasts to whom I would like to extend my heartiest thanks.

After such a large response, I had far more copies than I required, and so I have forwarded these to other correspondents who have inserted requests for the same issues.—E. S. WOOD (Canterbury, Kent).

[I was very pleased to receive this letter from Mr. Wood as it is encouraging to learn that readers of P.W. are so willing to help their fellow enthusiasts. I suggest that when more data is provided in response to such requests than is required, and when the sender states that he does not want it returned, readers should follow Mr. Wood's example and forward it to any other P.W. correspondents requiring the same data.—ED.]

### CROME TAPE IS PLASTIC

SIR,—With regards Mr. Featherby's suggestion in the September issue of P.W. that adhesive tape could be used for screening wires, I would point out that this sort of tape is in fact, a plastic, and would therefore be of no use for this purpose. —E. EVANS (Llandyssul, Cardigan).

### TRANSISTOR PROTECTION

SIR,—During the three years in which I have taken P.W., I have accumulated a fair knowledge of radio. However, due to lack of funds and no lack of homework, my main practical experience has been servicing the small transistor receivers of my schoolmates, which suffer from so many unaccountable accidents.

One of the most usual faults is the destruction of one or more of the transistors, by the reversal of the battery. Accordingly I tried the suggestion made by Mr. Beecham in the September issue, which was of a protection device to prevent damage to transistors when a battery is incorrectly connected. This device was to use diodes.

However I have found that the only diodes with sufficient reverse resistance to provide this protection, also have sufficient forward resistance to drop an appreciable amount of the voltage applied to the set.

I would, by the way, like to correspond with any radio enthusiasts of my own age—13 years—who are interested in taking the R.A.E.—C. HARGIS (Boscombe, Hampshire)

### COMPONENTS APPEAL

SIR,—I am employed as an occupational therapist at an Essex hospital, in charge of the metal work section. Within the last year I discovered that one or two patients were interested in radio and so I have added this to our list of activities. I managed to get hold of a number of broken radio and television receivers which were stripped down for spare parts. However, now that enthusiasm for this subject is increasing, many of the patients want to start building transistor receivers and the like, and I realise that salvaged components are not sufficient. Unfortunately our budget will not run to buying these components new and so I would like to appeal to any of your readers who may have components they might otherwise discard or never use, to forward them to the address below.

I am sure that if your readers realised how much the patients enjoy making up simple circuits, it would be ample reward for any donations of components they care to make.—J. A. CLOSE, M.O.T. Department, Warley Hospital, Brentwood, Essex.

### VOCIFEROUS HAMS

SIR,— I happened to be well placed for eavesdropping the ham bands in both halves of the world and what I haven't heard in the way of utter rubbish on the air, isn't worth hearing!

One wonders how some of these phone operators ever got their licence: some of their remarks on electronic subjects are staggering to say the least.

In addition to these "fortunate" licence holders, I have bagged a multitude of less fortunate, though

highly intelligent operators, having no call-sign. These boys are quite content to utilise their knowledge and ability to build and operate a transmitter both in and out of band, quite regardless of existing local regulations. But one must admit they cut the cackle to a minimum, a quality their licensed brethren would do well to adopt.

With due consideration to the operators across the Pacific, I must say they are the least technical in their ragchews, while those in the U.K. are dreadful gentlemanly and would do well to get tougher toward frequency squatters, lids, etc. Some of the neatest work I've heard is from the Australian and African hams.

But to go on to other matters, it is my opinion that the majority of radio hams are very aptly named being no more than "hams" in the truest sense of the word. Having bought or built their transmitters and certainly bought their receivers, they sweat up morse, acquire enough technical knowledge to scrape through an exam and then proceed to degenerate into talkative phone operators.

With the bands already choked, amateurs should count themselves fortunate to have any space at all. It might be an idea to close all amateur bands except those in the v.h.f. and u.h.f. regions. Then we would again see some real work done by the amateur, for any one who has tried to build and operate a transmitter over 220Mc/s will appreciate the technical difficulties involved.—HUGH A. L. WAGNER (Kuala Lumpur, Malaya).

