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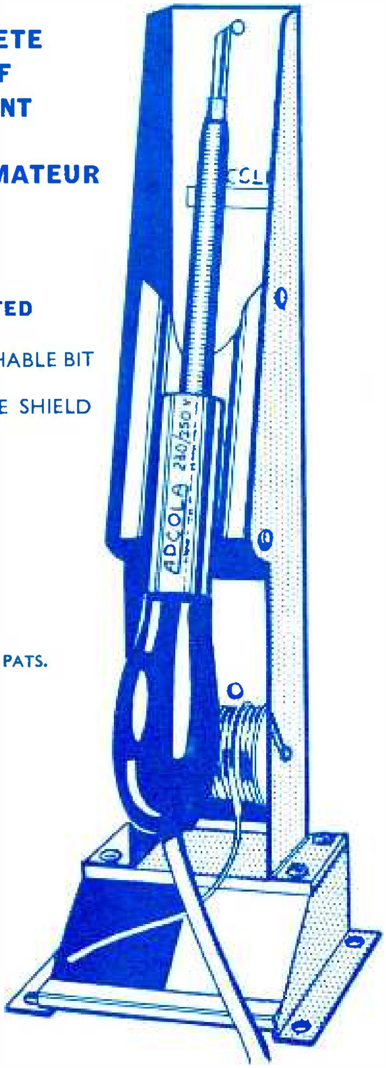

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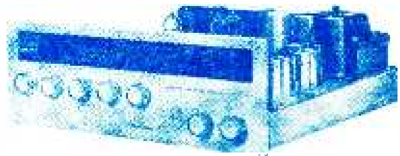
NEW HEIGHTS IN HI-FI

Armstrong

A NEW range of Tuner-Amplifiers with all the performance capabilities of separate tuners and amplifiers, superseding the Stereo 12 and Jubilee models.

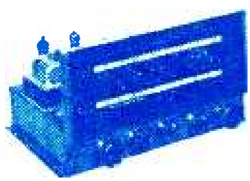


227 AM-FM STEREO TUNER-AMPLIFIER

20 watts power output. Covering the full FM and medium wavebands. Inputs for any ceramic or crystal pick-up and tape playback, also outputs for tape recording. Exceptional sensitivity and stability on FM, the Foster Seeley Discriminator being preceded by two IF Stages and a limiter stage. Medium waveband featuring automatic variable selectivity and heterodyne rejection filter provides Continental reception of good programme value PRICE **£48.15.0**

227 M. AM-FM TUNER-AMPLIFIER

This is the mono version of the 227 above and is identical in performance and specification except that a single channel control unit is incorporated with only one amplifier. Styling is also similar to the 227. PRICE **£33.18.0**



STEREO 55 TUNER-AMPLIFIER CHASSIS

One compact chassis combines AM and FM tuners, Stereo Control Unit and two power amplifiers. For mono reproduction the two amplifiers are used together so that up to 10 watts output is available. Provision for tape recording and playback is made with a choice of inputs for crystal or ceramic pick-ups including the Decca Deram. PRICE: **£29.18.0**

AF 208 AM-FM CHASSIS

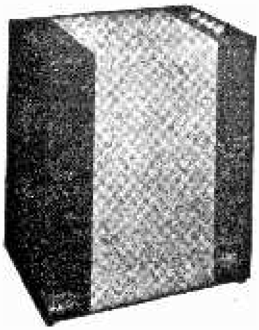
A high quality tuner amplifier chassis which can be used for the conversion of an existing radiogram or as the basis for building a new radiogram or reproducing system. PRICE: **£21.4.0**

Full descriptive literature available from Dept. No. PMT.

ARMSTRONG AUDIO LTD.

WARLTERS RD., LONDON, N.7. Tel: North 3213

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



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

Eminently suitable for bass, lead or rhythm guitar and all other musical instruments

- ★ 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.

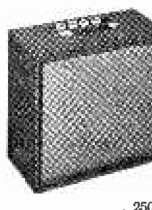
39½ Gns. Send S.A.E. for leaflet. OR DEPOSIT of £4.3.0 and 12 monthly payments of £3.9.11. Carr. 17/6.

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 complimentary shades of Rexine/Tygan. 200-250 A.C. mains. **£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 or 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 15 WATT LEAD or RHYTHM GUITAR AMPLIFIER

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. Loudspeaker is a heavy duty high flux 12in. 20 watt model with cast chassis. Cabinet is well made and finished as Junior Model. Size approx. 18 x 18 x 8in.



Only **18 Gns.** Carr. 10/-

Send S.A.E. for leaflet. Or DEPOSIT 35/- and twelve monthly payments of 35/-.

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 recess on 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.

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Three new branches opening early March

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

DERBY Now open at 26 Osmaston Road The Spot

HEAVY DUTY LOUDSPEAKERS IN SUBSTANTIAL REXINE COVERED CABINETS. Type BG1. Suitable for Bass Guitar. Speaker Unit 15in., High Flux, 15 ohms, 30 watts. Cabinet size approx. 24 x 21 x 13in. Only 19½ gns. Or Deposit 37/6 and 12 monthly payments of 37/6. Type BG3/2. Suitable Bass and Lead Guitar. Two 12in. high flux 15 ohm 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/-.

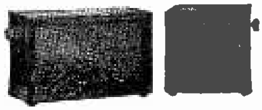
FANE EXTRA HEAVY L/SPEAKER 183. 18in., 15 ohms, 60 watts, 3in. diam. Speech Coil. Total Flux 375,000 lines. High sensitivity. ONLY 24 gns. or Deposit 51/- and 12 monthly payments of 42/9. Send S.A.E. for leaflet on 153 and 183.

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 5¼ x 2¼in. 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.*

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

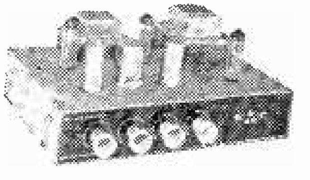
REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

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

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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

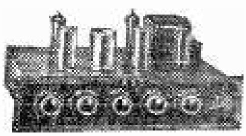


Two input sockets with associated controls allow mixing of "mike" and gram., as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 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 1⅞in., 3¾in., 7½in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9 gns. S.A.E. for leaflet.

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 and ready to use for 59/6 extra.

R.S.C. GRAM. AMPLIFIER KIT. 3 watts o/put. Negative feedback. Controls Vol., Tone and Switch. Mains operation 200-250 v. A.C. Fully isolated chassis. Circuit, etc., supplied. Only **39/9.** Carr. 3/9.

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 **39/6.** 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 **29/9.**

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, **£7.17.6.** 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 11¼ x 2¼ x 2½in. Controls: Vol. and Tone with Switch. Only **59/6.**

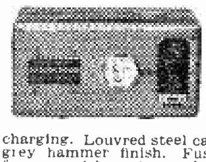
SENSATIONAL STEREO OFFER

A complete set of parts to construct a good quality Stereo amplifier with an undistorted output total 6 watts. **4 Gns.** 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.

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. BATTERY CHARGING EQUIPMENT Guaranteed 12 months.

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



ASSEMBLED 4 amps 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 grey hammer finish. Fused and ready for use with mains and output leads and battery clips. Carr. 4/6. **59/9**

Terms: Deposit **12/-** and 5 monthly payments of **12/-.**

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. **39/9** Carr. 3/9. **6/12v. 1 amp. 27/9** Less meter.

CHARGER KIT, 12 v. 14 AMP or 24 v. 7 AMP

Consisting of mains trans. 200-230-250 v. F.W. (Bridge) selenium Rectifier. Ammeter, Fuses, Variable Resistor, Heavy Steel Stove enamelled case and Circuit. Only **£9.19.6.** Carr. 15/-. Please state if 12 v. or 24 v. kit required.

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. with Ammeter and variable charge rate selector...... **52/9**

CHARGER AMMETERS 0-1.5 a., 0-4 a., 0-7 a. **8/9 ea.**

CHARGER KIT, 12v. 10 Amp. with variable charge rate adjustment and ammeter. **£4.19.6.** Carr. 10/-.

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

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

TOP SHROUDED DROP THROUGH

- 250-0-250v. 70mA. 6.3v. 2a, 0-5-6.3v. 2a.. **17/9**
- 350-0-350v. 80mA. 6.3v. 2a, 0-5-6.3v. 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**

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, 0-5-6.3v. 3a **27/11**
- 350-0-350v. 150mA. 6.3v. 4a, 0-5-6.3v. 3a.. **35/9**

FULLY SHROUDED (continued)—

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

OUTPUT TRANSFORMERS

- Midget Battery Pentode 66:1 for 3S4, etc. .. **4/6**
- Small Pentode, 5,000Ω to 3Ω .. **4/6**
- Small Pentode 7/8,000Ω to 3Ω .. **4/6**
- Standard Pentode 5,000Ω to 3Ω .. **5/9**
- Standard Pentode 7,000Ω to 3Ω .. **5/9**
- 10,000Ω to 3Ω .. **5/9**
- Push-Pull 8 watts, EL84, or 6V6 to 3Ω or matched to 15Ω .. **9/9**
- Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 to 15Ω .. **19/9**
- Following types for 3 and 15Ω speakers:
- Push-Pull 10-12 watts 6V6 or EL84 .. **18/9**
- Push-Pull 15-18 watts, 6L6, KT66 .. **22/9**
- Push-Pull Mullard 510 Ultra Linear .. **29/9**
- Push-Pull 20 watts, sectionally wound, 6L6, KT66, EL34, etc. .. **49/9**

MIDGET MAINS Primaries 200-250 v. 50 c/s.

- 250v. 60mA, 6.3v. 2a .. **11/9**
- 250-0-250v. 60mA, 6.3v. 2a .. **12/11**
- Both above size 2¼ x 2¼ x 2½in.

FILAMENT TRANSFORMERS All with 200-250v. 50 c/s primaries 6.3v. 1.5a., **5/9**; 6.3v. 2a, **7/6**; 0-4-6.3v. 2a; **7/9**; 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, 10H, 400 ohms **4/11**

CHARGER TRANSFORMERS All with 200-230-250v. 50 c/s Primaries: 0-9-15v. 1½a, **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.**

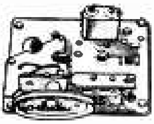
MICROPHONE TRANSFORMERS 120: 1 high grade, clamped, **8/9.**

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.

GÖRLER 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 at **67/6** P. & P. 4/6.

Heavy 8¼in. metal turntable. Low flutter performance 200/250 v. shaded motor with tap at 45v. for amplifier valve filament if required. Turnover LP/78 head.

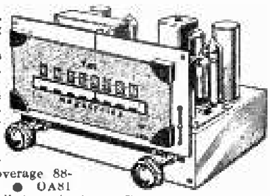
RECORD PLAYER AMPLIFIER

2 valve (EZ80, ECL82). A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7in. w. x 2½in. d. x 6½in. h. 55/-. P. & P. 3/-. Suitable speakers: 6½in. 15/- P. & P. 1/6. 10 x 6in., 26/-, P. & P. 1/6.

SPEAKER & CABINET FABRICS

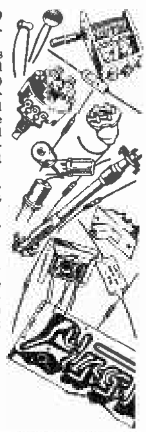
Oatmeal or Red and Gold Vynair for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard.
OUR PRICE **13/6** per yard length plus P. & P. 1/9 per yard. (Minimum order 1 yard). Send S.A.E. for samples.

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. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80's and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● 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 wavebands transistor superhet. ● Printed circuit panel (size 8¼ x 2¾in.) ● 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 3¼in. Suitable for above using 3½in. speaker, 25/-. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

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

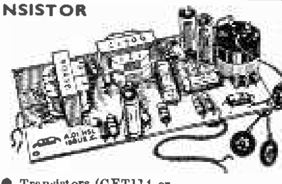
QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. Size 7in. w. x 2½in. d. x 5¼in. h. 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 CABINET

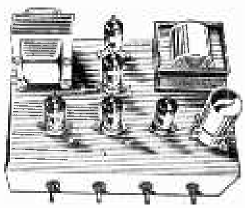
Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.
PRICE £3.9.6 Carr. 5/-

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 81 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 plugs. **£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
10in. x 6in. 26/-
Also 15 ohm 12 inch, **30/-.**
Rola Celestion approx. 9in. x 6in. middle register speaker 10/6
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 carrying handle. Overall size 13¾in. 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 **28/6** P. & P. 4/-.

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 filament if required, 2/6.

TAPE DECKS

COLLARO STUDIO DECK £10.10.0 plus 5/6 carr. and ins.
B.S.R. MONARDECK (Single speed) 3¾in. per sec., simple control, uses 5¾in. spools, **£6.15.0** plus 5/6 carr. and ins. (Tapes extra on both).

Superior CABINET To take 8 x 5in. speaker, with motor board will accommodate BSR UA14 or UA16. **£3.9.6.** Carr. 5/6. Speaker **10/6** extra. P. & P. 1/6 extra.
LARGE CABINET Similar to above with 3 ohm speaker. **£3.9.6** Carr. 5/-.

★ 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.
STANDARD COLVERN 50K W/W Pre-set Pots. 2 for 4/-. P. & P. 1/-.
STANDARD 1¼in. FUSEHOLDERS Laminated Twin, 2 for **1/6.** P. & P. 9d. Laminated Single, 2 for **1/-**. P. & P. 6d. Belling-Lee Panel mounting, single **2/-** each. P. & P. 6d.
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/-.
Precision made .0005 2-gang **TUNING CONDENSERS.** Size 2¼ x 2¾ x 1½in. **4/-** each. P. & P. 1/6.

MAINS TRANSFORMER
Drop thru' type. Tapped primary 110v., 200v., 220v., 240v. 320-0-320v. at 80mA and 6.3v. at 3 amps. Generous core. Stack size 3⅜ x 2¾ x 1⅝in. Weight 4lbs. ONLY **15/-**. P. & P. 3/6.
CONDENSERS. 5000 mFd. 12 v. wkg. Size 3 x 1in. dia. **3/-** each. P. & P. 6d. each.

8 x 2½in. 3 ohm SLOT SPEAKERS Specially designed to handle large output. Ideal for high quality reproduction when speaker space is limited. Special purchase, regret no further technical details available but an absolute snip at **8/-** each. P. & P. 1/6 per speaker.
FEW ONLY 6 x 4in. 3 ohm Speakers Similar to above. Only **9/-**. P. & P. 1/6 per speaker.
8 x 5in. 3 ohm SPEAKERS BY WELL KNOWN MAKER. Unrepeatable at only **10/6** each. P. & P. 1/6 per speaker.
A pair of these are ideal for Stereo.

◀ 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.

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

LASKY'S RADIO

For the Finest Value and TRANSISTOR RECEIVERS AND

We consider our construction parcels to be the finest value on the home constructor market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.

The SKYROVER

Controls: Waveband Selector, Volume Control with on/off Switch, Tuning Control. In plastic cabinet, size 10 x 6½ x 3½in. with metal trim and carrying handle.

Can be built for

£10.19.6

Post and Packing 5/- extra.

THE SKYROVER and SKYROVER DE LUXE

GENERAL SPECIFICATION: 7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. The SKYROVER and SKYROVER DE LUXE covers the full Medium Waveband and Short Waveband 31-94 M. and also 4 separate switched band-spread ranges 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions.

SPECIFICATION: Superhet, 470 Kc/s. All Mullard Transistors and Diode. Uses 4-U2 batteries. 5in. Ceramic Magnet P.M. Speaker. Easy to read Dial Scale. Band Spread Tuning. 500 MW Output. Telescopic Aerial & Ferrite Rod Aerial.

WAVEBAND COVERAGE: 180-576M; 31-94M and Band Spread on 13, 16, 19 and 25 metre Bands.

The SKYROVER DE LUXE

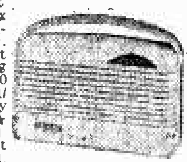
Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11½ x 6½ x 3in., covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

Can be built for **£12.19.6** P. & P. 5/- extra

Data for each receiver 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries, **2/8** extra. Four Leak-Proof batteries, **3/4** extra. *All Components Available Separately.*

The "REALISTIC" Seven

★ 7-transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5½ x 3½in. in one complete assembly. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3½in., in Red/Grey, Blue/Grey or all Grey. ★ Easy to read dial ★ External socket for car aerial. ★ I.F. frequency 470 Kc/s. ★ Ferrite rod internal aerial. Operates from PP9 or similar battery. ★ Full comprehensive data supplied with each receiver. ★ All coils and I.F.'s etc. fully wound ready for immediate assembly.

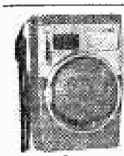


An Outstanding Receiver. **LASKY'S PRICE** for the complete parcel including Transistors, Cabinet, Speaker, etc., and Full Construction Data. Can be built for **£5.19.6** P. & P. 4/6.

PP9 Batt. **3/9.** Data and instructions separately **2/6.** Refunded if you purchase the parcel.

REALISTIC Seven DELUXE

By popular request a De Luxe version of the well-proven Realistic "Seven" now available. With the same electrical specification as standard model—PLUS A SUPERIOR WOOD CABINET IN CONTEMPORARY STYLING, covered in attractive washable material, with superchrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. ALL FOR ONLY **£1** EXTRA. P. & P. as for Std. model



THE "SPRITE"

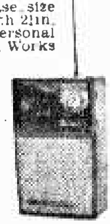
Can be built for **79/6**

P. & P. 3/6 extra.

★Six-Transistor Superhet Miniature Personal Pocket Radio. ★ Long and Medium wavebands. ★ Ferrite Rod aerial. ★ I.F. Frequency 470 Kc/s. ★ 3in. Speaker. ★ Printed circuit 2½ x 2in. ★ Slow Motion Drive. ★ In Plastic Case. Size 1 x 2½ x 4in. In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver and Output stages ready built with all components mounted on the printed circuit. The SPRITE preassembled, plus cabinet, speaker and all components for final construction, can be built for:— **79/6** P. & P. 3/6 extra. Data and instructions separately 2/6. Refunded if parcel is purchased. *Real calf leather case, wriststrap, personal earphone and case for earphone and battery* **12/6** the lot extra. **Make no mistake this is a SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit.**

READY BUILT BOY'S TRANSISTOR RADIO

Ready built, 2 transistor pocket radio in attractive plastic case, size only 4 x 2½ x 1in. Fitted with 2½in. loudspeaker. Socket for personal earpiece & telescopic aerial. Works from single PP3 type battery. Fully tunable over full medium waveband. Supplied complete with earpiece, telescopic aerial, carrying purse and 9 volt battery. Ideal Birthday Gift.



LASKY'S PRICE with all accessories. **Post Free** **42/-**

6 TRANSISTOR POCKET RADIO fully built, 4 x 2½ x 1in. with 2½in. speaker. Uses single PP3 type battery. Supplied complete with personal earpiece and leather case. Tunable over full medium waveband.

LASKY'S PRICE **79/6** Post Free

Complete with all accessories

PRIVILEGE PARCELS

A "Privilege Parcel" allows you to purchase the Audio System of your choice at a worth while cash saving. Some examples are listed below, but we shall be pleased to quote our "Privilege Parcel" Prices for any selection of equipment of your own choice. Send us details of your requirements.

Tudor Stereo Amplifier £15. 0.0	Tudor Stereo Amplifier £15. 0.0
Connoisseur Craftsman, 2-speed transcription player £16. 6.6	Braun PC4L Stereo Transcription Unit £12. 9.6
Decca FFSS Stereo Pick-up £18.16.0	2 x Sharon Loudspeaker systems £19.19.0
Total £50. 4.6	Total £47. 8.6
"PRIVILEGE PARCEL" Price: £47.10.0	**"PRIVILEGE PARCEL" Price: £45.0.0**
Collaro Studio Tape Deck, ½-track model £10.10.0	Collaro Studio Tape Deck, ½-track model £13.19.6
Lasky's Tape Amplifier £8.19.6	Martin Tape Amplifier, ½-track model £12.12.0
P'table Case £3.15.0	Portable Case with Speaker £5. 5.0
7 x 4in. spkr 15.6	
Total £24. 0.0	Total £31.16.6
"PRIVILEGE PARCEL" Price: £22.10.0	**"PRIVILEGE PARCEL" Price: £30.0.0**

Carriage and Packing on all the above parcels, 10/6 extra.

E.M.I. 4-SPEED RECORD PLAYER

New, unused and individually boxed fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13½ x 12½ x 4½in. A 9in. metal turntable is fitted. For use on 200/250 volt A.C. Mains, with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.s etc., but if desired a G.P. 67 LP/78 Mono cartridge will be supplied in lieu of the GP73 at no difference in cost.

LASKY'S PRICE 79/6 P. & P. 3/- extra.

COLLARO 4TR 200 TRANSCRIPTION RECORD PLAYER UNIT. New and unused—listed at 17 gns. LASKY'S PRICE £9.19.6. Carr. & Pack. 5/-.

207 EDGWARE ROAD, LONDON, W.2. Near Praed St. PADDINGTON 3271/2

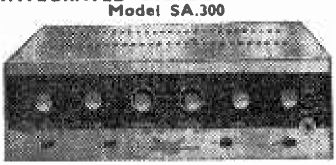
33 TOTTENHAM COURT ROAD, W.1. Nearest Stn., Goodge St. MUSEUM 2605

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

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

◀ *See opposite page for addresses*

INTEGRATED STEREO AMPLIFIER Model SA.300

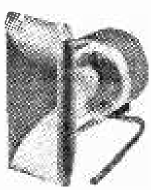


Engineered for the professional . . . designed for the home. A completely new dual 15 watt stereo amplifier for professional quality reproduction, remarkable versatility, and new distinctive styling—worthy of a place in the finest stereo Hi-Fi system, a full range of front panel controls and switches permit adjusting volume, balance and tonal characteristics through every delicate shading of the entire audio range. Supplied complete with installation and operation manual. PRICE £29.10.0. S.A.E. for further details.

CT.10 HORN TWEETER

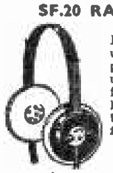
For true high fidelity reproduction of the upper, middle and top frequency ranges in multi-unit speaker installations. Pressure unit type utilizing a spun aluminium diaphragm. Output 10 watts. Frequency response 1500-1800 c.p.s. Impedance 16 ohm. Finished in matt black, flanged and drilled for baffle mounting. PRICE **29/6**

HT.20 HORN TWEETER



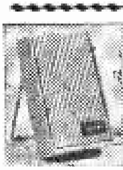
Designed for 2- and 3-way speaker systems, for smooth high-quality reproduction of the critical upper, middle and top frequencies. The operating system used is a pressure unit utilising a plastic domed voice coil wound with aluminium wire operating in a magnetic gap of high-flux density. Finished in stove enamelled gold with adjustable chrome base to permit mounting inside or on top of enclosures. Output: 20 watts. Response: 1500-18,000 c.p.s. Impedance: 16 ohm. Mounting: 4in. x 1½in. PRICE **69/6**

SF.20 RADIO EARPHONES



Hi-Impedance 2,000 ohms general use headset. Black and ivory plastic cased electro-magnetic units with adjustable headband for comfortable fit. Individual listening for all types of applications. Individually packed, with flexible cord attached. PRICE **12/-**

MM.71. MINIATURE DESK OR HAND MAGNETIC MICROPHONE.



Ideal for Tape Recorders, Intercoms, Amplifiers, Transmitters etc., where high quality at low cost is required. Complete with support and lead. PRICE **12/6**

DM.614. 50K DYNAMIC SUPER SENSITIVE DESK OR NECK MICROPHONE.

Never before such high quality at such low price. Complete with lavelier cord and desk stand. Lightweight PRICE 45/-. Complete in presentation pack

MINIATURE PORTABLE TAPE RECORDER MODEL TC.601

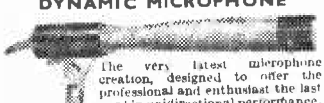
★ Fully transistorised.
★ Dual track.

★ Combined microphone/speaker.
★ Size only 10¼" x 3½" x 2⁵/₁₆"

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**

UD.19HL UNIDIRECTIONAL DYNAMIC MICROPHONE



The very latest microphone creation, designed to offer the professional and enthusiast the last word in unidirectional performance. Designed to provide the speed component from the periphery, thus eliminating all previous common unidirectional design defects. Exclusive features include high sensitivity and excellent frequency characteristics achieved by use of an aluminium wire voice coil. High stability by use of polyester film for the diaphragm. Extremely effective in minimising feed-back problems. Dual high and low impedance, swivel adaptor and shielded cable. PRICE £14.14.0.

DS.1 MICROPHONE DESK STAND

5 in. dia., grey plastic base.
3½ x ⅜in. dia. rod (27 thread).

PRICE **10/6**

AMT.31 3-TRANSISTOR SUB-MINIATURE AM TUNER

Covers full broadcast band. 4 transformers—3 IF and 1 Osc. Ferrite rod aerial. Completely wired superhet circuit on printed circuit board. Complete with instructions. PRICE 84/1.

MINIATURE EARPHONES

Fully guaranteed and complete with 3 feet cord, sub-miniature plug and socket. CR-5 High imp. crystal or MR-4 Low imp. magnetic.

ONLY **4/6** each. Post Paid.

TAPE SPLICER AND CUTTER MODEL T.635

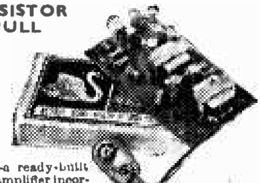
Cuts 2 rounded indentations in the tape splice leaving the edges of the tape which contact parts of the recorder entirely free of adhesive. As little as ⅛in. tape need be removed. Complete with instructions. PRICE 15/-

SIGNAL INJECTION PROBE ITI.1

Push button operation Ideal for making rapid checks on radios. TV. Amps, tuners, etc. PRICE **39/6**

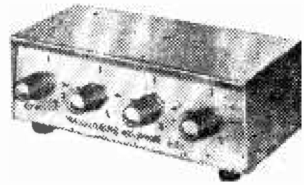
4-TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

Model EG.2004



Not a kit—a ready-built miniature amplifier incorporating input and output transformers, 4 transistors, 9 volt battery snap cord (for Power), speaker and volume control connection leads. The most useful amplifier ever produced. Complete with full instructions and circuit diagram. Ideal for making powerful transistor radios, tape recorders, baby alarms, record players, intercoms etc. Must be heard to be appreciated. ONLY **42/6**

MM.4 4-CHANNEL TRANSISTORISED MICROPHONE MIXER

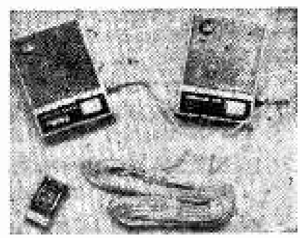


Add musical highlights and additional sound effects to your recordings. The MM-4 permits mixing of four signals such as microphone, records, tuner, etc. into a single output. Inputs and output take standard plugs. Fully transistorised and self-contained in handsome case. PRICE ONLY **59/6**

8" DOUBLE CONE HI-FI SPEAKER Model 8A7

Frequency range 50-16,000 c/s. Lowest resonance 60 + 15 c/s. Sensitivity 98dB. Programme source input 8 watts. Voice coil impedance 16 ohms. Nett weight 970 grammes. BRAND NEW AND GUARANTEED. PRICE **78/6**

HANDY TWO-STATION TRANSISTORISED INTERCOM AND BABY ALARM MODEL TI.206



89/6 Fully Guaranteed. Fantastic Value.

Complete with battery and 60ft. of wire. An intercom system for both calling and conversing, operated from a single battery. Ideal Baby Alarm. S.A.E. for further details.

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★ MARTIN RECORDAKITS ★

For HALF TRACK

	Dep.	&	Mthly. pmts. of
Tape Amplifier for Studio Deck with ready wired printed circuit, control and input panels, mains and output transformers, knobs, plans, screws, etc. EF86, ECC83, EZ80, EM85 and 2 EL84. 3 watts output. Magic eye, radio and Mic. inputs. Ext. speaker socket. Tone and Monitor controls. Can be used as an amplifier. .£11.11.0	24/-	12	19/-
Collaro Studio Deck. Very latest model, 3 speeds, 7in. spools £10.19.6	22/-	8	27/3
Case for above, with 8 x 5in. speaker, two tone grey £5.5.0	—	—	—
Complete Kit with Tape and Microphone £29.0.0	55/-	12	58/-
B.S.R. Monardeck TD2, latest model 5¾in spools £9.9.0	20/-	9	21/-
Tape Amplifier for B.S.R. Deck, printed circuit ready wired with ECC83, ECL82, EM85 and EZ80. Complete with all plugs, sockets, panels, knobs, etc. Mounts under deck making a self-contained unit £8.8.0	20/-	8	21/-

For QUARTER TRACK

	Dep.	&	Mthly. pmts. of
Collaro Studio Deck, Marriott "X" heads £17.17.0	27/6	12	29/5
Tape Amplifier for Studio Deck, described above, but quarter track £12.12.0	37/-	12	20/8
Case, with speaker, two tone grey £5.5.0	—	—	—
Complete Kit with Tape and Microphone £35.0.0	70/-	12	58/2
B.S.R. TD2 Deck with Marriott "L" Series heads £11.11.0	24/-	12	19/-
Tape Amplifier for B.S.R. deck, as over, but quarter track £9.9.0	20/-	9	21/-

TAPE PRE-AMPLIFIER

	Dep.	&	Mthly. pmts. of
For Studio Deck, with power supplies, ECC83, ECL82, EZ80 and EM84. Mic. and Radio sockets, gives an equalised output of 400 m/Volts.... Half Track £8.8.0	20/-	8	21/-
Quarter Track £9.9.0	20/-	9	21/-

Building Instructions available at 2/6 each Kit (refunded when Kit bought).

TAPE HEADS

	Dep.	&	Mthly. pmts. of
MSS Quarter track. Record/Playback and Erase per set £3.3.0	—	—	—
Bradmatic Half track Record/Playback head only £1.12.6	—	—	—
Bradmatic Half track Record/Playback and Erase on plate £1.19.6	—	—	—
Collaro pressure pad for third head position 4/-	—	—	—

BRENELL

	Dep.	&	Mthly. pmts. of
Mk. 5 Series 2 Deck, Half track 4 speed £32.11.0	65/-	12	54/-
Mk. 5 Series 2 Tape Amplifier with power pack £26.0.0	52/-	12	43/2

GRAMOPHONE UNITS, MOTORS, PICK-UPS

	Dep.	&	Mthly. pmts. of
Decca Deram Arm and Plug-in Shell £5.5.0	—	—	—
Decca Deram Transcription Cartridge £4.14.6	—	—	—
Decca Deram Auto Cartridge £3.13.6	—	—	—
Garrard SRP10 with GC8 cartridge, Mono, single player £5.9.11	—	—	—
B.S.R. UA14 with TC8 cartridge, Mono, 4-speed changer £6.19.6	20/-	6	23/3
Garrard Autoslim, Mono GC8 cartridge, 4 speed changer £7.17.0	20/-	7	22/6
Garrard AT6 Autoslim de Luxe. GC8 Mono cartridge £11.9.0	26/6	9	24/9
Garrard 4H/F with Mono GC8 cartridge £17.0.0	34/-	12	28/2
Garrard Lab Type "A" Transcription auto-changer. Mono with GC8 cartridge £19.14.9	39/6	12	32/9
Garrard 301 .... £20.12.2	43/2	12	34/-
Garrard 301 Strobe £22.0.0	44/-	12	36/6
Philips AG1016, Stereo cartridge, will change 7in. records (adaptor 10/- extra) £12.12.0	27/-	12	20/8
Goldring GL58 with arm, less cartridge £15.19.8	32/-	12	26/6
Goldring GL70 with arm, no cartridge £26.3.0	55/-	12	43/2
Goldring GL55X, as GL58 bnt less pick-up arm, £13.1.7	27/7	12	21/6
Goldring "88" Transcription, no arm £17.14.0	39/-	12	29/-

ARMSTRONG - NEW TUNER AMPLIFIERS

MONO

	Dep.	&	Mthly. pmts. of
AF208 A.M./F.M. Radio chassis, bass and treble controls, P.U. inputs, etc. £21.4.0	46/-	12	34/10
ST3 Mk. 2 A.M./F.M. Self-powered tuner £25.12.0	33/-	12	42/9
227M A.M./F.M Radio chassis 10 watts £33.18.0	70/6	12	56/1

STEREO

	Dep.	&	Mthly. pmts. of
Stereo 55 A.M./F.M. Radio chassis, with Stereo gram inputs £29.18.0	62/6	12	49/5
223 A.M./F.M. Self-powered (Tuner only) £28.15.0	57/6	12	47/9
224 P.M. only, Self-powered Tuner £22.10.10	45/-	12	37/4
227 A.M./F.M. Radio chassis, Stereo gram, 10 watts each channel £48.15.0	97/6	12	81/1
226 A.M./F.M. Radio chassis, Stereogram, 10 watts each channel, Filters, etc. £56.0.0	112/-	12	93/2

OTHER TUNERS

	Dep.	&	Mthly. pmts. of
Tripletone F.M. Tuner, less power £13.19.6	28/-	12	23/2
Tripletone F.M. Tuner, self-powered £15.14.6	31/6	12	26/1

STEREO AMPLIFIERS

	Dep.	&	Mthly. pmts. of
Armstrong 222, Integrated, 10W per channel. .£27.10.0	55/-	12	45/8
Dulci AC202, Integrated £12.12.0	27/-	12	20/8
Dulci GA505, Integrated £18.18.0	40/6	12	31/1
Rogers Cadet Mk. 2 with pre-amplifier, 4 ECL86 valves £26.15.6	53/6	12	44/5
Leak Stereo 20, Main amplifier £30.9.0	64/6	12	50/3
Leak Varislope stereo pre-amplifier £25.0.0	50/-	12	41/6
Quad 22 Stereo Control Unit £25.0.0	50/-	12	41/6

For Quad Main Amplifiers see Mono section.

MONO AMPLIFIERS

	Dep.	&	Mthly. pmts. of
Linear L45, 3 watt, 3 valve £5.19.6	—	—	—
Linear Diatonic, 12 watt, suitable Mic. or Guitar £12.12.0	27/-	12	20/8
Linear Conchord. 30 watt, ideal Guitar amp., with case £18.0.0	36/-	12	29/10
Dulci GA5, integrated amp., 5 watt, ECL86 valve £13.2.6	28/6	12	21/6
Dulci DPA15, 15 watt with 2 valve pre-amp .. £25.4.0	50/6	12	41/11
Tripletone Hi-Fi Major with pre-amp. Suitable for Guitar or Mic. etc. £15.18.9	35/3	12	26/1
Leak TL/12, 10 watt Main amp. only £18.18.0	40/6	12	31/1
Leak Varislope pre-amplifier £15.15.0	31/6	12	26/1
Quad, 15 watt Main amplifier only £22.10.0	45/-	12	37/4
Quad pre-amplifier, Mono £19.10.0	39/-	12	32/4

JASON F.M. AND TV SOUND TUNERS

	Dep.	&	Mthly. pmts. of
FMT1, complete with 4 EF91 valves £7.4.6	21/-	7	20/6
FMT2, less power, complete with 4 EF80 valves £9.4.6	20/6	9	20/6
FMT2, with power, complete with 4 EF80 and 1 EZ80 .... £11.4.6	22/6	9	24/9
FMT3, Fringe, complete with valves, less power £10.19.0	22/-	8	27/3
FMT3, with power, complete with all valves .. £12.19.0	26/-	12	21/6
JTV/2, switched F.M. and TV sound, self powered, all valves £15.12.6	33/6	12	25/8
Mercury II, as JTV/2 but less power, all valves £11.0.0	22/-	8	27/3
Instruction book included in all kits. Available separately, 2/6 and 3/6.			
JTV/2, ready built, state channels £22.5.0	44/6	12	36/11
Monitor, ready built (as Mercury II) £16.10.0	33/-	12	27/4

LOUDSPEAKERS

	Dep.	&	Mthly. pmts. of
Goodmans Axiette 8 .... £5.5.7	—	—	—
Goodmans Axiom 10 .... £6.5.11	—	—	—
Goodmans 5K/20/XL £7.0.0	—	—	—
Goodmans XO 5000 cross-over £1.19.0	—	—	—
Goodmans Axiom 201 12in. Unit £10.7.0	21/-	8	25/9
Goodmans Axiom 301 12in. Unit £14.10.0	29/-	12	24/-
Wharfedale Super 8/RS/DD £6.14.2	—	—	—
W.B. HF1012 10in. £4.7.6	—	—	—
R.T.C. 12in. Unit, 15 watt £5.5.0	—	—	—
R.T.C. Hi-Fi Master £8.8.0	20/-	8	21/-
Wharfedale W12/EG 12in. 15 watt Lead Guitar speaker £10.10.0	21/-	12	17/5
Wharfedale W15/EG 15in. 15 watt Bass Guitar speaker £17.10.0	35/-	12	29/-
Wharfedale Super 10/RS/DD 10in. high quality unit £10.18.0	23/8	12	17/11
Wharfedale RS/12/DD 12in. 15 watt Hi-Fi .. £11.10.0	27/6	9	24/9

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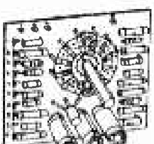
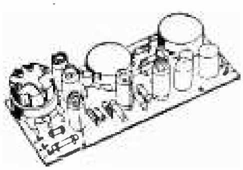


UNIT 1
FIVE STAGE SELECTOR

Enables up to 5 inputs to be connected and correctly matched to following pre-amp stage. With transistor, resistors and capacitors mounted on printed circuit board. Long spindle for adding stereo when required.

Size 3½ x 3in. For Magnetic and crystal P.U.s, Radio Tuner, Microphone, and output from tape head. Requires 9-15V. **47/6**



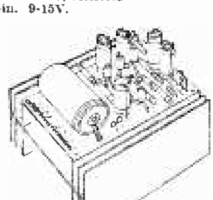
UNIT 4
COMBINED PRE-AMPLIFIER AND TONE CONTROL UNIT

Three stages of audio control—bass control operating between —16 to +10 dB: treble control between —16 to +12 dB: volume control with on-off switch to serve power supply to complete installation. With transistors, resistors etc., on printed circuit board. 6¾ x 2¼in. 9-15V. **62/6**

UNIT 5
MAIN AMPLIFIER

Complete with heat sink on which the six transistor printed-circuit amplifier is built. Transformerless output gives maximum of 10 watts into 3-ohm speaker operating from 24 volt supply. Pre-tested by makers.

Wharfedale 3 : 15 ohms Matching Transformer.. **13/6**



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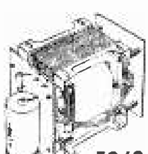
UNIT 6
POWER SUPPLY UNIT

Operates from 200-250 volts, A.C. giving D.C. output at 24 volts for main amplifier and tappings for power to other Martin Audiokit Units. Incorporates heavy duty transformer, full smoothing and latest type rectification.



52/6

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● TAPE ENTHUSIASTS — SEE DETAILS OF MARTIN RECORDAKITS — Page Opposite

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PCF80	7/-
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PCL81	9/-
PCL82	6/6
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5Y3G	4/-
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5Y3WGTB	9/-
5Z4G	7/-
6AB7	4/-
6AC7	3/-
6AG5	2/6
6AG7	6/-
6AH6	10/-
6AJ5	8/6
6AJ7	3/-
6AK5	5/-
6AK6	6/-
6AK7	6/-
6AL5	4/-
6AL5W	7/-
6AM5	2/6
6AM6	4/-
6AQ5	7/-
6AQ5W	9/-
6AS6	4/-
6AS6W	9/-
6AT6	4/-
6AU6	7/-
6AX4	8/-
6B4G	8/-
6B7	5/-
6B8G	2/6
6BA6	4/9
6BE6	5/-
6BR7	9/-
6BW6	9/-
6C4	2/6
6C5G	4/-
6C5GT	6/-
6C6	4/-
6C6G	3/-
6C8G	3/-
6CH6	5/-
6D6	3/-
6E5	6/-
6F5G	5/3
6F5GT	5/9
6F6G	4/-
6F7	6/-
6F8G	6/6
6F12	4/6
6F13	5/-
6F32	4/-
6F33	3/6
6G6G	2/6
6H1	6/-
6H6M	1/6
6J4	9/-
6J4WA	10/-
6J5	3/6
6J5G	3/-
6J6	3/6
6J6W	6/-
6J7G	5/-
6K6GT	5/6
6K7G	2/-
6K7GT	4/9
6K8G	4/-
6K8GT	8/3
6K8M	8/6
6K25	12/-
6L5G	6/-
6L6	9/-
6L6G	6/-
6L6GA	7/6
6L7G	4/6
6L34	4/6
6LD20	5/9
6N7	6/-
6N7G	5/9
6Q7G	6/-
6R7	6/-
6SC7	7/-
6SC7GT	5/-
6SG7	5/-
6SF5GT	5/6
6SH7	3/-
6SJ7	5/-
6SJ7GT	5/6
6SJ7Y	6/6
6SK7	4/6
6SL7GT	5/6
6SN7	4/6
6SQ7	6/-
6SS7	2/-
6U4GT	9/6
6V6G	5/-
6V6GT	5/6
6V6M	8/-
6X4	4/-
6X5G	5/-
6X5GT	6/3
6Y6G	6/-
6-30L2	10/-
6Z4	5/-
7B7	7/6
7C5	10/-
7C6	7/-
7C7	5/-
7H7	7/3
7Q7	7/-
7V7	5/-
7Z4	4/6
703A	30/-
8D2	2/6
9D2	3/-
11E3	17/6
12A6	2/6
12AH7	5/-
12AH8	11/-
12AT7	4/-
12AU7	5/-
12AX7	6/-
12AY7	10/-
12BA6	6/-
12BE6	7/-
12BH7	7/-
12C8	3/-
12H6	2/-
12J5GT	2/6
12K7GT	4/6
12K8M	10/-
12Q7GT	4/6
12SA7	7/-
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7GT	3/-
12SN7GT	5/9
12SR7	5/-
12Y4	2/-
14L7	7/-
15D2	6/-
19G3	10/-
19G6	9/-
19H1	6/-
20A2	17/6
20P4	17/6
21B6	9/-
25L6GT	7/-
25Y5	3/-
25Z4G	6/6
25Z5	7/6
25Z6GT	8/6
30	5/-
30C15	10/-
30F3	8/6
30FL1	9/6
30P19	14/-
30PL1	10/6
30PL13	10/6
35L6GT	7/-
35T	17/6
35W4	5/-
35Z3	8/-
35Z4GT	6/-
35Z5GT	6/-
37	4/-
38	4/-
41MP	4/-
50L6GT	6/6
53A	7/6
58	6/-
59	6/-
75	5/6
76	5/-
77	6/-
78	5/-
80	5/6
81	9/-
82	8/-
84	8/-
85A2	8/6
89	6/-
90C1	8/-
210VPT 7 pin	2/6
220PA	7/-
220TH	4/-
225DD	9/-
307A	5/6
350B	8/-
357A	70/-
368A	5/-
393A	15/-
446A	8/-
705A	15/-
715B	60/-
801	6/-
803	22/6
805	30/-
807BR	6/-
808	8/-
813	55/-
829A	30/-
829B	50/-
830B	4/-
832	15/-
837	9/-
843	5/-
866A	14/-
954	4/6
955	2/6
956	2/-
957	5/-
958A	4/-
1612	5/-
1616	3/-
1619	5/-
1625	6/-
1626	3/-
1629	4/6
2051	5/-
4043C	13/6
4063	8/-
5704	9/-
5726	6/6
6064	7/-
6065	6/-
7193	1/9
7475	3/-
8013A	25/-
9001	3/-
9002	4/6
9003	6/-
9004	2/6
9006	2/6

C.R. Tubes

CV1596 (09J)	55/-
E4103/B/4	28/-
E4504/B/16	28/-
VCR97	28/-
VCR138	30/-
VCR139A	35/-
3BP1	30/-
3FP7	45/-
5CP1	25/-
5FP7A	25/-

Photo Tubes

CMG8	5/-
G816	12/6
931A	55/-
6097C	350/-

Special Valves

ACT6	£8
ESU77	£10
1B24	25/-
3J/92/E	£37/10/-
723A/B	50/-
725A	30/-
726A	27/6

Transistors

OC26	25/-
OC44	6/-
OC45	6/-
OC72	7/-
OC81	7/-
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***MANY OTHERS IN STOCK** include Cathode Ray Tubes and Special Valves.* U.K. orders below £1 P. & P. 1/-; over £1, 2/-; over £3, P. & P. free C.O.D. 2/6 extra. Overseas Postage extra at cost.

MARCONI COMMUNICATION RECEIVERS. CR.150. Frequency coverage 2-60 Mc/s in 5 bands. Two IFs. Ist 1,600 kc/s, 2nd 463 kc/s. Image signal protecting over 40 dB up to 30 Mc/s and 20-40 dB from 30-60 Mc/s. Self checking calibration (built in calibrator). Stabilisation of supply and temperature compensation. Electrical and mechanical bandspread. Metering and visual tuning indicator. Bandpass from 100c/s to 10 kc/s in 5 stages. Acoustic filter associated with 100 c/s. Bandpass position for CW reception. Facilities for diversity reception. In as new guaranteed condition with original mains power supply unit **£70** or without power supply unit **£60.** Carriage 30/-.

CR.150/2. Frequency coverage 1.5-22 Mc/s in 4 bands, all other features as in CR.150. Price **£35.** Carriage 30/-.

P.C. RADIO'S mains power supply unit for above, **90/-.**

CR.150/3. Same as CR.150 with additional separate antenna trimmer on front panel, crystal controlled 1st oscillator for fixed frequency reception, muting switch (during transmission), wide bandpass extended to 13 kc/s. In as new guaranteed condition with original mains power supply unit **£75.** Carriage 30/-.

H.R.O. Senior. Table Model. In excellent, fully checked, and tested condition (without coils and power pack), **£15.10.0.** As above but rack mounted model, **£14.10.0.**

CHR HIGH RESISTANCE HEADPHONES. New, **16/-.** P. & P. 1/6.

Original mains power pack for H.R.O. 110/220 v. A.C. Brand new in original packing, **45/-.** P. & P. 4/-.

CONNECTORS FOR TCS RECEIVER, TRANSMITTER AND REMOTE CONTROL. with original plugs on both ends. New **£1.17.6** each. P. & P. 2/6.

TRANSMITTER RECEIVER. TYPE 68T. 3-5 Mc/s netting facilities. Low power consumption. Requires 150 v. h.t. and 3 v. l.t. dry batteries. In good condition. **35/-.** Carriage 8/-.

COMMUNICATION RECEIVER Type SR 40. 540 Kc/s-31 Mc/s in 4 bands. Built-in 5in. loudspeaker, telescopic aerial for SW reception. Calibrated "S" meter, automatic interference limiter. BFO circuit. 220v. A.C. Weight approx. 15 lb. **£29,** carriage free U.K.