## *FREEDOM, DEMOCRACY AND NOVICE LICENCES*

SIR,— I simply cannot allow Mr. R. L. J. Stevenson's letter (October issue) to pass without comment.

From the tone of his letter, I guess him to be both young and remarkably ill-informed, not only on the licensing of radio transmitters, but also about the meaning of a free and democratic society. Perhaps Mr. Stevenson should be reminded that in a democracy, rules are made "by the people, for the people," and are intended to safeguard the interests of society as a whole. It follows that breaches of the rules must inevitably lead to infringements of other peoples rights, to which they are equally entitled.

Similarly with radio, if just anyone could use a transmitter without proper knowledge, then chaos would reign and many more television sets would be consigned to the scrap heap as useless in the face of the obliterating interference caused by our freedom-loving neighbours, all happily exercising their individual rights.

Apart from all this however, there are the international agreements to be honoured, since radio waves have a habit of travelling quite a long way at times, and under these international rules, certain basic minimum requirements are laid down to ensure that essential services can survive, again for the benefit of the majority. — H. R. BOUTLE (Bedford)

SIR,—With the publication of yet another letter on the subject of "novice licences" (P.W., October) we hear once again the ill-disguised cry of "I'm too lazy to study the subject yet I want all the privileges just the same".

I laugh at the phrase "a highly technical examination. . .", Mr Stevenson. Blind and bedridden people can successfully cope so who are you to demand exemption? Where is your pride and self-respect? He is indeed a poor advocate who refuses to make any effort in something in which he professes great interest.

I suggest the time has come to declare this subject closed and to devote the space to more fruitful topics.—F. ALLAN HERRIDGE (Basingstoke, Hampshire).

SIR,—I fully endorse the comments of your correspondent, R. L. J. Stevenson. Because a ham has obtained a ticket it does not mean that he is a good operator, as a few nights listening to the amateur bands will prove.

Licences are peculiar things, aren't they? For 10s. anyone can get a driving licence with little or no questions asked. He doesn't have to know the technical details of an internal combustion engine, he may not even have read the Highway Code, yet he is let loose on the road to go where he likes. At the Post Office counter one can obtain a gun licence and blast away merrily with a double-barrelled shotgun.

Practical experience is the greatest teacher, and I am sure the City and Guilds of London Institute will not mind if I quote a paragraph from the No. 55 R.A.E. syllabus 1963/1965:—"Where courses are provided, it is recommended that theoretical lectures should be accompanied, wherever possible, by simple practical demonstrations and students should be encouraged to regard practical work as an integral part of their training".

I feel sure that arrangements could be made for practical work with transmitters, and given this experience many of us would turn out better operators.—E. F. TWEED (Great Yormouth, Norfolk).

***Sir—I would be grateful if any reader could sell or loan me . . .***

. . . the June and July 1958 issues of P.W.—G M., WATSON, 2 Winn Court, Winn Road, Southampton, Hampshire.

. . . any information at all on the type 46 Mk.III transmitter/receiver.—P. A. BOWEN, 147 The Crossways, Portchester, Nr. Fareham, Hampshire.

. . . the July 1951 issue of P.W.—P. RAMSEY, 259 Beckfield Lane, Acomb, Yorkshire.

. . . the issues of P.W. in which G. Favour described the construction of a v.f.o. unit.—J. T. JONES, 1 Chorlton Close, Childwall, Liverpool 16.

. . . the circuit and instructions of the miniaturised three-valve transmitter given in the August 1961 issue of P.W.—P. PLACE, 41 Milford Road, Plumstead, C.P., South Africa.

. . . the circuit and any other data for the R1392.D receiver.—R. F. COX, Three Lands Cottage, Chalford Road, Postcombe, Oxford.

. . . the May 1959 issue of P.W.—C. HERBERT, 71 Longthornton Road, Streatham, London, S.W. 16.

. . . the issues of P.W. giving details of the No. 19 set.—T. L. RICHARDS, Salisbury, No. 2 R.D., Timaru, New Zealand.

. . . the circuit and/or manual of any electric organ (H. R. McDermott's preferred). If required, I will return any data by registered mail.—F. BRINCAT, 87 Old Church Street, B'Kara, Malta.