R.209 RECEPTION SET. A 10-valve high-grade Superhet Receiver with facilities for receiving R/T (A.M. or F.M.) and CW frequency 1 Mc/s-20 Mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power-supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Dimensions: Length 12in. width 8in., depth 9in. Weight 23 lb. In as new, tested and guaranteed condition, **£23.10.0,** including special headphone and supply leads. Carr. £1.

P. C. RADIO LTD

170 GOLDHAWK ROAD, W.12

Shepherd's Bush 4946

Open 9–5.30 p.m. *Thursday* 9–1 p.m.

PRECISION WATT METERS made by Weston (USA) for D.C. and A.C. 25-1,000 c/s. Voltage coils 150 and 300 v., current max. 7.5 amps. Mirror dial calibrated up to 1,500 watts. Connecting instructions included. Overall measurements 6¼ x 5¼ x 3½in. Brand new **£9.19.6.**

CARBON INSET MICROPHONE. G.P.O. type, **2/6.** P. & P. 1/6.

PANEL METERS (round)

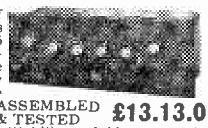
0-20 microamps	2⅝"	D.C.	79/-
0-50 microamps	3½"	D.C.	45/-
0-50 microamps	2½"	D.C.**	40/-
0-100 microamps	2½"	D.C.	35/-
0-100 microamps	2½"	D.C.**	35/-
0-200 microamps	2½"	D.C.	32/6
0-500 microamps	2"	D.C.	21/-
0-500 microamps	2½"	D.C.	30/-
0-1mA*	2"	D.C.	19/6
0-1mA	3½"	D.C.	35/-
0-1mA	3½"	D.C.**	35/-
0-5mA	3½"	D.C.	45/-
150-0-1,500mA	3½"	D.C.	29/-
0-15v	2½"	A.C.	17/6
0-50v	2¾"	D.C.	28/-
0-150v	2¾"	A.C.	24/-
0-500v (shunt)	2½"	D.C.	20/-
0-5kV	3½"	electrostatic	85/-
0-10kV	2½"	D.C.	63/-
Freq. 0-70 c/Sec125v	3¾"		52/-

*"Weston", as usually used also in H.R.O. as "S" meter. **Projection type.

STERN-CLYNE

Incorporating STERN RADIO LTD., PREMIER RADIO, CLYNE RADIO LTD.
Three well-known names with a reputation for quality and service.
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.

MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

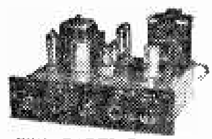


Designed mainly for Mullard Range of Amplifiers, also suitable for any Amplifiers requiring input up to 250mV. Incorporates 5 input Channels, including for Tape and Magnetic Pickups. Separate Bass and Treble controls. High pass filter 20 to 160 c/s. low pass filter 5-9 Kc/s. Totally enclosed in case size 11½" x 4½" x 4½. KIT OF PARTS **£10.0.0** (Carr. & Ins. 5/-). ASSEMBLED & TESTED **£13.13.0**
Instruction book and detailed price list (free with kit) available separately at 3/6 Post Free.

MULLARD "5-10" MAIN AMPLIFIER

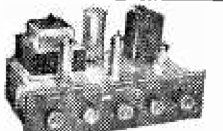
For use with MULLARD 2 or 3 valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS and MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer
COMPLETE KIT (Parmeko Output Trans.) **£10.0.0**
ASSEMBLED AND TESTED **£13.10.0**
(Carr. & Ins. 6/6).
ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.
Instruction book and detailed price list (free with kit) 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 (free with kit) available separately at 2/- Post Free.

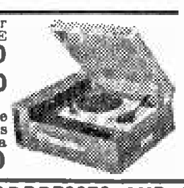
THE MULLARD 3-3RC



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 (free with kit) 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 (free with kit) available separately at 2/6 Post Free.

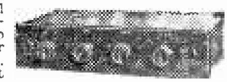


Perfectly suited for Portable Installations for which purpose we offer PORTABLE CASE (£3.10.0), the AMPLIFIER (Kit) and 8" x 5" SPEAKER (£1.0.0). All for **£9.0.0**
Alternatively with ASSEMBLED AMPLIFIER **£10.0.0**
(Carr. & Ins. 5/-).
The Case quoted above will accommodate some 4-speed Single Record Units. A larger model is available for extra 10/-. With this Equipment a COMPLETE PORTABLE RECORD PLAYER can be built for **£14.0.0**

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.

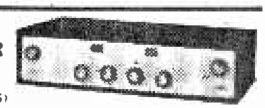
MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT



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 (free with kit) available separately at 2/- Post Free

THE "TUDOR" STEREO AMPLIFIER



PRICE **£15.0.0** (Pkg. & Carr. 7/6)
A self contained Shelf-mounting Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS.
The Cabinet is finished in Black Crackle. Size 14 x 8 x 4in.
Send for full specification

THE SINCLAIR SLIMLINE

A new 2-TRANSISTOR printed circuit pocket radio. Completely portable—the smallest ever—only 2¾in. x 1⅝in. x ⅝in. Uses Micro-Alloy Transistors and with built-in ferrite aerial will receive all stations on M.W.—B.B.C.—208, etc. Easy to assemble—no alignment problems. All required components, including earpiece. ONLY **49/6** P. & P 1/6.
All parts sold separately.

HI-FI STEREO HEADPHONES

For the connoisseur who requires perfection. Each Earphone consists of a 2½" Dynamic Loudspeaker with a full frequency range, fitted with foam rubber Ear Pads for added comfort to keep out noise and to maintain an excellent bass response. The resistance Junction box with change-over switch provides simple transfer from Phones to Speaker. Specifications: Frequency Range-25-15,000 c.p.s. Input Impedance—16 ohms. Power rating—½ watt. Weight—13 ozs.
PRICE **5 Gns.** P. & P. 2/6.
(Junction box 15/- ex.)

MONAURAL STETHOSCOPE HEADSETS

Suitable for Radio, Tape Recorders, or monitoring tape recordings, magnetic low impedance or Crystal High impedance. Complete with 4ft. of lead and miniature Jack Plug. PRICE **10/6** P.&P. 1/6

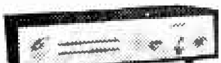
ACOS MONAURAL STETHOSCOPE HEADSETS

Suitable for Tape Recorders, or monitoring tape recorders. 100 ohm impedance magnetic. Complete with lead. (Originally 21/-) OUR PRICE **12/6** P.&P. 1/6

SEE FOLLOWING PAGES FOR ADDRESSES AND DETAILS OF OTHER STERN-CLYNE PRODUCTS

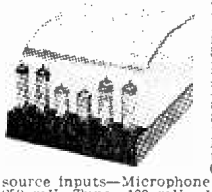
Great Britain's Greatest Electronic Hobbies Organisation

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 A.C. Valve line-up: ECC85, ECH81, EBF89, 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 90K. 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.



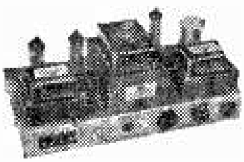
DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

A new conception in the field of audio engineering by Stern-Clyne development engineers. The most up-to-date circuitry is used in the Double Feature Pre-amplifier, it has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay.

This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck. *Offers superb reproduction from all sources at low cost. Available shortly.*

Brief Specifications:

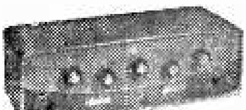
★ J.L.10 POWER AMPLIFIER



Incorporates the latest triode-pentode ECL86 valves in push-pull. PARTRIDGE ultra linear output transformer, PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner. Output impedance 3—7.5—15 ohms.

KIT OF PARTS **11 Gns.** C.&I. 7/6.
READY BUILT **14 Gns.**

★ DOUBLE FEATURE PRE-AMPLIFIER



Inputs for microphone, crystal or magnetic pick-ups, tuner unit, Push-button switching for 3 tape speeds equalised. Tape erase Bias Oscillator circuit incorporating ferrox-cube transformer. Function switch, separate base, treble and volume controls, level control and latest EM87 magic eye level indicator. The pre-amplifier is totally enclosed in a silver hammer finish steel case, and an attractive perspex front panel completes the presentation.

KIT OF PARTS **£17.0.0** READY BUILT **£21.0.0** C. & I. 5/-.

PRICES: If both above units purchased together:

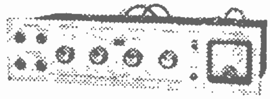
KIT OF PARTS **£27.10.0** READY BUILT **32 Gns.** C.&I. 10/-.

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).

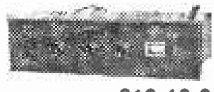
STEREO TAPE PRE-AMPLIFIER



MODEL STP-1. For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ½ and ¼ 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 (free with kit) available separately at 5/- Post Free.

TAPE PRE-AMPLIFIER MULLARD Type "C"

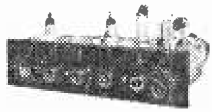


Suitable for most ¼ track, Mono Tape Decks. Incorporates Ferrox-cube Push-Pull Oscillator. Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit.

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

Instruction book and detailed price list (free with kit) 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 (free with kit) available separately at 3/- Post Free.

COMBINATION TAPE UNITS

All our Tape Units can be supplied specially matched to any Tape Deck such as Collaro, Brenell Mk.5 Series II, also the Wearite. Specimen prices as below.

	Kit	Assembled
STP-1 Pre-amp with Collaro Studio Tape Deck......	£36. 0.0	£42. 0.0
Assembled with track switch fitted, **£44.2.0.**		
STP-1 with Brenell Mk. 5 Series II with Track Switch fitted	£68. 4.0	
STP-1 with Brenell Mk.5 Series II, ¼ Track Deck......	£74.15.0	
Type "C" Pre-amp with Collaro Studio Tape Deck....	£24.10.0	£30. 0.0
Assembled with deck wired and matched, **£32.2.0.**		
Type "C" Pre-amp with Brenell Mk.5 Series II Deck..	£46.11.0	£53. 1.0
Assembled with deck wired and matched, **£55.3.0.**		
HF/TR3 with Collaro Studio Tape Deck...........	£24. 3.0	£29.10.0
Assembled with deck wired and matched, **£31.12.0.**		
HF TR3 with Brenell Mk.5 Series II Deck..........	£46. 4.0	£51.11.0
Assembled with deck wired and matched, **£55.13.0.**		

Carr. & Ins. 15/- on above units. Send S.A.E. for comprehensive price list.

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NORTH LONDON:	162 Holloway Road, N.7.	NORth 8161/5	Half-day Thurs
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CROYDON:	12 Suffolk House, George Street.	MUNicipal 3250	Half-day Wed
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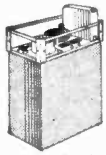
Great Britain's Greatest Electronic Hobbies Organisation

WIRELESS SET NO. 38 AFV



A lightweight portable transmitter/receiver with transmitting range 5 to 10 miles and frequency coverage 7.4 to 9 Mc/s. Operates from 3 and 120 v external dry batteries. Large, clearly numbered tuning control, with tuning lock. In good condition.

ONLY **39/6** Plus 5/- P. & P.

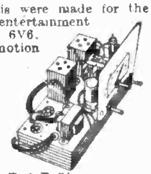
HIGH IMPEDANCE PERSONAL LISTENING EARPIECES

Suitable for all types of crystal sets and transistor sets. Complete with plug. P. & P. 6d. **5/11**

PORTABLE MAINS SOLDERING IRON

30 watts. Features removable handle that covers tip and barrel. Complete with lead and plug. ONLY **12/6** P. & P. 1/-.

SUPERHET RADIO CHASSIS



These well-made chassis were made for the Government for Forces entertainment with 6K8, 6K7, 6Q7, 6V6. Choke smoothing slow-motion tuning, printed scale, 200-550 metres. BRAND NEW, complete with valves and 6 volt Power Pack. Cabinet with 8in. speaker to fit. Complete in maker's cartons. **£3.19.11** P. & P. 5/-

SUPERB STREAMLINE MICROPHONE

Omni-directional response 60-10,000 c/s. Output level 52 dB. Built in on/off switch. Provision for conversion to hand held, cord suspended or stand mike. Attractive satin chrome finish.

Microphone **37/6** P. & P. 1/9
Desk Stand **10/-** P. & P. 1/9
Floor Stands Available

LIGHTWEIGHT HIGH IMPEDANCE HEADPHONES

Ideal for crystals sets and morse practice. **12/6** P. & P. 1/6

TODAYS SUPREME VALUE IN AMPLIFIERS!

BRITISH MADE GORLER TYPE AMPLIFIER GS12005. All-transistor subminiature quality amplifier 60-16,000 c/s ±3dB, 70-14,000 c/s ±½dB. 5mV for 1 watt out at 6v. Built and tested. **92/6**

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Fits any car anywhere. Complete with plug and suction pads. **12/6** P. & P. 1/-.

PORTABLE INTERCOM/ ELECTRONIC BABY SITTER

Amazing Transistor intercom system with approx. 66 ft. connecting flex. 9V Battery 2/6 extra. Every sound relayed. Two way buzzer, call and speak system. Also usuable on wall or desk. P. & P. 2/6. **£3.3.0**

1155 INSTRUCTION HANDBOOK

3/11 P. & P. 3d.

SONA

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Mullard OC 44	3/11	P. & P. 3d.
Mullard OC 45	3/11	P. & P. 3d.
Mullard OC 71	2/11	P. & P. 3d.
Mullard OA 90	1/11	P. & P. 3d.
Ediswan XD202 Germanium diodes	1/11	P. & P. 3d.
Transitor Holder, 3-pin 11d. each		P. & P. 3d.

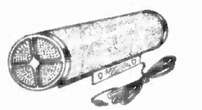
MICRO ALLOY TRANSISTORS

Mat 100	7/9
Mat 101	8/6
Mat 120	7/9
Mat 121	8/6
VHF Transistor ADT140	15/-

Above MAT's Postage Paid.

Ferrite Slab Aerials, suitable for transistor sets. 3/-. P. & P. 6d.

TRANS. RADIO TUBULAR SPEAKER



Booster Speaker. Plugs into earpiece socket of most radios and tape recorders. Gives double the volume and a hi-fi stereo effect that will amaze you, size Approx. 9 x 2¾in. PRICE **25/-** P. & P. 1/9.

VALVES

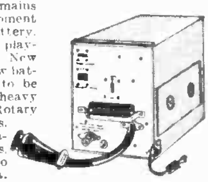
6B8G	1/11	P. & P. 3d.
6K8	3/6	P. & P. 3d.
6V6	3/6	P. & P. 3d.
1L4	4/-	P. & P. 3d.
1T4	4/-	P. & P. 3d.
1S4	5/6	P. & P. 3d.

METER TEST KITS

Comprising insulated leads and test prods, insulated croc. clips and meter terminal connectors. All contained in plastic hold-all. P. & P. 1/3 **9/11**

Meter Test Prods. P. & P. 9d. **4/11**

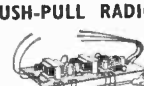
12 VOLTS CONVERTOR TO 240 VOLTS



Run all your mains a.c.-d.c. equipment from your car battery, shavers, record players, radios, etc. New type vibrator, low battery drain, not to be confused with heavy battery drain. Rotary transformers. Spare fuses, vibrator battery clips, etc. 12 volts to 240 at 100 m.a.

BRAND-NEW, tested in waterproof cartons. ONLY **35/-** P. & P. 5/-

4 TRANSISTOR PUSH-PULL RADIO AMPLIFIER 49/11

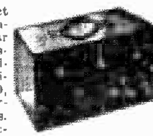


Complete with 3 ohm output transformer working from a standard 9 volt battery. Output in excess of 200 MW.

TAPE RECORDER

Fully portable. Twin tracked, 3in. standard tape. 4-transistor. Wonderful tone from speaker. Complete with mike, batteries and transparent cover. **£8.10.0** Post 5/-.

CRYSTAL CALIBRATOR TEST SET No. 7 MKI



New in Paxolin cabinet with circuit and instructions on rear panel. Calibrates transmitters AND receivers. 3 choices of calibration points: 10,100, 1,000 kc/s apart, harmonics up to 20 mc/s. Operates from 2v accumulator and 120v dry battery. P. & P. 3/6 **65/-**

CRYSTAL SET

Build your own crystal set and hear it work. Easy to build and tune. Picks up main stations. P. & P. 11d. **9/11**

With personal ear-piece. **12/11** P. & P. 11d With head-phones **22/11** P. & P. 1/6

TSL "KITBOARD"

The newest thing for the transistor constructor. Better than a printed circuit board! Perfect for assembling modern subminiature components into the smallest possible arrangements. Perforated 10 holes to the inch. Strong, light. Suitable for all transistor equipment.

Size 1 x 4¾ x 4in. 3/6
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LEAD ACID ACCUMULATORS

(Unspillable)

2 volts 16 A.H. Brand New. Size 4 x 7 x 2in. 4/11 each, 3 for 12/6. P. & P. 3/- per cell.

OPERATORS' UNITS

A host of valuable components (block condenser, jack plug, socket, etc.).

ONLY 1/11 EACH. P. & P. 1/3

IDEAL FOR CHILDREN 7 YEARS AND OVER—GENERAL ELECTRIC

Electronic construction kits made by General Electric Co.

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ELECTRONIC CONSTRUCTION KITS

8 Radio Circuits, including morse practice set. All components and single headphones provided. (No soldering necessary.) Post Free. **49/11**

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Gives choice of British and European programmes with staggeringly good quality and selectivity. Building is easy and interesting, and as well as providing superb listening through the earpiece, the "Slimline" makes a wonderful radio jack too. FULL coverage of medium waveband. Extremely robust construction. **49/6**

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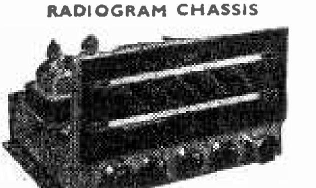
Hinged lid. Size 6½ x 6 x 2in. Padded inside, many uses. 2/6 each, 2 for 4/6. P. & P. 1/- each.

SONA

MORE BARGAINS OPPOSITE

ARMSTRONG AF208AM/FM RADIOGRAM CHASSIS



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- 5 WATTS OUTPUT. 7 VALVES.
- 15 dB NEGATIVE FEEDBACK.
- WIDE-RANGE BASS AND TREBLE CONTROLS.
- 2 COMPENSATED PICK-UP INPUTS.
- FREQUENCY RESPONSE 30-22,000 c.p.s. ±2 dB.
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- CONTINENTAL RECEPTION OF GOOD PROGRAMME VALUE.

FOR 3, 7½ and 15 ohms SPEAKERS.
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16/450V	3/-	1,000/12V	3/-	32+32/350V	5/-
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25/25V	1/9	8+8/450V	3/6	32+32+32/350V	7/-
25/50V	2/-	8+16/450V	3/9	50+50/350V	7/-
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TELESCOPIC CHROME AERIALS. 13in. extending to 43 in., 8/6 ea.
TRIPLEXERS Bands I, 2, 3, 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.
TWIN SCREENED per yd. 1/-. 80 ohms only.
Wirewound Ext. Speaker Control. 10Ω 3/-. 25Ω 6/6.
WIRE-WOUND POTS. 3 WATT. Pre-set Min. **TV Types.** All values to 10 ohms to 25 K., 3/- ea. 30K., 4/-. (Carbon 30 K. to 2 meg., 3/-).
WIRE-WOUND 4 WATTS Pots. Long spindle. Value, 50 ohms to 50 K., 6/6; 100 K., 7/6.
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TV etc. TRIMMER, 1000 pF. with knob. 2/-.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. **High Stability.** ½ w., 1%, 2/-. Preferred value 10Ω to 10 meg. Ditto 5% 10Ω to 22 meg., 9d.
BRIMISTORS. CZ1, 3/6; CZ2, 2/6; CZ3, 1/6.

WIRE-WOUND RESISTORS 10 ohms—10,000 ohms

5 watt	1/3
10 watt	2/-
15 watt	2/-
12.5K to 47K 10 w.	3/-

Volume Controls

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

80 ohm CABLE COAX

Semi-air spaced ¼in. Stranded core
40 yds. 17/6 **6d. yd.**
60 yds. 25/-
FringeQuality Air spaced **1/6 yd.**
Ideal 625 lines.

MAINS TRANSFORMERS 200 250 v. A.C.

Postage 2/- each transformer.

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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. 5:3:1 or 5:1 9/-. **O.P. TRANSFORMERS.** Heavy Duty, 5/6. Multi-ratio, 7/6. Multiratio heavy duty push-pull 10 w., 15/6. Battery 4/6. Sub min. 5/9. 10 w. O.P. matching trans. 3 7 15Ω 12/6.
L.F. CHOKES 15 10H. 60/65 mA 5/-; 10H., 85 mA. 10/6; 10H., 150 mA. 14/-.
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I.F. TRANSFORMERS 7/6 pair
465 K/s Slug Tuning Miniature Can. 2 x 1 x 1in. 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., 8/9; 2 a., 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6; 2 amps., 17/6; 4 amps., 22/6. Circuit included.
4 AMP CAR BATTERY CHARGER with ammeter Leads, Fuse Case, etc., for 6 v. or 12 v., 69/9.

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4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

Size 3 x 1⅞ x ¾.
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/-.

1964 RADIOGRAM CHASSIS

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

FIVE VALVES
LATEST MULLARD ECH81, EF89, EBC81, 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.
£9.15.6 Carr. & Ins. 4/6.

BAKERS SELHURST LOUDSPEAKERS

12in. Baker, 15w, Stalwart 3 or 15 ohms, 45-13,000 c.p.s. .. .. **5 gns.**
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. .. .. **7 gns.**
12in. Standard H.D. 20w. 40-14,500 c.p.s. .. **7 gns.**
12in. De Luxe 15w. 25-17,000 c.p.s. .. **9 gns.**
12in. Bass 25w. 20-18,000 c.p.s. .. **12 gns.**
15in. Auditorium. 35w., Bass, 20 c.p.s. to 12 kc/s. Ideal Bass Guitar, **18 gns.**
Portable enclosures for 12in. "Stalwart", **£3 each.**

LOUDSPEAKERS P.M. 3 OHM. 2½, 3, 4 5in.; 7 x 4in., 15/6; 6½in. Rola, 16/6; 8in. Plessey, 17/6; 9 x 6in., 21/-; 8 x 5in., 21/-; 10 x 6in. 22/6; 10in. Rola, 30/-; 12in. R.A., 30/-.
STENTORIAN HF1012. 10in. 3 to 15 ohms, 10w. 87/6; 8in. HF812, 72/-; Tweeter T359, 30/-; Cross-over CX3000, 30/-.
EXTENSION SPEAKER CABINETS. 5in., 15/6; 6½in., 18/6; 8in. 19/6; 10in., 29/6; 12in., 60/-.

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 1¼in. x 1⅝in., 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, 160 pF, 5/6. Solid dielectric 100, 300, 500 pF, 3/6.
CONDENSERS. New stock. 0.001 mfd. 7 kV. T.C.C., 5/6; Ditto, 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25 1/6; 0.5/350 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 **10/6** ready made with valve 1S5. **POCKET SIZE** 2¼ x 4½ x 1in. One resistor to change, full instructions supplied. Battery 8/6. 69V+1½V. Details Free.

WAVECHANGE SWITCHES
8 p. 4-way 2 wafer long spindle 6/6
2 p. 2-way, or 2 p. 6-way long spindle .. 3/6
4 p. 2-way or 4 p. 3-way long spindle .. 3/6
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High output. Size 1½in. dia. x ⅜in.
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B.B.C. Bands 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.**
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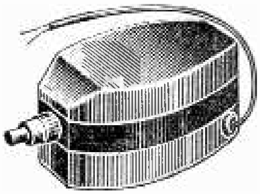

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			Spare Plastic Reels	
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Long Play	7in. reel, 1,800ft.	22/6	3in.	1/6
	5¾in. reel, 1,200ft.	17/6	4in.	2/-
	5in. reel, 900ft.	15/6	5in.	2/-
Standard	7in. reel, 1,200ft.	17/6	5¾in.	2/-
	5in. reel, 600ft.	11/6	7in.	2/6

"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.

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SLOW MOTION DRIVES. 6:1, **4/3**.
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Miniature Contact Cooled Rectifiers, 250V 50mA, **7/6**; 250V 60mA, **8/6**; 250V 85mA, **9/6**; **Selenium Rect.**, 300V 85mA, **5/-**.
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Coils Wearite "P" Type, **4/-** each.
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Screwdriver, 5in., **6d.** **Test Prods**, **2/9**.
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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**.
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MARTIN TAPE PRE-AMPLIFIERS & DECKS (PLAY-BACK THROUGH YOUR OWN HI-FI)

B.R.S. 2 track Pre-amp. £8.8.0	**B.S.R. TD2 tape deck £6.15.0**
Collaro 2 track Pre-amp. £8.8.0	**Collaro Studio tape deck £10.10.0**

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2 track B.S.R. amplifier £8.8.0	**Collaro amplifier £11.11.0**

MAINS DROPPERS. Midget adjustable sliders 0.3A, 1,000 ohms, **5/-**; 0.2A, 1,200 ohms, **5/-**; 0.15A 1,500 ohms, **5/-**; 0.1A 2,000 ohms, **5/-**.
MIKE 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 **1/-**. Expanded Metal, Gold, 12 x 12in., **6/-** Panel mounting fuse holder, **2/-**. Fuses 1¼in. 60mA-5A, **6d.** Insulated side cutters, **8/6**. Bib Stripper, **3/6**.

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

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COILS AND TRANSFORMERS FOR 2-WAVE 6-TRANSISTOR PRINTED CIRCUIT AND FERRITE AERIAL.

Long and Medium aerial—RA2W 6in. rod 208pF tuning, with car aerial coil	12/6
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3rd I.F. P50/3CC	6/-
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Driver Transformer—LFDT4	9/6
Wavechange Slide Switch d.p.d.t.	3/6
Printed Circuit—PCA1. 2¼ x 8¼in. Ready drilled and printed	9/6
Volume Control, 5K-DP	4/6
35 ohm Speakers, 3½in., 15/6; 5in., 17/6; 7 x 4in., 21/-	
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**.
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SINCLAIR "SLIMLINE" RADIO

Med. wave kit, 2 transistors, 2 diodes, earphone, ferrite aerial. Cabinet 3 x 1¾ x ¾in. **49/6**, batt. **3/6**.

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.

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AUTOCHANGER KITS COMPLETE (As above)		
B.S.R. Monarch	£11.10.0	P.P. 5/6
Garrard Autoslim ..	£12.18.0	P.P. 5/6
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E.M.I. Junior	£9.19.6	P.P. 5/6
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OR SEPARATELY		
Cabinet with board 14 x 13in. cut out to your choice	£3.9.6	P.P. 3/6
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BARGAIN		
B.S.R. Autochange UA12 Stereo/Mono	£7.10.0	P.P. 4/6

Replacement sapphire styli available from 5/3. Replacement Xtals 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 12¾ x 9¾in.

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D3035, 7.3 CT:1 Push-Pull to 3 ohms for OC72, 11/-
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D239, 4.5:1 Driver, ⅞in. x ⅞in. x ⅞in. 11/6
D240, 8.5:1 Driver, ⅞in. x ⅞in. x ⅞in. 11/6

ARDENTE TRANSISTOR VOLUME CONTROLS
VC1545, 5K with switch dia., .9in., 5/3
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SUB.-MIN. JACK and PLUG 3/6 pair

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0-300 V ..	27/6	"S" Meter ..	35/-

CABY MULTIMETER M.1
0-1200 v. AC/DC, ohms 0-100k, etc., 54/-.

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Practical Wireless

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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.

Definitions

WHAT is a "wireless" enthusiast? Should he really be called a "radio enthusiast"? And where does "electronics" fit into the picture? In our hobby there are many loose and rather vague demarcation lines and terms of doubtful validity. This comes to mind when occasionally a reader asks why we do not change our title from "Practical Wireless" to "Practical Radio", to "bring it up to date."

One reason is that our present name has been in continuous use for so many years that it has become traditional and universally accepted. For although, in isolation, "wireless" is an outmoded word, everyone knows what it means, even though it is capable of various interpretations.

Mr. X, for instance, is known as a radio enthusiast, but his main interests are test instruments and tape recorders—neither, strictly speaking, wireless or radio. And Mr. Y who likes building amplifiers, though by definition an audiophile is no doubt thought of as a radio enthusiast.

These anomalies have been with us for a long time. The pioneer "wireless enthusiast" was essentially an experimenter, the main preoccupation being to establish and improve methods of long-distance communication by wireless equipment.

When the broadcasting of entertainment material was established in the early 20's, a "wireless enthusiast" was most likely to be a completely non-technical builder of wireless sets using a set of point-to-point wiring diagrams and a kitchen table. Later on, when commercially built sets became more numerous and competitive in price, most of the do-it-yourself builders lost interest, leaving behind the more technically inclined.

In the early 30's, some "wireless" experimenters were working on television equipment, others were interested in circuits to amplify the magnetic pickups which had displaced the acoustic gramophone, and a few were even probing the possibilities of wire recording—little realising how these various offshoots were to develop in the years ahead!

The immense technical strides due to wartime research brought, after the war, a new impetus to old hands and introduced a new generation of enthusiasts. The transistor led to an enormous new interest in set building which can in some ways be likened to the activity of the early 30's, for many of these set builders were almost completely non-technical.

Then there is "electronics." The term is not always clearly understood, is often mis-applied and sometimes awkwardly overlaps radio, audio, video and other spheres.

In other words, the picture of a typical wireless or radio enthusiast changes, often fundamentally, wherever you cut the cake, and at what time period you cut it. This, perhaps, is the key to the continued and always expanding interest, for there can be very few hobbies which offer so many and so varied facets and can give their adherents such a large number of ever-changing spheres to explore.

So the next time you question the use of the word "Wireless", ask yourself if the term "Radio" is more precise. Most likely it won't be!

Our next issue dated April will be published on March 6th

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

SOUND SYSTEM FOR NEW THEATRE

THE extensive sound and telephone systems of the recently opened Nottingham Playhouse Theatre, have all been installed by Standard Telephones and Cables Limited. A 25-line telephone system links all parts of the theatre and for the producer and key theatre personnel, there is a loudspeaking intercom system.

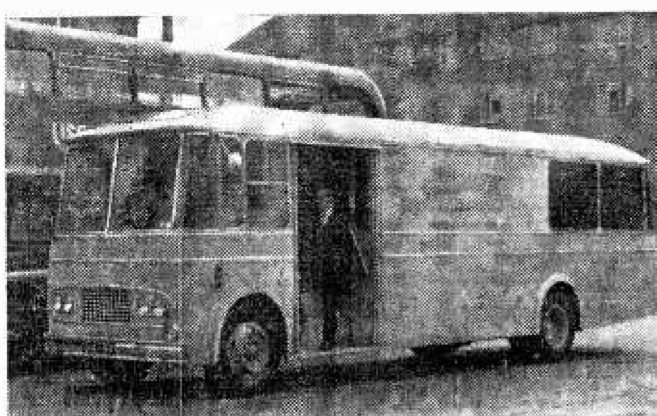
For the audience, eight loudspeakers in the auditorium carry sound from the stage and from the sound effects console. These loudspeakers are fed by a dual-channel amplification system which, in addition to providing for stereophonic reproduction, may be used to "move" sound from one part of the auditorium to another.

As an integral part of the system, sound from the stage is taken to 27 loudspeakers in dressing rooms and the theatre workshops so that actors and stage assistants can follow the progress of each performance.

Electrical Equipment to Tour Europe

TO help increase overseas exports, Avo Limited (part of the Metal Industries Group) has commissioned a new mobile demonstration vehicle to replace a similar vehicle which went into service in 1954 and which has helped boost sales abroad by travelling thousands of miles to grind Avo products right to the doors of prospective customers. The new unit will have similar duties and is expected to visit many European and Middle East countries during the year.

The vehicle has been built on to a Bedford public service vehicle chassis, and at 30ft. in length, is longer than a London bus. Inside the unit will be examples of Avo's electrical, electronic and nucleonic measuring instruments and coil winding machinery. Customers will be able to relax in the lounge area which has been provided in the vehicle, which is also fully air conditioned.



Avo's new demonstration vehicle all set for a tour of Europe and the Middle East.

EXTRA TELECOMMUNICATIONS STAFF FLOWN TO HOLY LAND

DURING the visit of Pope Paul VI to the Holy Land in January, more than 1,000 journalists and photographers from all over the world arrived in Jordan to cover the Pope's pilgrimage. The needs of the reporters for telecommunication facilities placed unprecedented demands on the Cable and Wireless station in Amman. To cope with this extra traffic, the Company flew in additional staff from London, Gibraltar, Malta, Aden, Nairobi and Bahrain. Cable and Wireless Limited co-operated with the Government of Jordan to provide the world press and radio with the essential comunication services between Jerusalem and Amman; between Amman and the rest of the world.

In all, an extra sixty engineers, technicians and operators helped man the station during the visit. They were accompanied at the Amman station by an extra five and a half tons of equipment which had also been flown in specially.

TRANSMITTERS FOR SWITZERLAND

TO provide private motorists and commercial vehicle users with a reliable and inexpensive communications service, the Post and Telegraph administration of Switzerland is to commence a public car-calling network which has been operating experimentally until recently. The network calls for ten v.h.f. radio-telephone transmitters each with an output of 1kW and these have been ordered from Standard Telephones and Cables Limited.

These transmitters are to be placed at strategic high points above the valleys and will be used for telephone operators to advise drivers of vehicles when a telephone call awaits them. On hearing such a message on his car radio, the driver will know to stop at the next telephone and contact either the operator or the person wishing to speak to him. This system obviates the need for motorists to install costly transmitter equipment and it further overcomes the disadvantage of a low-power, mobile transmitter, the range of which would be seriously restricted by mountains.

British Equipment for Tanganyika

BROADCASTING transmission equipment which will cover the whole of East Africa by radio, is to be supplied by the Marconi Company Limited to the newly independent Government of Tanganyika. This order was confirmed by Mr. Paul Bomani, Tanganyikan Minister of Finance, during a recent visit to Britain.

The equipment is for the new radio station at Dar-es-Salaam and will form part of an extension to the country's broadcasting facilities. The order is for two 50kW medium frequency transmitters, together with programme input equipment and ancillaries. Also included in the order is the aerial system, which will consist of directional array.

RADIO LINK IN OUTER HEBRIDES

TO link the Ministry of Aviation's radio stations at Mangersta and Stornoway in the Outer Hebrides, the Automatic Telephone and Electric Company Limited, will supply v.h.f. communication equipment. The ATE equipment will facilitate the remote control of the Mangersta station, providing a link in one direction which will carry audio and control switching signals for modulation and control of the transmitters, and another link will carry the audio output of the receivers in the other direction. Also to be provided under the order are the aerials, ancillary and test equipment.

Airborne Communications Equipment Ordered

LIGHTWEIGHT v.h.f. airborne communication equipment has been ordered recently from Standard Telephones and Cables Limited by the Ministry of Aviation. The equipment which is the STR.38 transmitter/receiver, will be used to equip medium light aircraft and rotocraft of the Army and Royal Air Force.

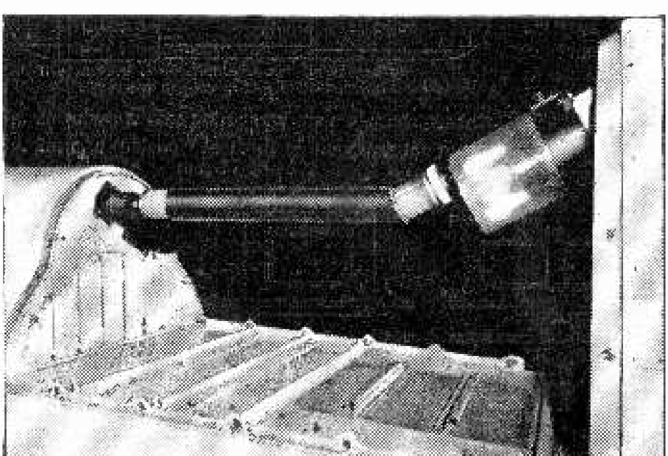
The STR.38 is well suited for this purpose, its weight being less than 14 lb., this being accomplished mainly by the use of transistors.

Supersonic Airliner to have New Type of Aerial

A DESIGN for an aircraft aerial which makes use of the metal skin of the aircraft as part of the aerial and which has already been used for the Trident and Vanguard airliners, is to be employed in the Anglo-French Concorde supersonic airliner. The "notch" aerial, as the design is known, was the result of work done by a team of technicians of Standard Telephones and Cables Limited, and now STC has secured the study contract for the aerial system from Sud Aviation of Paris.

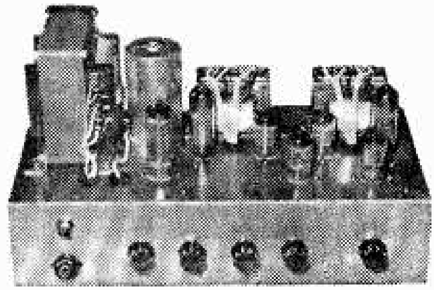
The special h.f. notch aerial unit will be fitted below the skin of the Concorde and covered with glass fibre to restore the original skin contour of the aircraft. The necessity of eliminating projections from the surface of the aircraft (which would produce intolerable drag on the aircraft and affect its performance) makes the notch type of aerial essential, conventional wire aerials previously used being completely unsatisfactory.

The unit in the notch will couple signals from the Concorde's transmitter to the aircraft's wings, tail and fuselage and vice versa.



This is the "notch" aerial unit—as used in the Trident airliner—to be used in the new Concorde aircraft.

The "7-20" stereo amplifier



by M. L. Michaelis

A NEW DESIGN USING THE ECLL800 AUDIO VALVE

THE most modern trend in high power stereophonic amplifiers is presented in this design. For clubs, schools, dances, parties and similar functions, for open-air use and even for the musical specialist at home some 8 to 10W power output on *each* channel is required.

Push pull operation is virtually essential for any high-power amplifier, as it affords the only really economical method of obtaining sufficient reduction of distortion and tolerable power efficiency. The principle objection to high-power push-pull output stages was formerly the relatively large number of valves required. In place of the single output valve of a single-ended amplifier, a pair of power valves was required, and, furthermore, a phase-splitter valve.

A basically new valve has now appeared on the market which is likely to revolutionise valve-operated audio power amplifiers.

Unidrive Push-Pull Output Valve ECLL800

The ECLL800 is, as its type designation implies, a combination of a phase-splitter triode and *two* power pentodes within a single envelope. It thus contains all the requirements for a push-pull output stage in the form of a single valve which is of *the same physical size* as a conventional EL84 pentode, and uses the same noval base. Furthermore, a set of Class B operating conditions is possible, under which the ECLL800 takes exactly the same h.t. drain as an EL84. The ECLL800 thus offers many very interesting opportunities for amateur experiments.

The present stereophonic amplifier design shows this valve under normal optimum operating conditions as recommended by the makers (Class AB).

The designation "Unidrive" for the ECLL800 means that the input drive signal required is that from a conventional single-ended voltage amplifier, e.g. from the anode circuit of one section of an ECC83, or from the anode circuit of an EF86. The ECLL800 contains its own phase-splitter, and this is in fact itself a completely new design and not a mere inclusion of a conventional voltage amplifier triode within the same glass bulb.

The tubular cathode of one pentode section is extended upwards beyond the end of the pentode anode. The protruding section is positioned symmetrically inside a re-entrant half-cylindrical anode. Midway between the extended cathode and this anode, on both sides, are situated flat metal plates with a large rectangular cut-out to allow the electron clouds to pass through. These "rectangular iris windows" are joined together and to the control grid of one pentode system, and connected externally to pin 2 of the noval base. This combination electrode, conventionally termed "triode grid plus pentode No. 1 control grid", is the input electrode of the ECLL800, requiring a single-ended drive signal of 8V r.m.s. for 8·5W push-pull output at 5 per cent distortion.

With the adoption of the usual negative feedback arrangements, as employed in our present design too, the total distortion of the *entire amplifier* is less than 1 per cent at 8W output *per channel*.

The rectangular iris grid of the phase-splitter triode is designed such that the triode has a gain of exactly unity when an anode load of 150kΩ is employed (R64, R65 in our design). The signal at the triode anode (pin 1) is then of the same amplitude but opposite phase, as the input signal, and can be coupled externally to pin 6, the control grid of the other pentode section.

All three cathodes and both suppressor grids are commoned together to pin 7 of the base, and the screens of the two pentodes are commoned to pin 9. Pins 3 and 8 are the two pentode anode connections going to the two ends of the centre-tapped primary of a push-pull output transformer, the common h.t. supply being fed in, as usual, at the centre tap.

All electrodes of the three valve sections are thus accommodated on seven pins, the remaining two being used for the heater, in the normal position, pins 4 and 5. The total heater consumption of an ECLL800 is only 0·6A at 6·3V, which is astonishingly low for a complete push-pull output stage.

Curvature Compensation

The control characteristic of the rectangular irises on the triode has been made such that its residual curvature (non-linearity) is compensatory to that of the pentodes, so that the overall linearity of the ECLL800 is better than for any of its

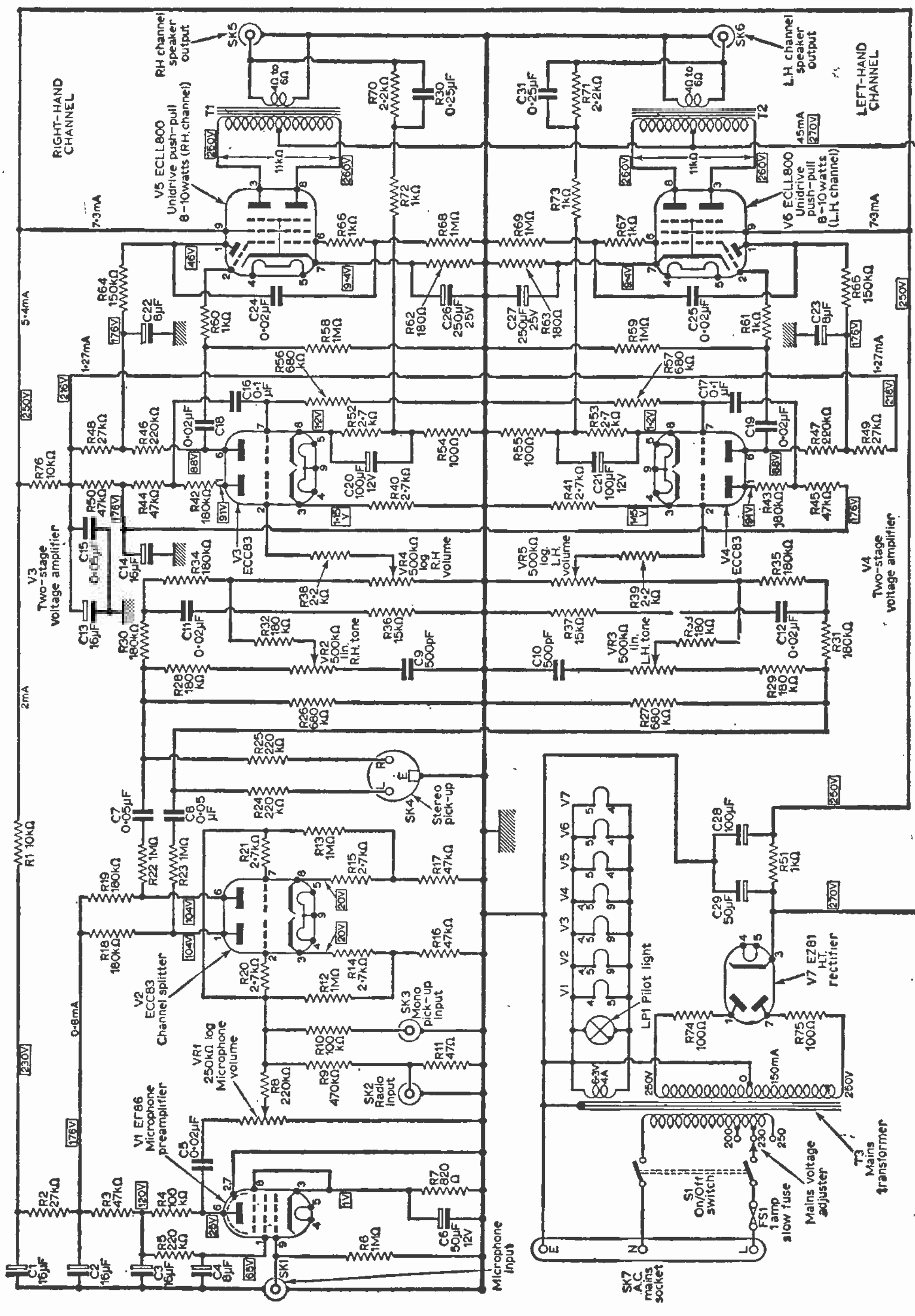


Fig. 1: The circuit. Numbers in circles indicate positive voltages w.r.t. chassis, as measured for prototype, using 20kΩ/V meter and with all volume controls at zero setting (no signal). Values shown against arrows on h.t. feeds are as calculated from above mentioned voltage readings.

sections alone. This is the first deliberate exploitation of this method of compensating distortion known to the author in commercial production practice. Certainly it is in general simpler and more economical to use negative feedback for improving linearity, in the familiar manner, yet the adoption of "compensatory control characteristics" for two or more stages in an amplifier chain offers, in principle, the possibility of driving the amplifier well beyond the linear part of the characteristics of individual stages, without undue overall distortion.

In *combination* with conventional negative feedback, this leads to greatly improved conversion efficiency of h.t. input power to audio output power. The ECLL800 probably represents nowhere near the ultimate of what may be achievable with such techniques, and valve manufacturers will doubtless bring out new types along these lines in the future.

Functions of the "7-20" Stereo Amplifier

This amplifier is designed for universal stereo and monaural (conventional) applications. V2 is here a channel-splitter, for feeding ordinary monaural inputs evenly onto both channels, the amplifier then functioning as 20W power output system for such signals.

The fact that half of this power is fed to each of two speakers or speaker systems, which can be placed some distance apart (ideally in opposite corners of the room, or opposite wings of a stage, for stereo use), enables an impressive projection of the sound into the room to be achieved, even for monaural inputs from ordinary pickups, tape decks or radio tuners. The use of such an amplifier system, employing two channels, is thus definitely worth while even for such signals. The sound appears to stand in the room, and *not* "come out of a hole", as otherwise with single speaker systems. Moreover, the intensity of sound is greater for the same power, and subjective quality and brilliance are improved.

It is, of course, essential to use speakers able to handle 10W peak power. It is not safe to use smaller speakers, even if one keeps the general volume turned low, because transients could still drive the amplifier momentarily to full power and rupture the cone and voice-coil system of a small speaker. Examples of suitable speakers are the WB Stentorian units HF 1016, in any of the makers cabinets or well designed amateur-built cabinets. For outdoor use, suitable horn speakers may be employed.

The Pre-amplifier

The pre-amplifier system included in the "7-20" stereo amplifier is quite comprehensive since the public address and entertainment applications require the frequent use of an announcer's or soloist's microphone.

High gain reserves are incorporated, which can be brought into use by internal variation of certain component values (as discussed below), to any extent such as to trim the complete amplifier to simultaneous optimum performance at all inputs for a particular microphone, tape deck, stereo pickup, etc.