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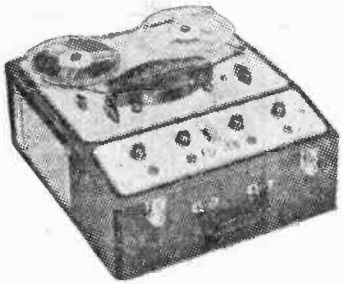

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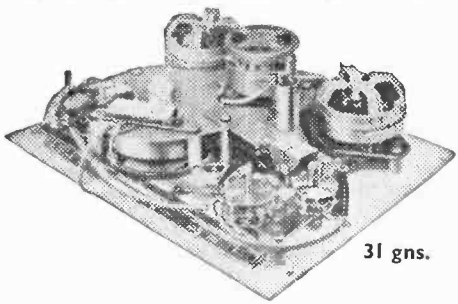

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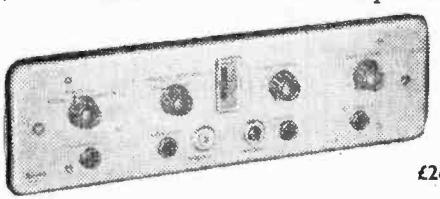

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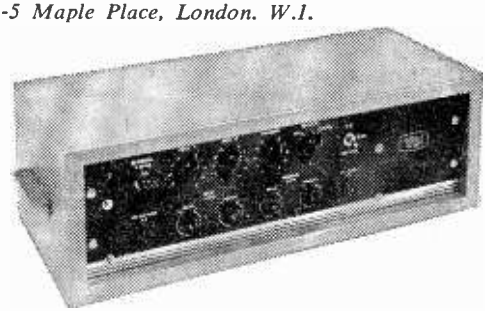
This amplifier (model T636) has a power output of 30W with less than five per cent total distortion. The manufacturers are *Trix Electronics Limited, 1-5 Maple Place, London. W.1.*



*This high-gain amplifier is made by Trix Electronics Ltd.*

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The circuit uses a standard 9V battery for power and draws an average of 18mA. The design includes a continuously variable attenuator and a three-position switched output multiplier.

The model 63 audio generator is housed in a mild steel case and is made by *Nombrex Ltd., Estuary House, Camperdown Terrace, Exmouth, Devon.*

*The Nombrex 63 audio generator is illustrated on the right.*

### *Three-waveband Portable*

THE model R500 is a new transistor portable receiver from Roberts' Radio Co. Ltd. The 7-transistor circuit provides 1W output through an 8in. x 5in. elliptical loudspeaker. Medium, long and short wavebands are covered by this receiver, and for short waves, a telescopic aerial is included, whereas on long and medium the usual ferrite rod aerial is used.

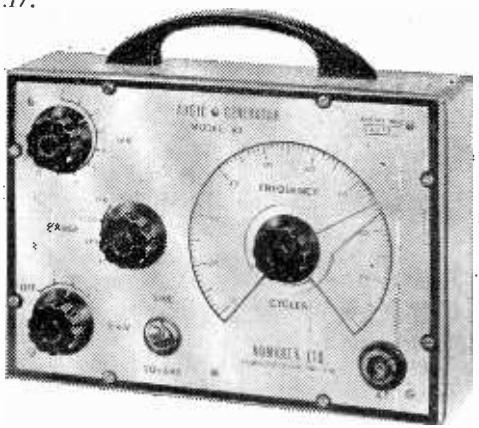
The R500 is built into a wooden cabinet which is attractively finished in Rexine which provides for a choice of four colours. The price of this new receiver is 17½ guineas. *Roberts' Radio Co. Ltd., Molesey Avenue, West Molesey, Surrey.*

### *Four Track Tape Recorder*

AMONG the newly-released tape recorders from Sound Tape Recorders Ltd., is the Slimline Three-four, which is a three-speed, four-track model.

The Slimline Three-four uses printed circuits and gives an output of 3·5W. Full mixing and superimposition facilities are provided as well as a tone control and visual recording indicator.