The channel-splitter, V2, allows *simultaneous* monaural and stereophonic operation without mutual interference. Such requirements arise, for example, if a public stereophonic concert (or an educational stereophonic concert in a school) is being given in a hall, with the two speakers in the wings of the stage, and a commentator wishes to inject explanations or announcements into the amplifier via a microphone. He may do so without any switching whatsoever, and whilst a stereo recording is actually playing, his voice will come equally over both channels, and will thus appear to originate from mid-stage, where he will, in fact, probably be situated.

Controls

The arrangement of controls has been designed with such applications in mind. Thus each main channel has been given two controls, a volume control and a treble tone control. Balance controls and other ganged arrangements have been discarded, as they bring added complexity and confusion. It was decided to dispense with a manual bass control too, in order to keep the number of controls down to a very minimum. A treble control is much more important than a bass control, and it is generally satisfactory to run the amplifier with some 15dB fixed bass boost for musical purposes and associated commentaries, as has here been done. Details of varying the degree of fixed bass boost are given below, as well as for the introduction of manual bass controls if required—there is still ample room for such on the chassis.

These considerations led to the use of just four simple controls for the main amplifier, with the addition of a fifth, VR1, the microphone volume control. The commentator can "mix himself in" on to a playing stereo or monaural recording at any desired relative intensity from zero to full power.

Monaural Inputs

The microphone input at SK1 may, of course, be used for any other weak signal input requiring greater amplification than a pick-up, e.g. a conventional monaural tape deck. V3 and V4 anode circuits (pin 1) can be adjusted (see below) such that inputs of 1mV or less at SK1 suffice to fully load the amplifier. VR1 is operative only for inputs at SK1. Inputs at SK2 and SK3, as well as stereo inputs at SK4, are controlled only by the four main amplifier controls, which, of course, also control SK1 inputs once again.

The radio input at SK2 is intended to be fed from the extension speaker sockets of a radio (low impedance). R11 is inserted to make this input insensitive to hum pick-up, so that long unscreened twin flex leads can be employed. If the insertion of the appropriate plug in the extension speaker sockets of the radio disconnects the internal speaker, the value of R11 must be reduced to the speaker impedance of the radio receiver, and must be of sufficient power rating to absorb the entire output power of the radio set. This demand can be satisfied by leaving R11 as shown, and wiring the necessary additional parallel resistor in or near the plug fitting SK2, if desired.

The input at SK3 must be screened. The resistors R8, R9 and R10 effect mutual decoupling of the three monaural inputs, so that all three may be left connected even when not operative. Many

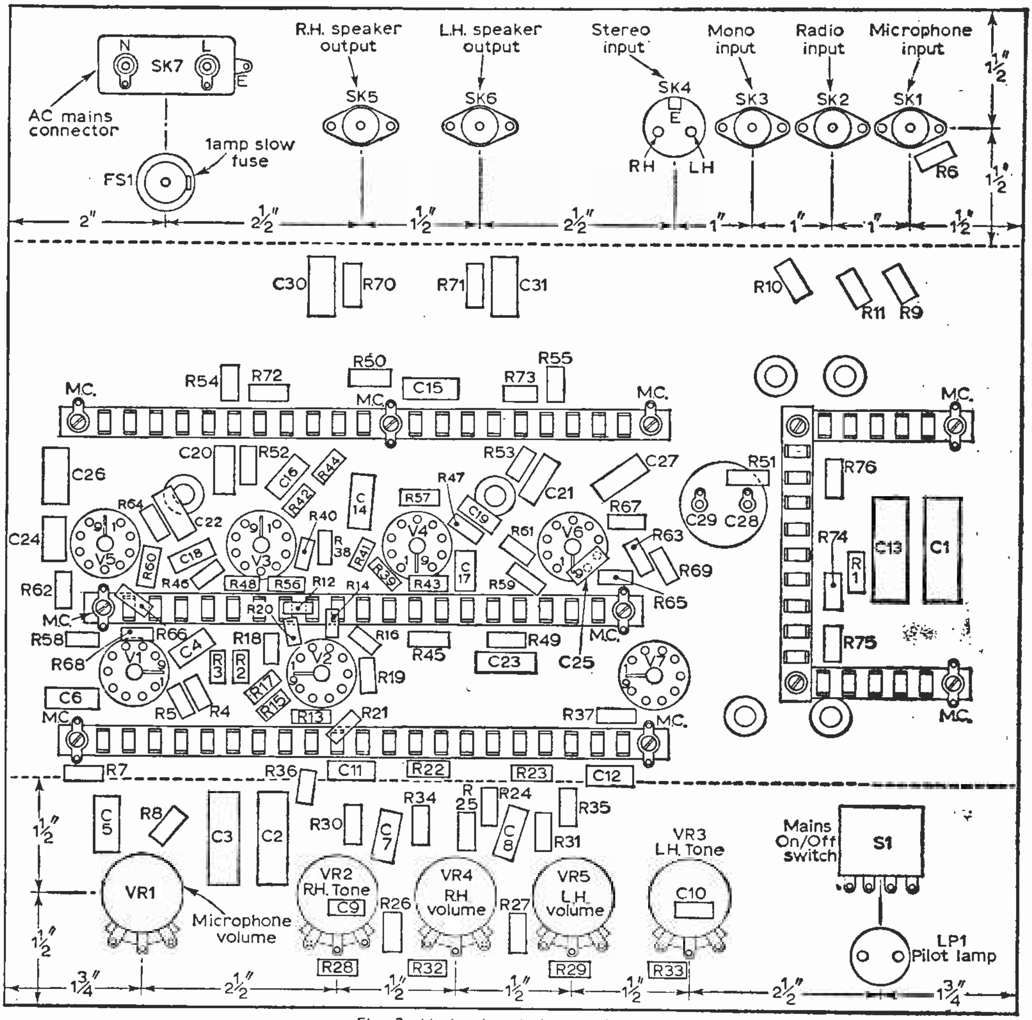


Fig. 2: Underchassis layout diagram.

pick-up units have extra contacts shorting the output when the motor is not running: R10 (and R24, R25 in the case of the stereo input SK4) thereby prevent shorting of other signals in the amplifier. At the same time, these decoupling resistors permit a wide range of fixed adjustments to the relative gains for the various inputs to be made, for optimum performance with a particular set of equipment.

Hum Removal

The principal gain *reserves* of the "7-20" stereo amplifier lie in the anode circuits of V3, V4 at pin 1. Gain can be increased by increasing the values of R44 and R45 and decreasing the values of R42, R43 by the same amount—and vice versa. In the extremes, the gain of the entire amplifier can be raised by a factor of five times, or reduced to zero, by these measures.

When making adjustments, it should first of all be checked whether the arrangement shown, with split anode loads, gives least hum output, or whether it is better to replace R42-R45 by a pair of 220kΩ ½W resistors, taking C16 and C17 still to the tops of R56 and R57, but splitting these resistors appropriately for the grid pin 7 feeds. The precise conditions will here depend somewhat on the exact positions of heater wiring, etc.

In general, heater wires should be run low in the chassis, hard up against the metal bottom, and other circuit wiring held well clear. If necessary, heater wires should be in the form of tightly twisted leads, one of which is earthed to chassis in passing each valveholder. It may also prove of advantage to experiment with small aluminium shields (earthed to chassis) between the rectifier (V7) valveholder and the control panel VR1 to VR4.

Gain Adjustments

Having minimised residual hum, the split anode or grid loads (whichever are finally adopted) in V3 and V4 should be adjusted until the desired *normal* volume of output (not necessarily full power) is obtained from the chosen microphone connected at P1 and whilst speaking at the average intended distance and loudness, VR1 being at mid-track and all other controls at maximum.

Having completed this adjustment, VR1 should be turned down to zero, and all other controls to half-track. The desired radio receiver should then be adjusted to normal intensity on its internal speaker, and then switched over to SK2 of the amplifier, making adjustments to R11 if necessary, as already discussed. R9 should then be adjusted until the amplifier is on the verge of overloading, on both channels.

The radio receiver should then be disconnected from SK2 and the desired monaural pick-up connected at SK3. If the makers specify a particular pick-up circuit, the additional resistors and capacitors must be included below the pick-up arm mount on the record player.

The four main amplifier controls should be advanced to maximum, and a medium intensity record played. R10 should be adjusted such that the amplifier definitely overloads, to allow a margin of safety for weaker recordings. The same procedure should then be repeated for the stereo input socket, SK4, adjusting the values of R24 and R25 (but always maintaining them equal).

It should be added here that, in general, the use of both monaural and stereo pick-ups, at SK3 and SK4, is not necessary, as all stereo record players will also play normal monaural records (but *not* vice versa: stereo records are immediately destroyed if played on a normal record player). However, the use of two turntables, only one of which need be stereophonic, gives greater scope for the producer and his helpers during dances and other functions.

Choice of Components and Alternatives

Specified values of electrolytics should not be reduced, though slightly larger values, if able to be accommodated are permissible.

The main smoothing resistor, R51, may be replaced by a choke of about 10 to 20 henries inductance and about 30mA (not less) current rating. C28 and C29 must be high surge-rating electrolytic cans: whether two separate cans or a single double-value can is used is immaterial. The voltage rating must be 500V, for low leakage current at the operating voltage. All other electrolytics are small tubular items of lower voltage rating, as specified in the parts list.

The mains transformers h.t. windings must be 250-0-250V. Other voltages, lower or higher, are *not* permissible. The no-signal d.c. current drain from the rectifier cathode is 110mA and rises to 150mA at full drive. The transformer and rectifier must thus be rated for 150mA.

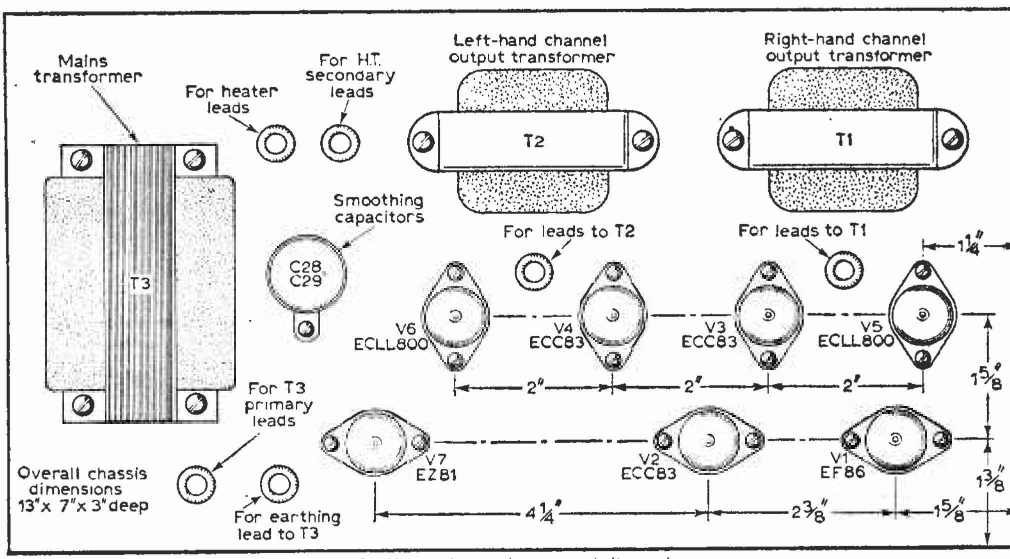


Fig. 3: Above-chassis layout and dimensions.

Regarding output transformers, types standardised for a pair of 6V6 or EL84 valves in push-pull are usable, and should present no difficulty in obtaining. If winding these items oneself, according to general tables and experience, one should aim at an impedance of 11kΩ anode-to-anode, this being the optimum value, but by no means over critical.

An EZ81 rectifier, as specified, is essential. Type EZ80 is *not* suitable as a substitute, as it has insufficient maximum current rating.

Tone Controls

In the following discussion, component numbers from the right hand channel will be referred to. Similar remarks apply to corresponding components in the left hand channel.

Beyond C7 the feed to V3 is split into a bass branch (via R30) and into a treble branch (via R28). The treble branch is variable, giving maximum (level) treble response with VR2 slider at the top; movement of the slider towards C9 reduces treble response. The action can be made more powerful, if desired, by increasing the value of C9, and vice versa. If rising treble response is desired, a capacitor of between 100pF and 250pF should be inserted between the top end of VR2 and R28.

The bass branch gives about 10dB fixed boost. This can be reduced by increasing the value of R34. Increase of bass boost is achieved in the negative feedback circuit if required (see below).

If a variable bass control is to be added, this should be in the form of a 500kΩ linear potentiometer whose track is connected across C11, R34 then goes to its slider.

A further (approximately) 5dB of bass boost are obtained by means of R70 and C30, which reduce negative feedback over the main amplifier loop at low frequencies and thus increase gain. The amount of bass boost contributed here can be increased by increasing the value of R70, and vice versa. The turnover frequency for the bass boost can be *raised* by *decreasing* the value of C30, and vice versa.

Whatever alterations are made to one channel during all these adjustments *must* be made to the

—continued on page 1070

COMPONENTS LIST

Resistors:

R1	10kΩ 1W	R39	2·2kΩ
R2	27kΩ 1W	R40	2·7kΩ
R3	47kΩ 1W	R41	2·7kΩ
R4	100kΩ 1W	R42	180kΩ
R5	220kΩ	R43	180kΩ
R6	1MΩ	R44	47kΩ
R7	820Ω	R45	47kΩ
R8	220kΩ	R46	220kΩ
R9	470kΩ	R47	220kΩ
R10	100kΩ	R48	27kΩ
R11	47Ω 1W	R49	27kΩ
R12	1MΩ	R50	47kΩ 1W
R13	1MΩ	R51	1kΩ 2W
R14	2·7kΩ	R52	2·7kΩ
R15	2·7kΩ	R53	2·7kΩ
R16	47kΩ	R54	100Ω
R17	47kΩ	R55	100Ω
R18	180kΩ	R56	680kΩ
R19	180kΩ	R57	680kΩ
R20	2·7kΩ	R58	1MΩ
R21	2·7kΩ	R59	1MΩ
R22	1MΩ	R60	1kΩ
R23	1MΩ	R61	1kΩ
R24	220kΩ	R62	180Ω 2W
R25	220kΩ	R63	180Ω 2W
R26	680kΩ	R64	150kΩ
R27	680kΩ	R65	150kΩ
R28	180kΩ	R66	1kΩ
R29	180kΩ	R67	1kΩ
R30	180kΩ	R68	1MΩ
R31	180kΩ	R69	1MΩ
R32	180kΩ	R70	2·2kΩ
R33	180kΩ	R71	2·2kΩ
R34	180kΩ	R72	1kΩ
R35	180kΩ	R73	1kΩ
R36	15kΩ	R74	100Ω 2W
R37	15kΩ	R75	100Ω 2W
R38	2·2kΩ	R76	10kΩ 1W

All Carbon, ½W, ±10%, unless otherwise stated.

Capacitors:

C1	16μF electrolytic 350V
C2	16μF electrolytic 350V
C3	16μF electrolytic 350V
C4	8μF electrolytic 350V
C5	0·02μF paper 500V
C6	50μF electrolytic 12V
C7	0·05μF paper 500V
C8	0·05μF paper 500V
C9	500pF ceramic 500V
C10	500pF ceramic 500V
C11	0·02μF paper 500V
C12	0·02μF paper 500V
C13	16μF electrolytic 350V
C14	16μF electrolytic 350V
C15	0·05μF paper 500V
C16	0·1μF paper 500V
C17	0·1μF paper 500V
C18	0·02μF paper 500V
C19	0·02μF paper 500V
C20	100μF electrolytic 12V
C21	100μF electrolytic 12V
C22	8μF electrolytic 350V
D23	8μF electrolytic 350V
C24	0·02μF paper 500V
C25	0·02μF paper 500V
C26	250μF electrolytic 25V
C27	250μF electrolytic 25V
C28	100μF } double can electrolytic 500V
C29	50μF } double can electrolytic 500V
C30	0·25μF paper 500V
C31	0·25μF paper 500V

Potentiometers:

VR1	250kΩ log	VR4	500kΩ log
VR2	500kΩ lin	VR5	500kΩ log
VR3	500kΩ lin		

Valves:

V1	EF86	V5	ECLL800
V2	ECC83	V6	ECLL800
V3	ECC83	V7	EZ81
V4	ECC83		

Sockets:

SK1	Coaxial panel type
SK2	Coaxial panel type
SK3	Coaxial panel type
SK4	Stereo pick-up
SK5	Stereo speaker
SK6	Stereo speaker
SK7	Mains connector, 3 pole

Transformers:

T1, T2 Push-pull output transformer. Primary 11kΩ, secondary to suit speaker. (Allen OP1348). Any conventional transformer for 6V6 or EL84 valves is suitable.

T3 Mains transformer. Secondaries: 250-0-250V 150mA; 6·3V 4A.

Miscellaneous:

FS1 Panel fuse

LP1 Panel pilot lamp 6·3V

S1 D.P.S.T./Q.M.B. on/off toggle switch

Chassis 7in. x 13in. x 3in. approx. Perforated cover. Wire, sleeving, tagstrips, bolts, grommets. Control knobs. Seven noval (B9A) valve holders.

A New Build-and-Learn Series—1

The "JUNIOR" Crystal Set

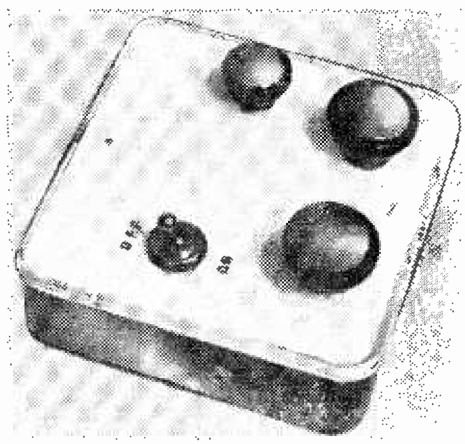
This series of receivers was designed primarily to give practical aid to students at an Evening Class. The circuits are unusual, but not novel. The final stage receiver is much more sensitive than most two transistor receivers, but is not more difficult to build.

The text is written for the young beginner and naturally more advanced readers will find some of the information superfluous. The author is sure that any beginner will be able to make this radio as a result of this article.

STAGE-BY-STAGE method of construction is adopted in this new series for the beginner. The design develops from a simple basic crystal receiver to an advanced two-transistor regenerative reflexed circuit for operation on long and medium waves. At the end of each stage the constructor will possess a fully-working receiver; he will, furthermore, have acquired a good understanding of the theory involved, since a simple description of how each circuit functions is given in addition to full practical details concerning components and wiring.

Much enjoyment will undoubtedly be obtained from the operation of each receiver in the series and for a time the beginner may be loth to embark on the modifications necessary to convert one model to the next design. However, in his own good time he can follow this series of articles through to the conclusion.

It is not recommended that earlier stages be 'short-circuited' in an attempt to build the final receiver as soon as possible. Beginners should adhere closely to the text and build and test out each stage in succession. In this way full benefit will be obtained from this "build and learn" series.



The final stage receiver complete.

The Components

The components and other materials required are given in the components list. All items could be obtained straight away; alternatively just those for the first stage circuit (see Fig. 3) and others acquired as the construction proceeds.

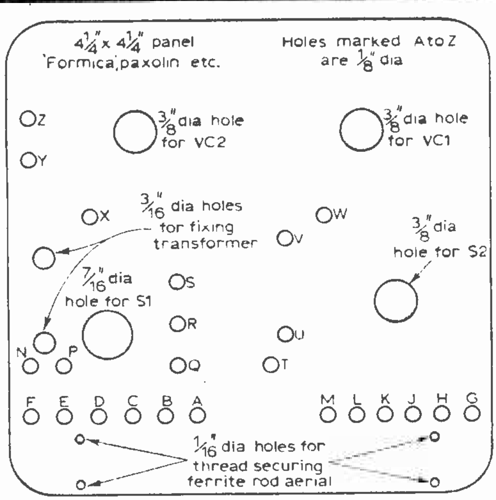


Fig. 1: Drilling details of the plastic board.

Commencing the Construction

A piece of Formica or similar plastic board is sawn with a tenon or hack saw to the size shown in Fig. 1. The edges are rounded and it is tried for easy fitting into the clear plastic sandwich box.

The holes for the reaction and the tuning capacitors must be so placed that the capacitors fit inside the plastic board but as near to the top of Fig. 1 as possible. The switch S1 is then measured and the hole drilled to suit (probably

$\frac{7}{16}$in.). A similar ($\frac{3}{8}$in.) hole is drilled for the rotary switch (S2).

Numerous small $\frac{1}{8}$in. holes and two $\frac{3}{16}$in. holes are then drilled as shown; great accuracy is not required. The holes are then lettered in pencil to provide a check when wiring up. The plastic board then appears as in Fig. 1.

Mounting the First Component

The tuning capacitor (VC1) is mounted as shown in Fig. 2(a) and secured with a lock washer and nut. A nut and bolt with two solder tags are then fitted to each $\frac{1}{8}$in. hole (that is those marked A to Z), three of these being shown in Fig. 2(a). The nuts are on the component side of the sheet and the heads on the "knob" side. The two tags fit together on the component side. Alternatively constructors may prefer to add the nuts, bolts and tags as they proceed stage by stage rather than fitting them all at the commencement.

The first working practical circuit and layout is shown in Fig. 3 and the tags needed are clearly shown.

Winding the L.W. Coil

Full details for winding the l.w. coil are given in Fig. 4 but only stage 1 is required now.

A small piece of postcard is cut to make a tube to slide easily over the ferrite rod and is held with Sellotape. Tie an identification knot in the loose

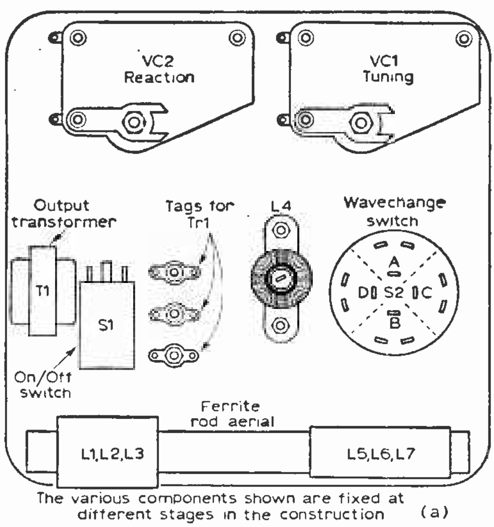
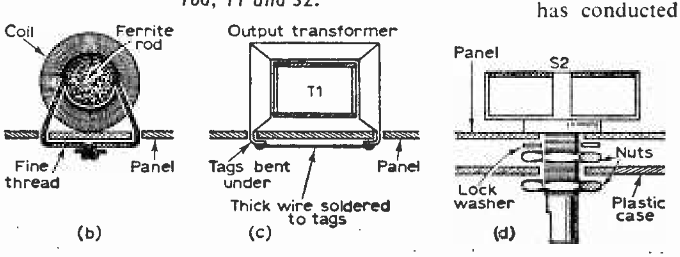


Fig. 2a (above): The positions of the major components.

Fig. 2b, c, d (below): Methods of mounting the ferrite rod, T1 and S2.



end of a reel of 32s.w.g. enamelled copper wire (do not pull this tight or the wire may break). Leave a few inches spare for connection later and then wind on 65 or 70 turns in as small a pile as possible. Then move over to make another similar pile $\frac{1}{4}$in. away wound definitely in the same direction. Wrap lightly with Sellotape to prevent

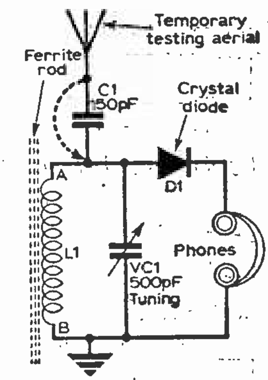
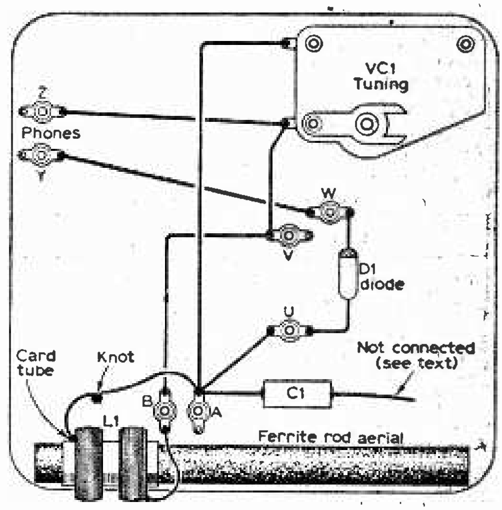


Fig. 3a (above): The first stage circuit.

Fig. 3b (below): Wiring for the diode receiver.



the coils coming loose. The knotted wire is "A" in Fig. 3, the unknotted end being "B". If the coil has been correctly wound the ferrite rod will slip nicely in and out of the coil at will.

Wiring the First Receiver

The beginner is advised to use only radio-type multi-cored solder and no other flux than that contained in the solder. Every connection point, both wire or tag, must be scraped absolutely clean and bright with a penknife and then tinned. The iron must be held on the part until enough heat has conducted to make this tinning perfect. Do not make any joint by piling on solder. If the tinning is not done properly a "dry joint" will result and the set will either fail to work or will be very noisy.

Thin covered connecting wire is used and only a $\frac{1}{16}$in. to $\frac{1}{8}$in. length is bared at the ends. No surplus whiskers of wire must be left sticking out

Fig. 4a: Stage 1 of construction of long wave coil.

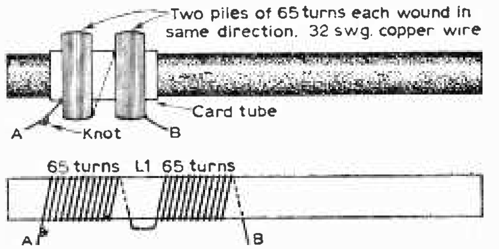


Fig. 4b: Stage 2.

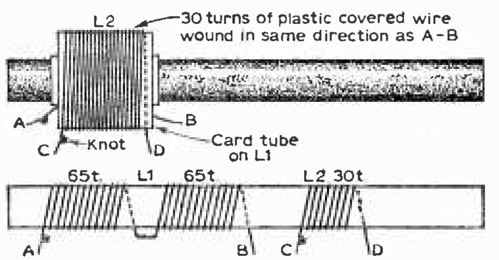


Fig. 4c: Stage 3.

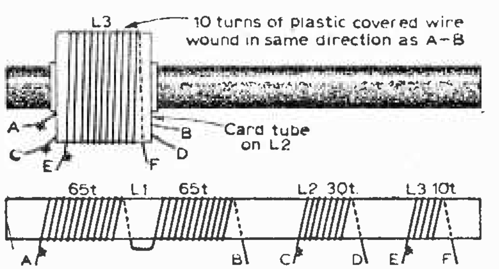


Fig 4d.: Stage 4.

of joints to cause unwanted and annoying shorts.

The following connections are made:

1. Tag B to V and on to moving vanes of VC1 (rotor).
2. A to fixed vanes of VC1 (stator).
3. A to U.
4. Moving vanes VC1 to phones tag Z.
5. W to other phones tag Y.
6. The coil ends are scraped of enamel and soldered to A and B respectively. Join also C1 to A.
7. The diode D1 is soldered in (either way round) between W and U.

Soldering Diodes and Transistors

Care is needed when soldering semiconductor devices such as diodes and transistors. Do not shorten the leads on these components to less than about 1in. Use a small instrument-type soldering iron and when this is fully heated apply the bit to the joint and complete the soldering operation as quickly as possible. It is a good idea to place a metal tool on the diode (or transistor) lead so that this conducts heat rapidly away and thereby

COMPONENTS LIST

A complete list of all the components required covering all stages of construction.

Resistors:

R1 150kΩ brown, green yellow
R2 10kΩ brown, black, orange
R3 47kΩ yellow, violet, orange
R4 2·2kΩ red, red, red
R5 100kΩ brown, black, yellow

Colour code: The colours given above read as follows: 1—band at extreme end of resistor, 2—second band, 3—third band.

All resistors are carbon composition, 10% tolerance, and ¼ or ½W.

Fixed Capacitors:

C1 150pF (0·00015μF) ceramic or mica
C2 0·1μF paper, any working voltage
C3 150pF (0·00015μF) ceramic or mica
C4 5μF electrolytic, 12 to 25V working
C5 25μF electrolytic, 12 to 25V working
C6 0·01μF paper, any working voltage
C7 100μF electrolytic, 12 to 25V working

Variable (Tuning) Capacitors:

VC1 500pF (0·0005μF) mica dielectric } (Radio-
VC2 300pF (0·0003μF) mica dielectric } spares)

Ferrite Rod:

Rod, preferably ⅜in. diameter, and at least 4in. long, although the longer the better. A ¼in. diameter rod could be used, but the results would be somewhat inferior.

Inductances (Coils):

L1, L2, L3 are coils (Long Wave) wound on the ferrite rod.
L5, L6, L7 are similar Medium Wave coils.
L4 is a small home-made high frequency choke.

Wire for these coils: 2oz. of 26s.w.g., 2oz. of 32s.w.g. enamelled copper wire, and a few yards of *thin* plastic covered connecting wire.

Coil Former: ¼in. diameter by 1¼in. high, with a few ferrite cores (an old T.V. set will supply this).

Transistors:

Tr1 OC44, first grade, not surplus.
Tr2 Preferably OC81, but an OC72 will do.
D1 Germanium diode, OA70, OA81.

A.F. Transformer:

T1 Radiospares T/T3, ratio 3·3 : 1.

Switches:

S1 Toggle type, on/off.
S2 Rotary type, single wafer, four-poles, two-ways.

Battery:

B1, 9V Exide DT3 or Ever Ready PP3

Miscellaneous Items:

3 doz. 6 B.A. nuts and bolts, ½in. long is sufficient. 3 doz. solder tags to suit. Cored solder. Thin, plastic covered, coloured connecting wire. Knobs. Plastic sandwich box, approx. 5in. x 5in. or 5in. x 7in. if a miniature speaker is to be fitted later. Phones: ex-Govt. DLR type (reed type) are best, but crystal insert can be used. Battery connectors. Laminated plastic sheet, 5in. x 5in.

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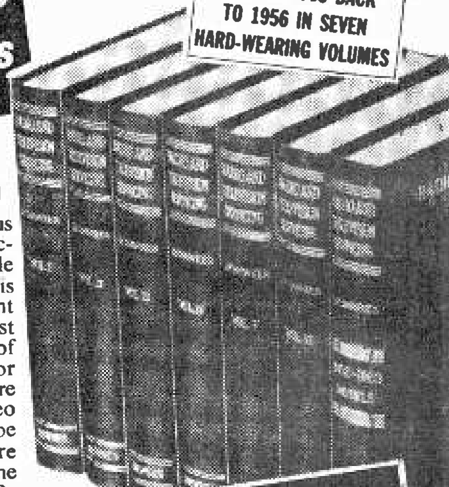

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prevents the component becoming heated. *Excessive heat can cause serious damage to semiconductor devices.* Do not allow the iron to approach near the diode or transistor body.

A pair of pliers can be used as a "heat shunt" in the manner shown in Fig. 5.

Testing the First Circuit

At this stage the circuit is a simple diode receiver as shown in Fig. 3(a) and it may be tested as follows. For this test an aerial and earth is required, although when entirely completed the receiver will be fully portable and no external aerial or earth will be needed.

A wire is taken from a water tap (or other good direct earthing point) and connected to tag B. About 100ft of wire is temporarily erected in the garden (or slung backwards and forwards across the loft) and one end is connected to A. A pair of headphones are connected to the labelled tags (Fig. 3). The ferrite rod is placed so that it is almost entirely *out* of the coil. The tuner capacitor VC1 is fitted with a knob and is adjusted so that the vanes are fully open.

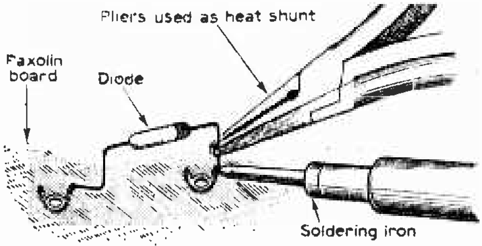


Fig. 5: Using a pair of pliers as a heat shunt during soldering.

If all is well the Light Programme (Droitwich, long wave) will be heard on 1,500m. It may be tuned by moving the capacitor VC1 vanes and/or the ferrite rod in the coil L1. If this station is not received the circuit has not been correctly wired or a joint has been incorrectly made or a component is faulty.

Component Testing

Simple continuity and installation checks can be performed with the aid of a small battery and a flashlamp bulb. Fig. 6 illustrates the use of such equipment to check a variable capacitor and an inductance.

If the capacitor is in good order no light will appear in the lamp. The spindle should be turned to and fro during the test. If the lamp does light this indicates that the moving vanes (rotor) and the fixed vanes (stator) of the capacitor are touching.

This fault will be due either to mechanical misalignment of the two portions of the component or to one or more of the vanes having become bent.

Another cause of intermittent contact between the two sections of the capacitor could be the presence of dirt and dust containing metallic particles. Second-hand components in particular should be carefully examined and cleaned if necessary with a feather or pipe cleaner.

When the test is applied to the inductance—see Fig. 6(b)—the lamp will light, although maybe not at full brilliance. No light from the lamp indicates an "open-circuit" coil and the break in the wire must be located and repaired if possible.

The tests described are simple yet effective. Furthermore, the principles involved are basic to those more elaborate methods of testing that you are likely to encounter as your experience increases.

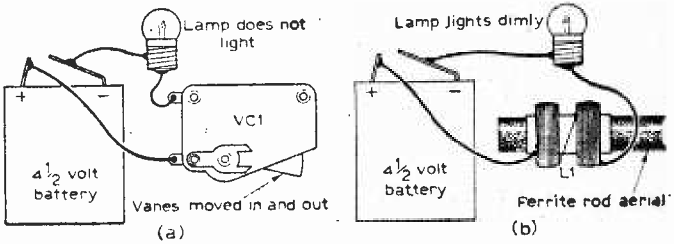


Fig. 6a: Testing the variable capacitor, VC1; b: testing the coils.

A Further Test of the Fist Circuit

When testing you will note that the ferrite rod had to be almost out of the coil and VC1 almost open. This means really that the coil L1 has been made too long: this is deliberate because later on no *external* aerial is to be used.

If reception in the first test was reasonable (and at Bognor Regis in Sussex and in London it was exceptionally good) remove the aerial from A and connect it temporarily to the spare end of C1 (Fig. 3).

Place the coil somewhere near the centre of the ferrite rod and tune with VC1. Now the tuning will be sharper (selectivity better) and the vanes will be almost but not quite in. If they have to be put right in then either you have made L1 too small or VC1 is of a lower value than 500pF (sometimes expressed as 0·0005μF).

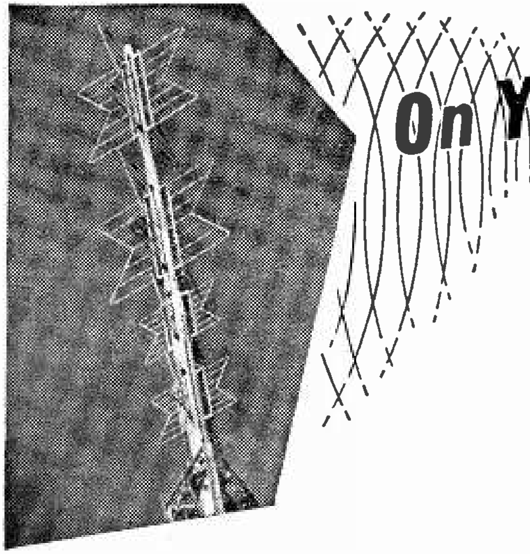
Purpose of the Parts in this Circuit

L1 and VC1 form a "tuned circuit" which resonates (like piano strings do) at certain frequencies according to the setting of VC1. The aerial receives most frequencies, the one tuned by VC1 will set up oscillations in L1 and these are rectified, i.e. converted into pulsating d.c. by the diode D1. This d.c. "audio" signal is fed to the phones and causes magnetism in them to fluctuate so the diaphragms are moved and produce sound waves.

No r.f. (radio frequency) bypass capacitor is required as the windings on the phones will bypass sufficient r.f. to earth due to their self-capacity.

The ferrite rod increases the inductance of the coil, which would otherwise have to contain many more or larger turns of wire.

TO BE CONTINUED



On Your Wavelength

By THERMION

A SHORT time ago I commented on the apparent lack of initiative of those beginners who never venture beyond assembling radios bought in kit form, and I suggested that they were missing an awful lot by not shopping around for the individual parts.

Mr. Ken Greenberg, of Chicago, U.S.A., agrees in principle with me and in an interesting letter recalls his own first attempts at radio construction in the mid-thirties. He does, however, suggest (regretfully) that a youngster "... would be foolish to try and build something today by going out and buying the various parts needed from individual parts houses. In this country, anyhow, gone are the helpful clerks and shop owners of years ago. In fact most store owners are noticeably disturbed when a kid comes in for 'just a few resistors'."

Thus it seems so far as the U.S.A. is concerned the good old days of radio construction are something to be mourned, just another victim of the increasing tempo of present day life. However, I think it would be generally agreed that such a state of affairs has not yet developed in this country. Traditionally we have been more inclined (or perhaps compelled) to build our own equipment; on the other hand it is true that commercial equipment partly assembled, or in kit form is becoming more commonplace, and some will say that already "the writing is on the wall".

Components for All

Surely, as long as there is a real demand for components, component shops will continue to cater for the individual, even if he only wants a 47k. The abundance of ex-Government and ex-Manufacturers' surplus equipment and components would seem to be an assurance against the disappearance of the component shops through non-availability of cheap parts.

As regards to the attitude of the man behind the counter, it would be idle to pretend than in all cases he is eager and willing to solve beginners' problems, but—and this is part of my argument in favour of "shopping around"—it does not take long to learn to discriminate between the obliging and knowledgeable shopkeeper or assistant, and the merely mercenary merchant who can't be bothered.

The Kit Danger

One does not become a radio constructor merely by wiring up a transistor radio kit, any more than one becomes a carpenter by glueing together a factory prepared set of legs and a piece of plywood to make a coffee table. Here I must make it clear that this does not refer to the "build and learn" type of kit, which is intended for educational purposes and is accompanied with a printed text giving full instructions and explanations. Such kits are generally very useful teaching aids.

As I see it, a serious objection to the proliferation of kits is that scores of people not having any interest in radio theory or design are induced to purchase a transistor radio kit simply because they hope to save a few pounds as compared with the cost of a commercially made receiver. One hears of the lack of interest, or even hostility of shopkeepers when such a purchaser returns to explain his trouble. I refuse to believe that radio shops nowadays are staffed only by sales automatons. What I think is likely is that the patience and good humour of many radio salesmen has been dissipated over recent years by the vast numbers of uninformed, inexperienced customers they have had to deal with. Such people devoid of any knowledge of electricity or radio take on the construction of, say, a multistage transistor radio of Lilliputian proportions, the set refuses to work first time (nothing particularly unusual here, as every experienced constructor knows) but the clueless ones do not know where to look and what simple tests to apply. Thoroughly disheartened, all they can do is return to the shop and burden the salesman with their tale of woe.

Prudent Selling

Coming now to the crux of the matter, has not this state of affairs been brought about largely by the retailers who "push" these kits. Perhaps a little advice to the intending purchaser if he seems to be considering something rather too ambitious for his apparent talents would pay in the end. The immediate cash reward for the sale of a simpler and cheaper kit might not be too appealing—but the greater chance of a happy and satisfied customer with no subsequent complaints or bewildering faults to sort out must surely count for something on the credit side.

A basic stabilised POWER PACK

By P. Cairns

This unit will provide a steady d.c. supply from either 150 to 260V or 190 to 310V.

AN extremely useful piece of equipment for the amateur workshop is a stabilised power pack. Where any serious experimental work is carried out such a unit is almost a necessity. Stabilised power units are also much used for supplying oscillators, transmitter v.f.o. and buffer stages and any other apparatus where frequency stability is at all dependent upon a constant h.t. voltage.

Inexpensive and Reliable

The unit to be described has the advantage of being both inexpensive and reliable. It may be built up as an entirely new unit or an existing power pack may be modified.

Performance Details

The purpose of any stabilised power unit is to provide a steady d.c. output which remains constant despite any reasonable variation in input voltage or load. This h.t. voltage should also be capable of variation over a specific range and have a low ripple content. In the power unit described the specification is extremely good. The h.t. voltage is variable over the range 150V to 260V or 190V to 310V depending upon the value of R9, with an h.t. stability factor of ±0·5% for variations in load current between 0-100mA, and a stability factor of less than 1% for variations in supply voltage of ±10%. Ripple value is less than 25mV at 250V

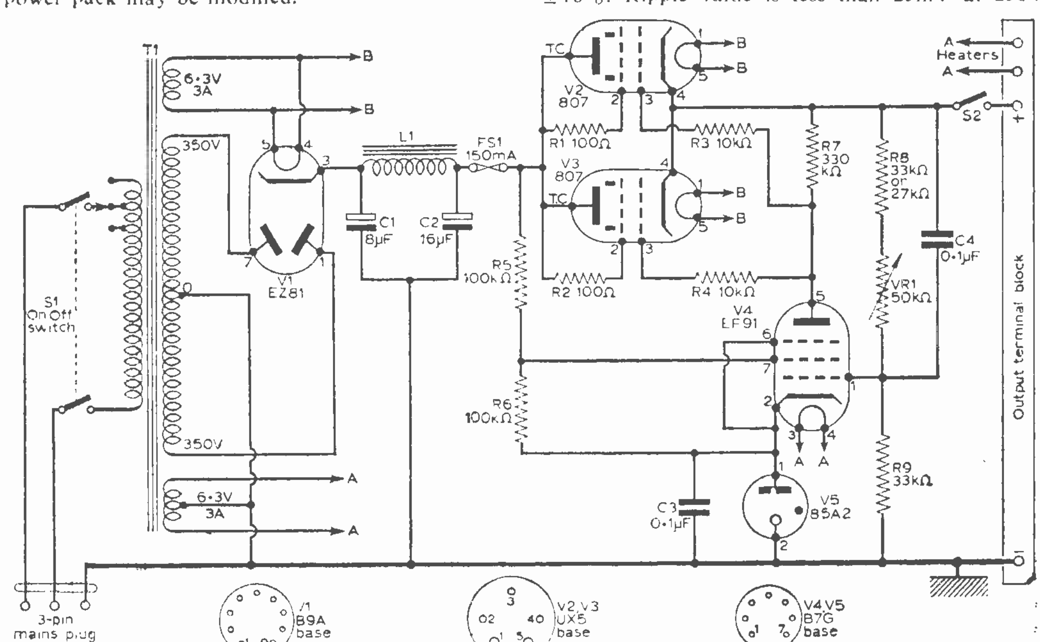


Fig. 1: The circuit diagram of the power pack.

with a 50mA current drain, i.e. ripple factor is better than 0·01%.

If a smaller current output is required, that is, if lighter loads are anticipated, a smaller VA transformer can be used and one of the series stabliser valves omitted. Thus, using a transformer having a 60mA secondary and with V2 omitted the rest of the circuit and

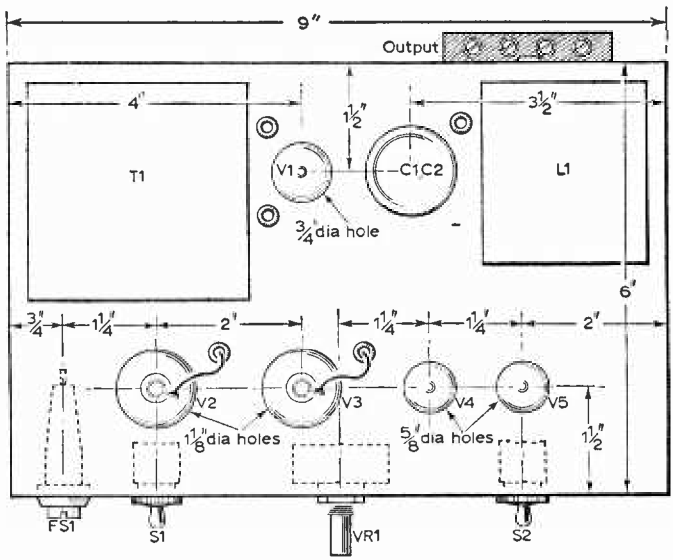


Fig. 2: An above-chassis view of the unit.

specification remains the same except that a load current of only 50mA is available.

As can be seen from the circuit diagram in Fig. 1, the front end of the unit is comprised of a standard mains transformer and full wave rectifier V1. The positive output is taken from the cathode of V1, via the smoothing circuit and fuse, to the stabilising circuit. Switches are included in both mains and h.t. circuits. A conventional type LC smoothing circuit is used, L1, C1 and C2, further smoothing being carried

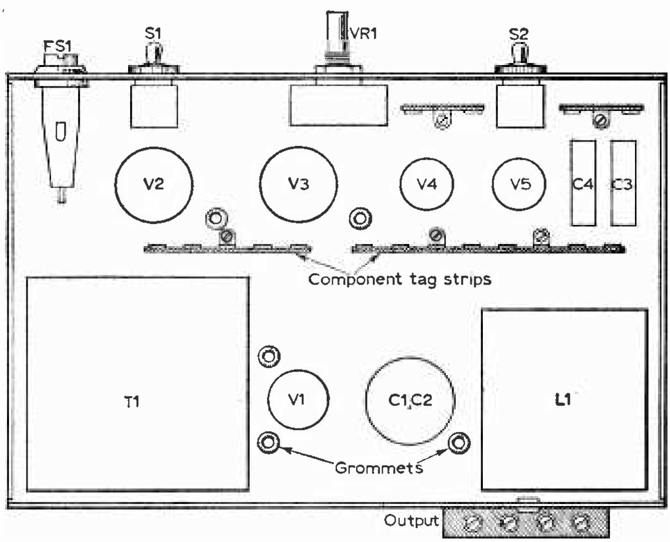


Fig. 3: The under-chassis layout of components.

out by the stabilising circuit which "sees" the h.t. ripple simply as variations in the mean h.t. voltage level and immediately compensates for these variations. The result is an extremely smooth h.t. supply with a ripple value well below that of the average power unit and LC filter.

The Stabilising Circuit

The stabilising circuit is composed of two series stabiliser valves, V2 and V3, in parallel, the amplifier V4 and the neon reference tube V5.

The amplifier V4 is connected as a high-gain pentode, its cathode being maintained at a constant voltage (about 85V) by means of the reference neon V5. The grid of V4 is connected to the lower junction in a chain of resistors, R8, VR1 and R9, the grid voltage being variable over a limited range by means of VR1. The output from V4 anode is taken to the grids of the series stabiliser valves. A closed feedback loop is therefore formed, from h.t. line to V4 grid, from V4 anode to V2, V3 grids, then back to the h.t. line, the common reference point being the cathode voltage of V4 which remains constant despite any changes in h.t. voltage or current.