The price of this model is 45 guineas and the makers are *Sound Tape Recorders (Electronics) Ltd., 784-788 High Road, Tottenham, London, N.17.*



# CLUB NEWS

**COVENTRY AMATEUR RADIO SOCIETY**
**Hon. Sec.: A. J. Wilkes, G3PQQ, 141 Overslade Crescent, Coudon, Coventry, Warwickshire.**

Most of the Society meetings for October were devoted to constructional evenings, however the club transmitter (G2ASF) was on the air on the 21st.

The Society's rendezvous has been changed recently to Westfield House, Radford Road, Coventry, where members meet on Monday evenings at the usual time.

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

On 6th October a number of members met at Markeaton Park for the start of a direction finding contest for the President's Trophy. The other d.f. event for October was the final practice run held on the 16th.

On 9th October members enjoyed a film show and on the 23rd G. P. Miles gave a lecture on the "Theory of Adding Machines". This was followed a week later by another talk by Mr. Miles on the "Application of Adding Machines".

A coach party on 2nd November took a large number of members to London for the International Hobbies Exhibition. On 6th November a surplus sale was held.

**MANSFIELD AMATEUR RADIO SOCIETY**
**Hon. Sec.: F. N. F. Bewley, 116 Westfield Lane, Mansfield, Nottinghamshire.**

Recent changes amongst the Society's officials has seen Mr. F. Knowles elected to the committee, Mr. A. George becoming chairman and Mr. F. N. F. Bewley becoming secretary.

**MELTON MOWBRAY AMATEUR RADIO SOCIETY**
**Hon. Sec.: D. W. Lilley, G3FDF, 23 Melton Road, Asfordby Hill, Melton Mowbray, Leicestershire.**

The Society's meeting for October, which was held on the 17th, was devoted to an R.S.G.B. tape recorded lecture. The tape, made by Roth Jones, VK3BG, was entitled "Amateur Radio in the Antarctic".

**MITCHAM AND DISTRICT RADIO SOCIETY**
**Hon. Sec.: A. L. Thurley, 50 Bruce Road, Mitcham.**

On 11th October the committee of this Society called a special general meeting for all members, to discuss the proposal that the Society go into voluntary liquidation. The reason that the committee have considered this proposal, is a general lack of interest among members and a serious drop in attendance figures.

Should the proposal be accepted the Society's funds and trophies would be transferred to another Society in the locality.

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

On 23rd October this Society held a display of members' gear.

Early in November a group of members visited the International Radio Communications Exhibition in London, and at the meeting for 6th November a talk was given on the use of electrical energy.

**PLYMOUTH RADIO CLUB**
**Hon. Sec.: B. J. Curnow, 112 Mount Gold Road, Plymouth, Devon.**

The main Club event for October was a film show, given on the evening of 15th October.

**SALOP AMATEUR RADIO SOCIETY**
**Hon. Sec.: Dr. K. E. Jones, G3RRN, Greystones, Shrewsbury Road, Church Stretton, Shropshire.**

This Society was recently formed in Shrewsbury to promote interest in all branches of radio and electronics and to provide a common meeting ground for local enthusiasts.

Official meetings are to be held on the second Thursday of each month, beginning at 7.30 p.m. Informal meetings will usually be held on the last Thursday of the month. The headquarters of the Society have been established at The Tennis Club, Harlescott Crescent, Harlescott Lane, Harlescott, Shrewsbury, where application forms for membership may be obtained on meeting nights.

One of the first aims of the Society is to establish a radio station at the headquarters and a suitable call sign has already been reserved with the G.P.O. A programme of lectures and demonstrations is being organised and visits to other societies, exhibitions, etc., will also be arranged.

Prospective members should have a genuine interest in radio and electronics and be willing to support the organised meetings of the Society. An introductory meeting was held on 10th October, when a display of amateur equipment was given for the benefit of newcomers. An informal meeting was held on the 24th.

The next meeting will be 14th November which will take the form of a bring-and-buy sale.

**SCARBOROUGH AMATEUR RADIO SOCIETY**
**Hon. Sec.: P. B. Briscombe, G8KU, "Roseacre", Irton, Scarborough, Yorkshire.**

On 10th October members enjoyed a film show. This was followed a week later by a "constructors' night" meeting.

A talk entitled "Mobile" was given by G3PEJ on 24th October.