The action of the stabiliser circuit is self compensating and quite simple to follow.

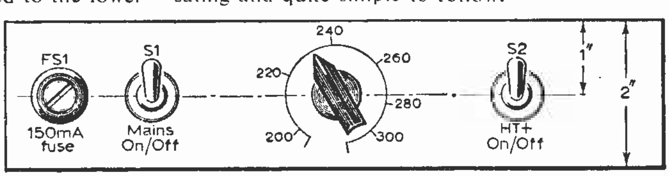


Fig. 4: The front panel of the unit.

Assume a sudden increase in load. the voltage across the resistor chain R8. VR1 and R9 will drop, V4 grid voltage will therefore drop and go more negative with respect to the cathode which is fixed. This tends to cut V4 off, reduces anode current and therefore reduces the voltage drop across the anode load resistor R7. The anode will now go positive (towards h.t.) and as this is d.c. coupled via the grid stoppers R3 and R4 to the grids of V2 and V3, these grids will go positive. The current through these valves will therefore increase and compensate for the extra load being delivered.

The action described is. of course. instantaneous. For a sudden decrease in the load current the action is reversed. Variations in input or mains voltage result in a similar reaction. The cathode of V4 is decoupled by C3 and the grid by C4. this further reducing ripple by increasing the time constant of the grid circuit and also obviating any tendency for V4 to oscillate. The small stopper resistors in the screens of the stabiliser valves are to prevent parasitic oscillation.

Increasing the Current Supply

The value of load current which can be taken is limited only by the maximum anode current and dissipation ratings of the series stabiliser valves. assuming. of course. that an adequate transformer is used. If therefore a larger current supply is required. an extra stabilising valve (or valves) is simply connected in parallel with those already in use without any other circuit alterations being necessary. the VA of the transformer being increased to suit.

The writer has used up to ten valves in parallel when a stabilised supply of 500mA was required.

Though there are many types of valve which can be used as series stabilisers. including special types designed for this specific purpose (KT55. 12E1, etc.). most large output valves with a high maximum. The stopper resistors R1 and R2 should be relatively low ra value are suitable. the valves being triode connected as in the circuit shown. Here 807 valves were used as they are a common type used by many amateur constructors and can be bought on the surplus market for a few shillings.

Practical Layout

The author's unit was originally designed to be added to an already existing power pack. Should a suitable type of power pack be already available the stabilising circuit can either be built on the existing chassis or if insufficient space is available, built on a separate sub-chassis.

A suitable layout for a complete unit is shown in Figs. 2 and 3. all relevant dimensions and layout being shown. The layout is not at all critical. tagstrips being used at convenient points for mounting components. The amplifier V4 and its associate circuitry should be kept reasonably clear of mains and transformer leads to keep pick-up to a minimum. The stopper resistors R1 and R2 should be connected directly on to the appropriate valve base pins.

Though the prototype unit had the controls mounted on the chassis front plate. a separate front panel can be made if required. this will facilitate rack mounting.

The Mains Transformer

Two heater windings, both 6·3V, are required. One is for the rectifier and series stabiliser valves, the other is the main centre-tapped supply for external use, V4 also using this supply.

The separate unearthed heater winding is necessary for the rectifier and series valves as the cathodes of these valves are all up at h.t. potential. and if a common earthed supply were used for all the valves. heater cathode insulation breakdown could occur in the rectifier and series valves.

The output supplies may be brought out to a four-way terminal block or to a multi-pin output plug or socket. Two ranges of voltage output are available. these being dependent upon the value of R8 which simply determines the maximum bias level obtainable on the grid of V4 by means of VR1. Suitable values for R8 are shown in the components list.

When the unit is complete and the wiring checked. the variable voltage control VR1 can be calibrated.

With the unit switched on and an external load connected. connect a d.c. voltmeter across the positive and negative output points. Turn VR1 to its earthy end (maximum output voltage) and mark the value with marking ink on a suitable scale. If a pointer knob is used. the calibration points can be marked on to the chassis itself. The control is then turned in the opposite direction and the voltage calibration points marked at appropriate intervals. say every ten volts, until the minimum value is reached.

The unit is now ready for use and should prove extremely useful and reliable over a long period while requiring but the minimum of attention. ■

COMPONENTS LIST

Resistors:

R1	100Ω	R6	100kΩ
R2	100Ω	R7	330kΩ
R3	10kΩ	R8	33kΩ for 150-260V range
R4	10kΩ		27kΩ for 190-310V range
R5	100kΩ	R9	33kΩ

All 10%, ½W carbon

VR1 50kΩ wire-wound potentiometer

Capacitors:

C1 8μF electrolytic 500V
C2 16μF electrolytic 500V
C3 0·1μF paper 350V
C4 0·1μF paper 350V

Valves:

V1 EZ81
V2, V3 807
V4 EF91, Z77 or 6AM6
V5 85A2

Switches:

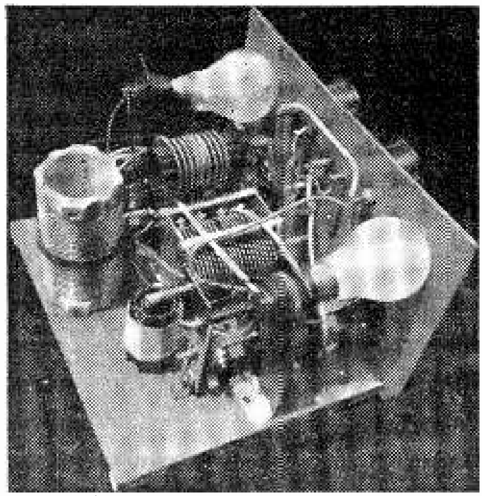
S1 D.P.S.T. toggle
S2 S.P.S.T. toggle

Miscellaneous:

L1 Smoothing choke 10H 100mA
T1 Mains transformer. Secondaries: 350-0-350V 120mA; 6·3V 3A; 6·3V 3A centre tapped
FS1 Cartridge fuse 150mA
Valveholders: one B9A, two UX5; two B7G with screening cans. Four-way terminal block. Pointer knob. Tagstrips and grommets.

AN ALL BAND AERIAL TUNER

by F. G. Rayer



THE simplest form of transmitting aerial capable of being used on all bands from 160 to 10 metres is the end-fed wire, and some type of aerial tuner is practically essential for operating this kind of aerial. The tuning unit described here is suitable for transmitters of up to 150W input on 80—10m, and 10W on 160m.

To facilitate testing without using the aerial, lamp loads are provided, and prove very useful for those checks which can be made with an artificial aerial.

The tuner circuit is shown in Fig. 1, and all types of working are selected with switches. Switch sections S1A and S1B are on a single spindle (2-pole 6-way) and have the following positions:

(1) Transmitter (or receiver) directly to aerial.
(2) Link coupling to 10 and 15m coil.
(3) Link coupling to 20 to 80m coil.
(4) Link coupling to series tuned 160m coil.
(5) Transmitter to 75W lamp.
(6) Transmitter to 15W lamp.

The 15W (LP1) lamp is intended for low power transmitters, and the top band transmitter, where the power limit is 10W. The 75W lamp (LP2) may be replaced by a 40W, 60W or 100W lamp, if preferred, in accordance with the r.f. power expected from the 80—10m transmitter. The lamp loads are suitable for many tests, such as modulation, tuning up exciter and driver, etc. Lamps are not satisfactory when a transmitter is being keyed, but can, of course, take the output of a c.w. transmitter being tested without keying. Use of the lamps avoids unnecessary interference to other stations.

Switch wafers S2C and S2D are a 2-pole 5-way unit, with the following positions:

(1) Parallel tuning of 10—15m coil.
(2) 20m parallel tuned.
(3) 40m parallel tuned.
(4) 80m parallel tuned.
(5) 160m series tuned.

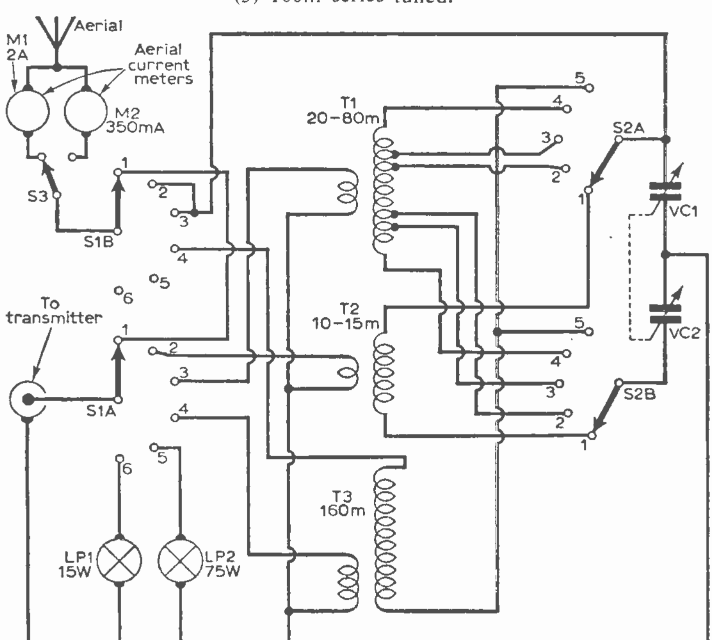


Fig. 1: The circuit of the aerial tuner.

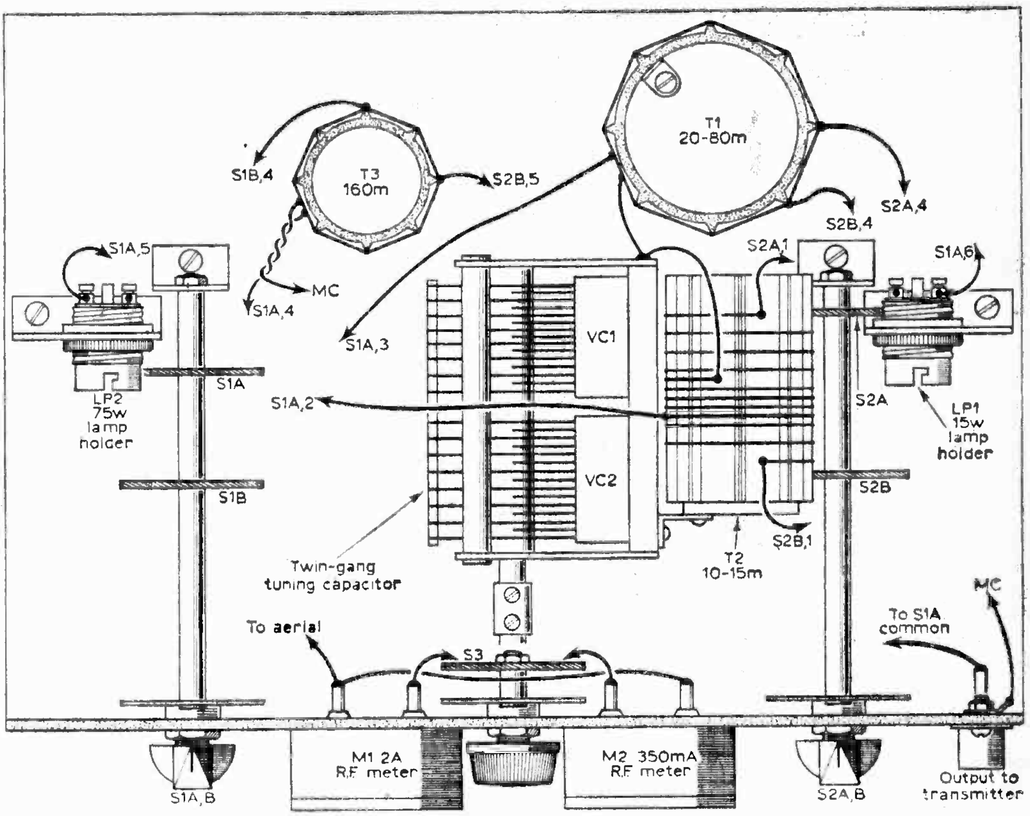


Fig. 2: Above-chassis layout of components.

The 10—15m coil (T2) is separate from the 20—80m coil in order that suitable link windings can be provided, as it is not easy to use a link giving suitable coupling from 10—80m on a single coil. As the aerial was a half-wave on 80, parallel tuning is in order from 10—80m. VC1 and VC2 are sections of a 2-gang 150pF wide-spaced capacitor.

As the aerial length is a quarter-wave on 160m, series tuning is necessary on this band. Position 5 on switch S2 places VC1 and VC2 in parallel, to obtain enough capacity, the capacitor being at the bottom end of the 160m coil (T3), in the usual way.

Switch S3 is a single pole 2-way unit, selecting 2A (M1) and 350mA (M2) r.f. meters, to show aerial current. The purpose of these meters is to give immediate visual indication that the transmitter is radiating its accustomed signal. With a given aerial, any increase in aerial current will correspond to an increase in the radiated signal, so the readings are useful when adjusting drive or other conditions. The use of either meter allows both low and high power transmitters to be connected to the tuner, and also covers those circumstances when the aerial impedance is relatively low on some bands.

The switch S1 is used to select 10—15m, 20—80m, and 160m links, as appropriate. Position 1 on this switch gives straight through working, which is useful when checking over the bands with the receiver, or listening on frequencies not covered by the coils. With some transmitters and aerials, the transmitter may be loaded directly by the aerial, but with many aerials this is impossible, and will in any case result in more harmonic radiation.

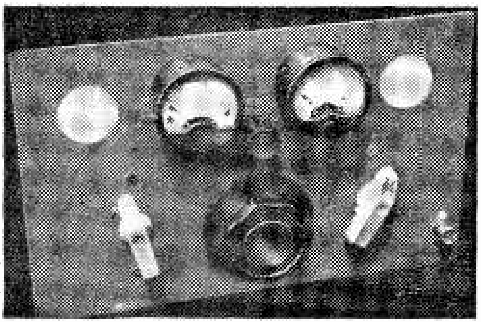
Layout and Coils

Fig. 2 shows the layout adopted, which provides quite short leads in the tuned circuits. The switches are large, heavy duty types, unwanted contacts being ignored. Each switch is supported by a bracket at the back, to increase rigidity.

The 2-gang capacitor has a short extension spindle. A hardboard front panel is used, to avoid the need for extra insulation for the meters. A coaxial socket on the panel receives a plug, a few feet of 75Ω coaxial cable being used between transmitter and tuner.

The 10—15m coil (T2) is wound on an 8-ribbed former, 1¼in. in diameter across the ribs. Eight turns of 14s.w.g. wire are used, spaced to occupy 1¾in. The link is two turns of well insulated wire, wound over the centre of the eight turns. The coil is supported by a paxolin strip held by a bracket to the gang capacitor.

The 20—80m coil (T1) is 2½in. in diameter. notched to take about 8 turns per inch (Eddystone 2½in. x 5in. frequentite). The winding is 26 turns of 20s.w.g. wire. Tappings C3 and D3 are six turns from each end. Tappings C2 and D2 are four turns from tappings C3 and D3. The link is three turns of well insulated wire. This coil is fixed vertically by means of a bracket screwed to the baseboard.



The finished aerial tuner.

For 160m (T3) the coil is 1½in. in diameter, and has 48 turns, side by side, of 24s.w.g. wire. The link is overwound at the "earthed" end of the coil, and consists of eight turns.

Other coils can be satisfactory, and the number of turns can be adjusted as required, to suit the aerial, transmitter, or capacity of VC1 and VC2.

Strips of paxolin 6in. long and 1½in. wide are cut to take ordinary pendant holders. Each strip is held vertically by a bracket, so that the bulbs are pressed against 1½in. holes in the panel.

Terminals are fitted for Earth and Aerial, the latter terminal being supported on an insulated strip. These leads pass out of the back of the tuner cabinet. The complete cabinet was 12in. wide, 7½in. high, and 9in. deep, inside measurements, but dimensions can easily be changed to suit any fairly large case or box available.

Notes on Working

An aerial of about 138ft., this being a single uncut wire. forming both top and down-lead, will be satisfactory. All parts of the aerial should be as far from earthed objects as possible. This, and similar lengths. will take parallel tuning on all bands except 160m. Here, series tuning is used.

If 160m is not required, the 160m coil can be omitted. If space is not available for 138ft. then half this length will give parallel tuning on 40—10m. with series tuning on 80m.

The tuner is in use for reception as well as transmission (except for switch position 1) and this will increase receiver signal strength where the receiver has a 75Ω or similar input. If the tuner is to be omitted for reception, the receiver/transmitter aerial relay or switch is removed from the transmitter side of the tuner, to the aerial side.

If an aerial giving some intermediate impedance is used, this may need tapping down the coils, for correct loading. If so, the switch S2 will need an extra wafer, to avoid moving clips by hand. ■

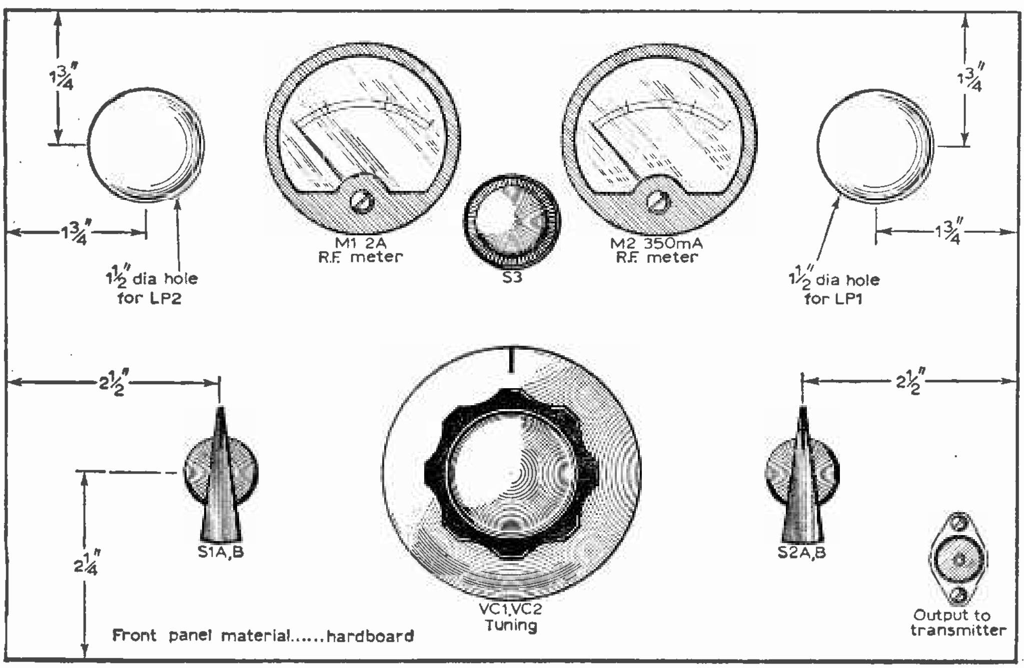
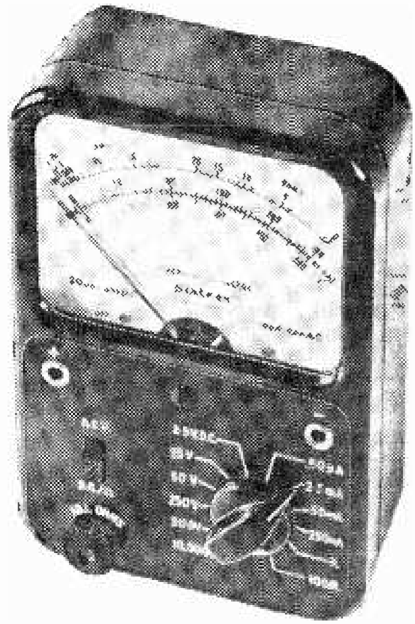


Fig. 3: Layout of controls and meters on the front panel.

Audio Testing with the "PRACTICAL WIRELESS" "Sixteen" Multirange METER



WITH the aid of a good meter, practically all the tests for "goodness" can be made on domestic equipment. True, there are a number of specialised measurements, and those involving frequency change, phase comparison, etc., where an oscilloscope is the obvious instrument to use. But, even audio equipment, with its need for stringent frequency response limitations and low hum and distortion figures, can be dealt with, using the high resistance a.c.-d.c. meter, such as the P.W. "Sixteen", and sufficient patient application.

The following notes are practical workshop methods of carrying out operating tests on audio equipment, from the humble record player to the hi-fi, stereo tape recorder. Some of the points are common to most domestic equipment, and will receive only brief mention. Reference should be made to the previous article (February PRACTICAL WIRELESS) and to the "Typical Tests" given on the back of the PRACTICAL WIRELESS "Sixteen" blue-print.

The Record Player

The simplest type of record player consists of a one-valve amplifier, with the valve heater fed from either a mains dropping resistor, a motor winding, or from a tapping on a transformer. H.T. may be provided by a small, contact-cooled metal rectifier, either half-wave connected through a surge limiting resistor from the mains, or full-wave (or bridge) connected from a transformer winding. A typical circuit of the former type is shown in Fig. 1, with test points arrowed.

First test is for a.c. to both motor and amplifier, proving the double-pole switch.

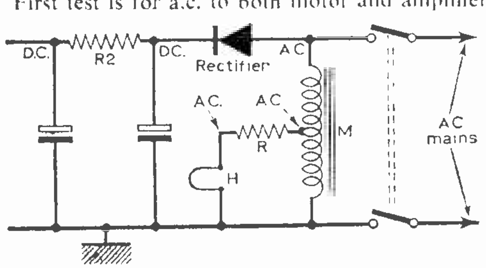


Fig. 1: Power supply circuit of a simple record-player, showing test points.

IMPORTANT NOTE CONCERNING BATTERIES

Attention is drawn to an error in the battery references on the blueprint of the P.W. "Sixteen" Multirange Meter (included in the January issue).

The theoretical circuit (Fig. 1) shows the batteries correctly: B1 15V battery (B121); B2 1·5V cell (U10).

The circuit references B1 and B2 should be transposed in the Components List, also in Fig. 3, upper portion only relating to SIC tag 9 and tag 10.

The last paragraph but two on page 813 should be amended in a similar manner.

Next, the voltage at the tapping point of the motor windings should be checked, and, if a limiting resistor is included, as in Fig. 1, the voltage at the "hot" side of the valve heater. The difference between these last two readings enables us to compute the valve heater current also by using Ohm's Law—having first made a resistance check of the limiting resistor, of course.

From this point, we go to the h.t. from the rectifier, and thence to the h.t. applied to the system. Again, the difference between these two readings gives the voltage drop across R2, and enables us to calculate the h.t. current. Thus, by making two or three quick tests with the multimeter, disturbing nothing in the circuit, we have a pretty good idea of the "health" of the record player. From there fault-finding procedure is a matter of simple elimination.

Audio Amplifiers

First tests on audio amplifiers are again: h.t. and l.t. voltages.

In general, rectifier circuits will be full-wave with the anodes fed from outer ends of a centre-tapped secondary winding of the mains transformer. Voltages used on many audio amplifiers are considerably higher than on the average radio or television receiver: a 500-0-500V secondary is by no means unusual. Care must be exercised when taking these measurements, and the highest voltage range must be employed, with one side of the meter returned to chassis, or centre-tap. The basic circuit may be as shown in Fig. 6 of the blueprint published in the January 1964 issue of PRACTICAL WIRELESS.

Quite wide variations may be found, however, and voltage readings can be misleading unless the exact circuit is known. For example, one method of hum reduction is as shown in Fig. 2.