**SPEN VALLEY AMATEUR RADIO SOCIETY**
**Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Nr. Leeds.**

"How to use Transistors" was the title of the talk given by Mr. M. Taylor of Baird Television, on 17th October.

On the 23rd a group of members paid an interesting visit to the Northern Heights Amateur Radio Society. At the last meeting of the month A. W. Walmsley gave a lecture on "S.S.B."

A party of Society members made the trip to London on 2nd November for the Radio Communications Exhibition.

**UNIVERSITY OF KEELE RADIO SOCIETY**
**V. J. Reynolds, G3COY, 90 Prince's Road, Hartshill, Stoke-on-Trent, Staffordshire.**

At the "mart" staged recently by the student society of the University of Keele, this society operated a station on 40, 80 and 160m to attract the interest of new students and thus recruit new members.

On 14th October members enjoyed a film show which included one on the subject of transistors.

**WESSEX AMATEUR RADIO GROUP**
**Hon. Sec.: G. J. Fowle, 138 Surrey Road, Branksome, Poole, Dorset.**

Two visits have been arranged for October, the first of which was to the ITA repeater station at Stockland Hill. This was on 6th October and on the 14th members made the trip to the Telephone Exchange, Bournemouth.

The meeting for 21st October was devoted to a ragchew and that for 4th November to a junk sale and raffle.

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**R.S.G.B. CONTESTS FOR NOVEMBER**

7 Mc/s DX Contest—c.w. (2nd to 3rd November); Second 1·8 Mc/s Contest (9th to 10th November) and 21/28 Mc/s Telephony Contests (16th to 17th November).

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# A VERSATILE DOUBLE-TRACE OSCILLOSCOPE

REFERRING to the supply network for the cathode ray tube (see Fig. 7, page 404, Sept. P.W.), the values for R9 and R10 vary according to the type of tube employed. Suitable values are given below.

| | VCR97, VCR517, ECR-60, E4504-B-16 | 5AP1-4 | 5BP1 | 5HP1-4A |
|---|---|---|---|---|
| R9 | 470kΩ | — | 220kΩ | 330kΩ |
| R10 | 220kΩ | 680kΩ | 470kΩ | 390kΩ |

Capacitor values: C18 should be 500pF, C19 100pF.

## RECEIVERS & COMPONENTS

**VERSATILE D.T. OSCILLOSCOPE.** S.A.E. for price list. AJAX ELECTRONICS, 572 Fulham Road, London, SW6.

**TRANSISTORS** now half-price. unmarked but tested packets of 16: unmarked untested packets of 40; duds suitable as diodes, packets of 80. All packets **10**/- each, postage 1/-. Four packets post free. C.W.O. K. R. WHISTON (Dept. PWT). New Mills, Stockport.

## NEW VALVES GUARANTEED!

| | | | | | |
|---|---|---|---|---|---|
| C1C | 5/- | PEN 36C | 5/- | 6SA7m | 5/- |
| CL33 | 7/6 | PEN 46 | 2/6 | 6SG7m | 5/- |
| CY31 | 7/6 | OZ4 | 5/- | 6SJ7m | 5/- |
| ECC85 | 5/- | VP23 | 4/- | PCL82 | 7/11 |
| HL23DD | 4/- | 1D5 | 5/- | 6 x 4 | 3/6 |
| KT33C | 5/- | 1T4 | 2/6 | 6 x 5G | 5/- |
| MU14 | 5/- | 6K7G | 1/3 | 7C5 | 5/- |
| PCL84 | 5/- | 6AG5 | 2/6 | R19 | 9/6 |
| PEN A4 | 7/6 | 6BW7 | 5/- | PY83 | 6/11 |
| | | | | 25L6GT | 4/6 |

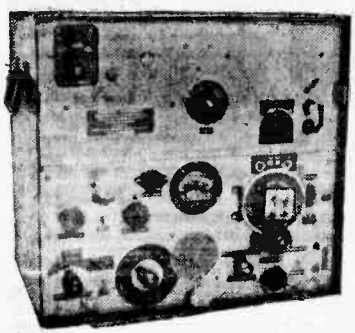
Cash with order only. Postage 6d. per valve. Any parcel insured against damage in transit 6d. extra.

**A.D.A. MANUFACTURING Co., 116 Alfreton Road, NOTTINGHAM.**

**WANTED:** VALVES, TRANSISTORS, Etc. Bought for Cash.

**"HEATHKITS" can now be seen in London and purchased on easy terms.** Free brochure. DIRECT TV REPLACEMENTS LTD., Dept. PW7/9, 126 Hamilton Road, West Norwood, SE27. GIPsy Hill 6166.

## MARCONI CANADIAN RECEIVER No. 52 (Brand New)



AMATEUR SHIPPING BROADCAST **Magnificent 10 Valve Receiver.** 3 waveband 1.75-16Mc/s. (19-170 metres), with 3 valve Xtal calibrator, speaker and phone outputs, complete for 230/240 AC mains or 12V DC. Fully tested before dispatch. **BRAND NEW £12.19.6. Carr. £1.**

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**HRO POWER PACKS.** 115/250V AC. 25/-, NEW 35/-, post 5/-. Many other bargains. List 6d. Stamp inquiries.

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## RECEIVERS & COMPONENTS *(continued)*

**TRANSISTORS.** OC45. OC70, OC81, OC81D, AF116, PXC101A etc. Diodes OA79, GD12. GD13. All 2/- each. RADIO SALES, 11a Roe Green Lane, Hatfield, Herts.

**MULLARD HIGH SPEED VALVE TESTERS** with cards in first-grade working order and condition. £22.10.0, carr. 30/-, including crate.

**AMAZING COMPONENT PARCEL.** Aerial base, jack plugs, 12 volt vibrator. Warehouse clear-out for new stock, all less than half wholesale price, all parts new. BASIC, 6 Brit. octal moulded valve-holders, 4 gang 350pF tuning gang, potentiometers, tag strips, plugs and lead, battery charger rate adjuster to 10 amps, 6 trimmers, coils and R.F chokes, 20ft. P.V.C. twin wire, rectifier, slow motion drive, l.f. transformer, condensers, resistors, two smoothing chokes 100mA, small high speed and p.o. relay, panel switch, 2 panel mt. fuseholders, Pye coax plugs and lead, fuses. PLUS MANY MORE ITEMS. Subject to slight changes. ONLY 20/-, or any 10 listed items 12/6. NEVER CAN SUCH A BARGAIN BE OFFERED AGAIN AT ONE-THIRD OF TRUE VALUE.

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**19 SET RECEIVER POWER UNIT KIT.** 200-50 input mains, to 275 v. D.C. 12 v. L.T., choke smoothed with connector to set (state 6 or 12 pin). 45/-. Post 5/-. **Mike and Headset,** new, 17/6. **Connectors,** 12-12 pin, 8/6, 6-6 pin, 5/-. Post both 1/6.

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**1155 RECEIVER** case made in alloy. BRAND NEW and boxed, 12/6. Post 1/6.

**CRYSTAL CALIBRATOR No. 7 Mk. I** using 6 valves, a 1 Mc/s crystal osc. is used to synchronise 2 multi-vibrator osc. operating at 10 Kc/s and 100 Kc/s respectively. Harmonics of 10-100 and 1,000 Kc/s are available up to 20 Mc/s, far beyond this on any sensitive set, modulator also incorporated for receiving. In small Bakelite case with carrying handle, power 2 v. L.T., 80-120 v. H.T. Circuit and instructions supplied. BRAND NEW, 70/-. Post 5/-.

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**VALVES** 5/-. Components, Recorders, Players, Transistors. Bargain lists. Mail only. 98 Greenway Avenue E17.

**CIRCUIT** containing 4 transistors, over 12 diodes etc. 3/6, pp 6d; 3-10/- p/free. Satisfaction or refund. 6 Vaudrey Street, Southampton.

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**EXCEPTIONAL VALUE:** Picture Tubes, brand new, Mazda 19in., CME1901, Mullard 19in. AW47-90/91. £4/10/-; Mullard 23in., AW50/90 £6/10/-; carriage (insured) paid. 12 months guarantee. Note: All brand new. We also supply most other sizes completely regunned at £4/17/6, guaranteed 12 months. TOMLINS, 156 Lewisham Way, New Cross, SE14. TID 3857.

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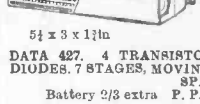

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ECL80, EY86, PCC84, PCF80, PL81, PY81, all at 5/- each.
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Electro methods printed circuit connectors, 31-way, 4/6. Gold-plated contacts. Other sizes in stock.
19 Set Variometer. 5/-.
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**TRANSISTORS** and other components fixed to small printed circuit boards to be cleared, very cheap. Write for list to Box 52.

**GWM RADIO LTD.**

**12 volt MOBILE RECEIVERS**
**Cover approx. 80 to 100 Mc/s.** Originally crystal controlled, crystal not supplied. Suitable for conversion to tunable 4 metre receiver. Rotary for 250v 60mA H.T. supply. In good used condition complete with 5 EF91, 3 EF92, 1 EL91, **£2**, post 7/6. Matching 3 ohm speaker in crackle case, **7/6**, post 2/6.
**Marconi CR100, 60 Kc/s to 30 Mc/s.** in good condition and working order, **£18.10.0**, carriage £1.
**Control Units No. 1 Canadian for 52 set.** Complete with chamois padded low resistance headphones, microphone morse key, hand generator and bell, etc. Brand new at 27/6, post 7/6.

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**250 "12 DRAWER UNITS".** New, ex-works, **£4/15/-**, carriage paid (mainland). Each drawer 5½in. wide. 3in. high, 10½in. long. Stove enamelled green, heavy gauge perfect steel. 12 dividers free. Catalogue free. (Dept Z4). N. C. BROWN LTD., Eagle Steelworks, Heywood, Lancs.

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Consists of Plastic Bath and Case. Size 9 x 5 x 2 in. Contents: Solvent, Etchent, Resist, 100 sq. in. Copper Laminate Board. Comprehensive book gives examples and circuit layouts. **18/6** inc. post.

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**SEMI-CONDUCTOR STABILISED** mains driven. d.c. Power Supply Units for the home experimenter from **£3/19/6**. You state voltage and maximum current required. Ask us for cheapest method.
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Super sensitive transistor amplifier driven Relay, 4 pole C.O.S. 3A. State sensitivity required to switch on. Typical setup:—100μA drive cost **£3/14/6**. A standing 24V is required. TRADE ENQUIRIES INVITED.
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SPECIAL OFFER **Sub Min. Coax Plug and Socket,** made by M.E.C.. **4/6** pair, also other items include Adaptors, Connectors, Junctions, Elbow Plugs, all by M.E.C.
Complete list on application.

**Type 55 Power Pack. Stabilised Mains Input.** Outputs below.
+200 volts at 120 mA, stabilised, DC H.T.
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4.25 volts at 3 amp. 5 volts at 2 amp.
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**90/-** SEND FOR FURTHER DETAILS.

**BREAKDOWN UNITS**
**Transmitter Receiver Control Box** containing 7 instrument knobs, 4 toggle switches, 3 rotary switches, 20 small potentiometers, 2 Plessey Sockets, cases rough but components O.K. **6/-** each, post paid or 2 for **10/-.**

**19" RACK FITTING CABINET,** 34" high by 16" deep with telescopic drawer slides. Louvred sides, back and top. Brand new Swedish make. **£4.0.0.** only plus B.R.S. delivery.

**Control Box for Photo Flash, Mk. 1,** containing 4 Toggle Switches, 2 Panel Lamps, 1 11-way 5-bank Wafer Switch, 2 Digital Counters, Electro magnetic 0 to 99 with 100 ohm coil, 4 Press-button Switches, etc. **18/-,** post paid.

**Filter Unit, Type 504.** New, boxed in smart alloy case. Setable from 34 Mc/s to 86 Mc/s, with 6 Digit Counter. Complete Unit, **11/6,** post paid.

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Latest Type Panel Lamps. MES red bezel **1/6** Arco Electric Panel Indicator Lamps, red, clear, amber, **4/6.**

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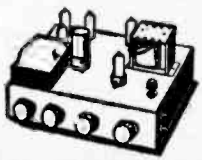

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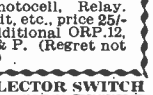

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