Here, the centre-tap of the h.t. secondary of the mains transformer is not returned directly to chassis, but is applied, via a variable resistor VR to the heaters of pre-amplifier valves, or valves in the early stages of the amplifier. The h.t. current then passes through the heaters and VR is adjusted to provide the correct energising current. The centre-tap is thus negative to chassis. This negative voltage may also be used as a convenient source of bias. The electrolytic capacitor C will invariably be found and acts as a bypass to the low frequencies and as a bias filter component.

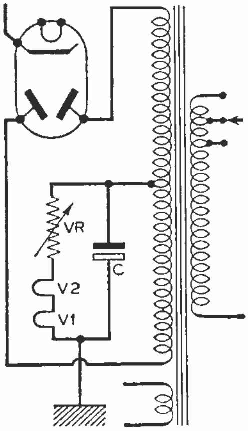


Fig. 2: Full-wave rectifier input to audio amplifier, with hum-reducing heater connection.

When measuring a.c. applied to the rectifier anodes of this type of circuit, one side of the meter should be taken to the centre-tap, rather than to the chassis. A further reading of the d.c. between chassis and centre-tap then gives an indication of the h.t. current being drawn.

Hum Cancelling Arrangements

The circuit of Fig. 2 was used on a number of earlier amplifiers. Modern equipment often employs a different method of heater hum reduction, by energising the heaters from a low-voltage secondary winding of the mains transformer, (a.c.), and applying a slightly positive potential, either from a "bleeder" across the h.t. or from the cathode of an output stage. The purpose of this device is to attract random electrons back to the heater, now at a slightly higher potential than the cathode. Allowance for this positive d.c. voltage must be made when taking a.c. heater voltage measurements on circuits of this nature.

A more usual, hum-reducing circuit is the balanced heater line. A potentiometer, usually consisting of a wire-wound variable resistor with slider connected to chassis, is connected across the heater supply, acting as a "humdinger". Fig. 3, which is an illustration of the power pack of a well-known amplifier, demonstrates this method.

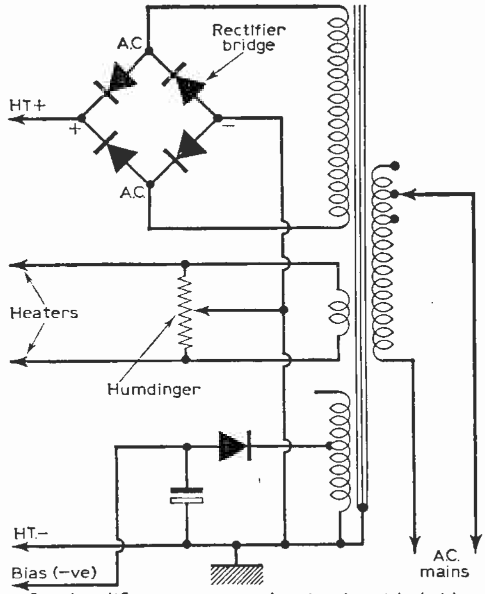


Fig. 3: Amplifier power supply circuit with bridge-connected full-wave rectification, balanced heater supply and separate bias source.

Also notable in this circuit is the use of a bridge-connected metal rectifier for h.t. supply and the rectified negative bias supply from a further secondary tapping.

Hum is a very real problem in audio amplifier design, as most constructors are well aware. One way of checking the filter circuits with the aid of a meter is to use an a.c. meter with an isolating capacitor, as in Fig. 4. The "hot" side is applied to points A, B, and C in turn, with no signal and under maximum signal conditions. A considerable reduction in readings should be noted from A toward C.

D.C. Balance of Output Stages

Perhaps the most stringent condition as regards use of the meter apply at the output end of any audio amplifier. Whilst it is important that earlier stages should be in order to eliminate spurious hum pick-up, noise and some distortion, it is in the output section of the amplifier that the greatest care is needed with trouble-shooting. Push-pull output stages of conventional design are especially

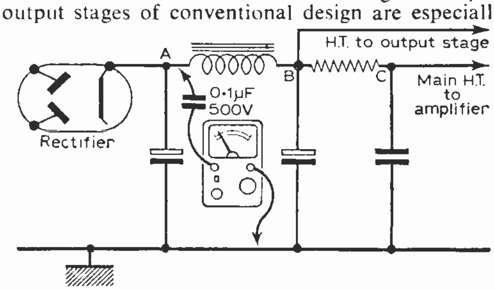


Fig. 4: Rough check for hum level in smoothing circuits.

critical: it is essential that they are exactly balanced, with the current in each half-section of the output transformer primary equal and opposite.

The bias of each valve is adjustable over a limited range by a balance control, so that from the d.c. aspect, this circuit may be considered as a balanced bridge. This is clearly seen in Fig. 5, where it will also be noted that each valve has a separate cathode resistor.

Adjustment of the balance control should enable the d.c. currents through the two valves to be equalised. This can be checked by connecting the meter across the transformer primary, as shown, and adjusting for zero reading. It may be necessary to reverse the meter when making this adjustment, to ensure that the correct zero reading is obtained.

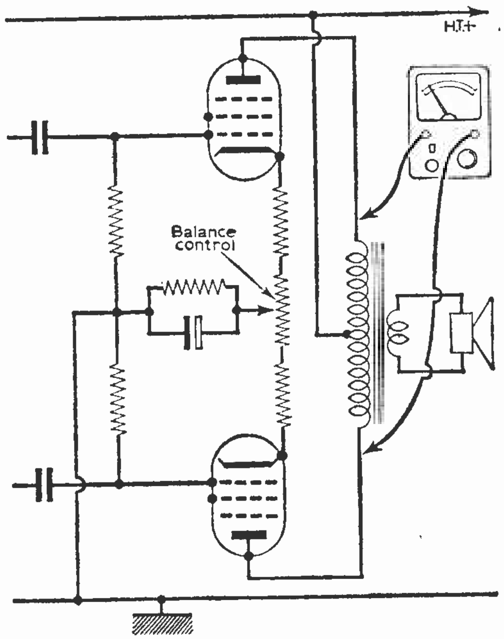


Fig. 5: Push-pull output stage balance adjustment.

If the meter indicates a low standing voltage, this may be caused by a low emission valve, and can be proved by transposing the two valves, when the standing voltage should reverse polarity. If it stays the same, suspect the cathode bias resistor or one of the coupling capacitors from the previous stage. A coupling capacitor with poor insulation resistance will tend to neutralise the negative bias and increase current through the particular valve it feeds. This condition seldom remains static, the usual result being a steady deterioration, increase in distortion and eventual over-running of the valve, which often shows signs of distress by glowing red.

Loudspeaker Phasing

Troubles at the output are usually the result of mis-matching of loudspeakers to the transformer, especially where more than one loudspeaker is used.

A lack of bass will often indicate that speakers have been connected out of phase. This can be checked by first disconnecting the speakers, then applying a d.c. voltage from a low impedance source (a torch battery is sufficient). Note whether the loudspeaker cone pulls in when the connection is made—do not maintain the connection—and mark the polarity. Connect each speaker so that in parallel the polarities match, and in series the positive of one speaker is connected to the negative of the other. The meter comes in handy when a convenient low d.c. has to be identified.

Output power can be checked by first substituting the loudspeaker with a wirewound resistor of equivalent resistance to the given a.c. impedance of the speaker, then measuring the a.c. voltage developed across this resistor with a constant level signal input.

A series of readings taken in this way enables one to make a rough check on the overall response of the amplifier. The curve is produced by plotting audio output against frequency. Accurate readings are not so important here as the need for a constant amplitude input, which must be chosen to avoid overloading the amplifier at certain frequencies. A.C. power is calculated by dividing voltage obtained by resistance.

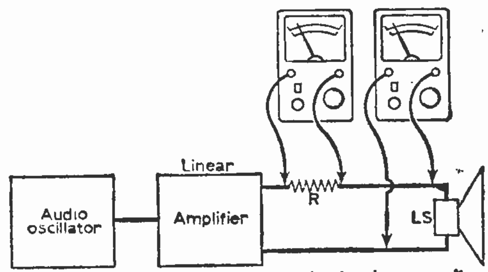


Fig. 6: Loudspeaker impedance check. Low readings only.

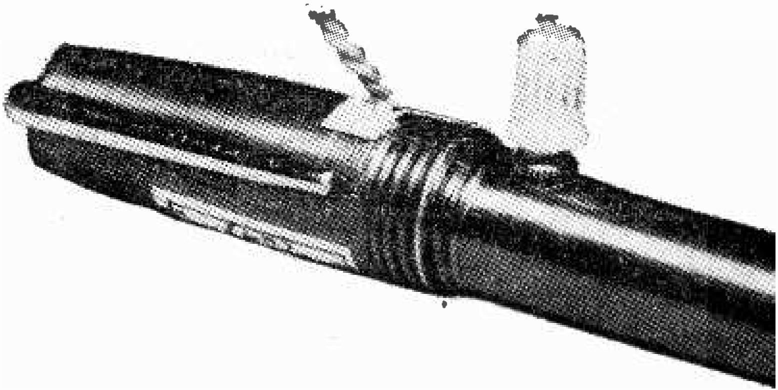
It is sometimes necessary to determine the impedance curve of a loudspeaker. While this is generally done with the aid of an impedance bridge, it is nevertheless possible, with the aid of our multimeter, to make practical tests.

If an audio oscillator is available, a hook-up such as illustrated in Fig. 6 enables us to take voltage and current readings at various frequencies, and plot a curve. A word or two of warning: the curve produced may look like an Alpine range; this is not at all unusual, as the loudspeaker response and the loading of the enclosure together make for a smooth output.

Tape Recorders

Tape recorders testing requires attention to many of the above points, plus the measurement of oscillator voltages and currents. During recording, an h.f. bias voltage of between 45 and 60kc/s is applied to the recording head, the signal being superimposed on this. Correct level of bias is essential for good recordings, and it must be of sufficient amplitude to overcome inherent noise and free from distortion.

—continued on page 1085



SIGNAL TRACER·POCKET SIGNAL TRACER·POCKET

THIS signal tracer comprises basically a germanium diode detector circuit feeding into a two-stage transistor amplifier which ultimately feeds its output into a miniature high impedance earpiece. The unit is suitable for tracing r.f., i.f. and a.f. signals but care should be taken when using it not to overload the diode.

All components are mounted on a small paxolin chassis which itself is fitted inside the casing of a small penlight torch casing of the type which can be obtained from Woolworths for 1s. 10d.

This torch casing has a shaped plastic nose cone to shield the bulb and this allows the streamlining of the probe tip to be made really professional, so producing an entirely useful piece of apparatus which has a very commercial appearance.

The power supply for the signal tracer is a leak-proof 1·5V "Ever Ready" type U7 dry cell which is fitted inside the torch casing, so making the unit entirely self contained except for the earpiece, which, of course, of necessity is outside the casing anyway.

The tracer can be clipped into the service man's pocket just like a fountain pen and so is quite portable and takes up very little room.

The resistors and capacitors are of the sub-miniature type which in these days of continued miniaturisation are quite easily come by. C1, however, should be of the paper tubular type and should have a very high working voltage so it can protect the diode if the probe tip accidentally touches a very high voltage point when tracing in mains operated equipment. In the author's model C1 is 2·7kV d.c. working. The transistors used are also sub-miniature and are in fact smaller in size than the resistors or capacitors and are of American manufacture. However, Mullard are now producing a sub-miniature version of the "OC44"—this version being the "OC44M"—and these can be used and it is quite likely that no alteration in the value of the resistors or capacitors will be necessary. Normal size surplus transistors, r.f. or a.f., may also be employed, but if so it is important that the length of their body (not leads) is not longer than about 8mm, otherwise they will impede the fitting of the chassis into the casing when this unit is completed.

The circuit of the signal tracer is given in Fig. 1.

THE MAIN CHASSIS

The main chassis upon which most of the components of the signal tracer are mounted is made from a small rectangular piece of paxolin $\frac{1}{32}$in. thick, $1\frac{1}{2}$in. long and $\frac{9}{16}$in. wide.

Such a small piece of paxolin will probably be found in the average constructor's "junk" box and because of this thinness may be trimmed to size with scissors. This chassis is shown in Fig. 2. As can be seen, two small pieces are cut out of the ends of the chassis. The piece out of the left-hand end is $\frac{1}{4}$in. wide and 2/10in. deep and the piece cut out of the right-hand end is $\frac{1}{4}$in. wide but only $\frac{1}{16}$in. deep.

Also, as can be seen, a number of holes are pricked into the chassis. The specific positions of these holes are indicated in Fig. 2. Their positions should first be accurately marked on the paxolin chassis with a needle or pin and then pierced, using a red-hot sewing needle. This process is very quickly done since the paxolin is so thin.

The positive and negative supply lines (+ve and −ve rails) should now be attached to the chassis. These are made of thin gauge bare copper wire and are fixed to the chassis via the holes bored at each end of it in the manner shown in Fig. 3. The negative supply rail should be mounted above the chassis and the positive rail mounted below the chassis. These rails are fixed by passing their ends through their respective holes at the end of the

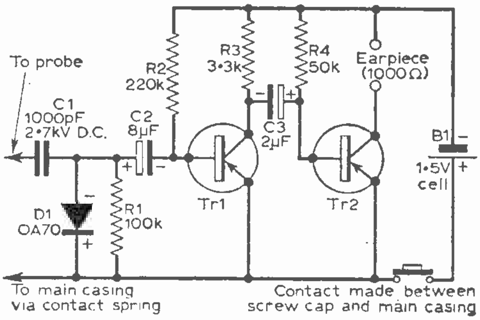


Fig. 1: The circuit of the tracer.

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By R. W. KNEESHAW

chassis as shown in Fig. 3. These ends are then doubled over and passed through the adjacent hole, then snipped off, bent over and soldered to keep the rails permanently fixed in place.

Next the contact spring that carries the connection from the positive battery terminal from the main torch casing to the positive rail should be mounted in place. This contact spring is made from a piece of brass strip such as the brass strip terminals found on the flat 4½V torch batteries. This spring may be cut from such a thin piece of brass strip 1¼in. long and $\frac{5}{32}$in. wide and curved to the shape portrayed in Fig. 4.

The bent-over part of the strip should fix over the end of the chassis in the ¼in. x $\frac{1}{16}$in. cutaway piece. This is shown in this drawing. The part where the contact spring is fixed to the chassis should then be lightly squeezed with a pair of pliers, so making a very firm attachment.

The spring contact must be electrically connected to the positive rail and this is done by means of a little piece of brass strip of length $\frac{5}{16}$in. and width $\frac{5}{32}$in.

This piece of strip bridges the gap under the chassis between the fixed end of the spring contact and the positive rail and is soldered to these points as shown in Fig. 5. The soldering in place of this brass bridging strip enhances the rigidity of the fixing of the spring contact to the chassis.

WIRING UP THE COMPONENTS

The components of the signal tracer are now to be soldered correctly in place on the chassis.

The position of the components is clearly shown in Fig. 6. Apart from C1 and C2 all components are mounted above the chassis. C1 is mounted in the ¼in. x 2/10in. cutaway piece at the end of the chassis as shown. C2 is mounted under the chassis and should be of the sub-miniature electrolytic type. One end of C2 should be soldered to the under-chassis junction of C1, R1 and the diode D1 (indicated "X" in Fig. 6) and its other end should be soldered to the under-chassis connection between the base of Tr1 and R2.

The other outward end of C1 is snipped off quite short and bent over the first two or three turns of a small spring (about ½in. long and 1/10in. diameter), thus fixing the spring tightly to it. The mounting of this spring is shown in Fig. 6. This spring should be quite gentle in pressure and its function is to complete the connection of the signal input from the probe tip to C1.

Small plastic sleeving should be slipped over the transistor leads to prevent them shorting together. When soldering, heat sinks should be used to conduct the heat of the iron away from the transistors. These heat sinks may be in the form of long pieces of copper wire, twisted round each lead, or may be effected by gripping the transistor leads with a pair of pliers or tweezers when soldering them.

When the soldering is completed on the chassis a small piece of transparent adhesive tape should be stuck over the end of the contact spring where it is attached to the chassis. This is to prevent the spring from shorting on to the earphone socket which is to be connected up later. Another piece of transparent adhesive tape should also be stuck over the diode, so preventing its ends from touching the inside of the torch casing when the chassis is inserted into the casing.

THE EARPHONE SOCKET

The miniature earphone socket must now be soldered to the chassis. Two of the tags on this socket should be shorted together and lead "A" attached to them. These two tags are depicted in Fig. 8 (is is important the right pair are strapped together), this diagram showing clearly how the earphone socket is connected up to the main chassis. The other soldering tag on this socket must have lead "B" connected to it. Both leads "A" and "B" are about ½in. long and lead "A" is connected to the negative rail above the chassis and lead "B" connected to the collector wire of Tr2 below the chassis.

Part of the switch contact arm on the earpiece socket should be snipped off, the portion to be cut off being ascertained by reference to Fig. 7.

A small ebonite collar is slipped over the screwed link of the earphone socket together with a celluloid or mica washer (external diameter ½in. and internal diameter $\frac{5}{32}$in.). The small ebonite

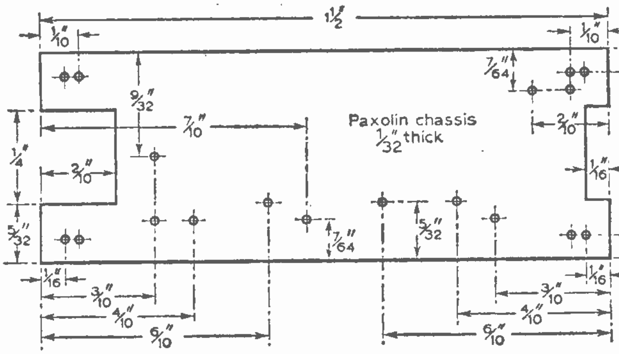
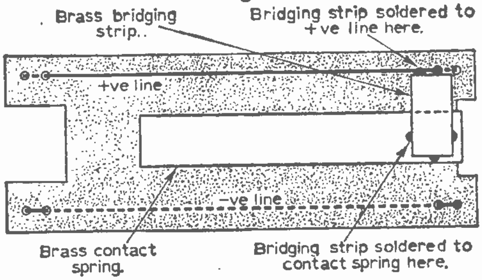


Fig. 2

COMPONENTS LIST

Resistors:			
R1	100kΩ	R3	3·3kΩ
R2	220kΩ	R4	50kΩ
Capacitors:			
C1	1,000pF paper 2,700kv		
C2	8μF electrolytic		
C3	2μF electrolytic		
Semiconductors:			
D1	OA70		
TR1, 2	OC44M		
Battery:			
B1	1·5V cell U7		

Fig. 5



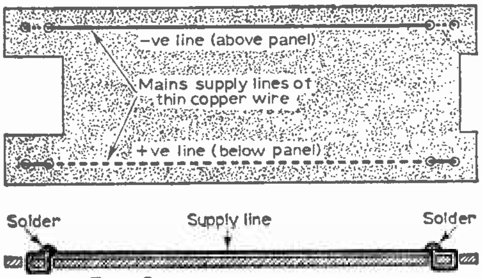


Fig. 3

Fig. 6

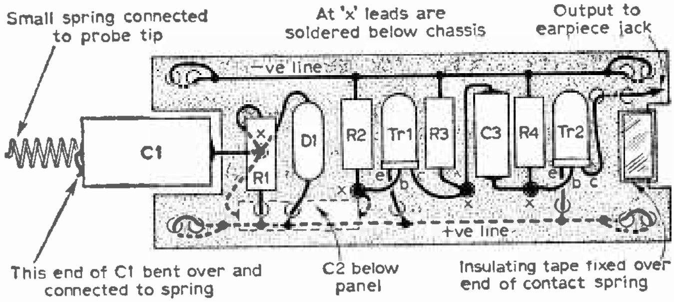
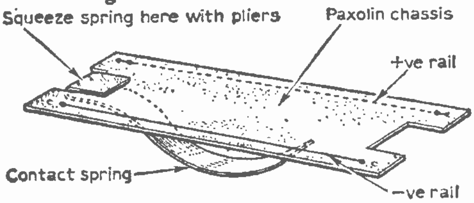


Fig. 4



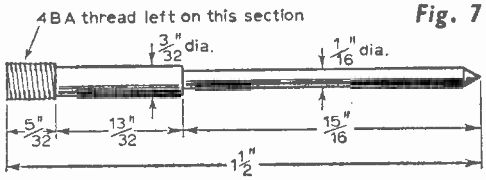
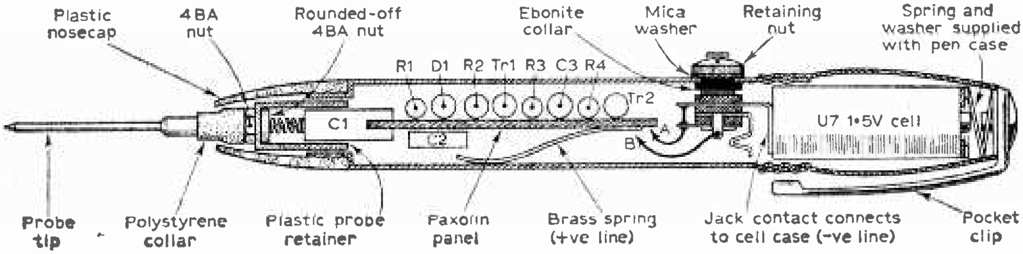


Fig. 7

Fig. 8: A sectional view of the completed instrument.



collar was taken from an old headphone jack plug (normal size, not miniature). If an old jack plug isn't handy such an insulating collar will probably be found in some old piece of radio or electrical apparatus such as switches, banana plugs or sockets. A suitable washer can be cut from an old photographic negative.

The only modifications to the penlight torch casing are: (i) The spring (and the washer attached to it) which is found inside the casing when it is bought must be transferred into the screw cap (the spring entering before the washer); (ii) a hole $\frac{3}{16}$in. in diameter must be bored in the casing *exactly* $\frac{1}{2}$in. from the end of the casing that screws into the screw cap. It is important that the position of this hole is correct, otherwise the positive pole of the battery will not make contact with the rivet in the end of the screw cap when it is screwed into the casing or it may be found impossible to screw the cap on properly.

The main chassis may now be placed inside the lower half of the torch casing shown. However, before this is done the wiring of components on the main chassis should be checked against the circuit diagram and any errors corrected. Also the inside of the casing should be lightly scraped with a round file to ensure good contact between it and the contact spring attached to the main chassis.

To fit the chassis inside the casing unscrew the retaining nut from the earpiece socket and also take off the celluloid washer, but leave the ebonite collar on, and then push the chassis gently into the casing (C1 entering first), making sure that the contact spring enters unimpeded. When the chassis is properly inside C1 should be slightly protruding out of the other end of the casing (the end into which the torch bulb was to be screwed) and the screwed link of the earpiece socket should be located right beneath the hole drilled in the casing. With a pair of tweezers or long-nosed pliers grip this socket and gently push the screwed link through the hole in the casing until the ebonite collar fits into that hole. Then place the celluloid washer over the screwed link (now protruding through the side of the casing and screw the retaining nut tightly on to it. The chassis is then firmly fixed inside the casing. The battery can now be placed inside the casing and the screw cap screwed on. The negative zinc casing of the battery should be resting on the switch contact arm of the earpiece socket. Fig. 7 shows the chassis, battery and socket correctly positioned inside the penlight torch casing.

THE PROBE TIP

The probe tip is made from a $1\frac{1}{2}$in. length of 4B.A. brass screwed rod. It was fashioned by filing it whilst it was being turned in the chuck of a hand drill (the latter was clamped in a vice and so was used as a crude type of lathe). A power drill, of course, would shorten this job immensely but, even so, since the screwed rod is of brass and is fairly soft the job only takes about half an hour using a hand drill.

The rod is fitted down to the dimensions shown in Fig. 7.

As can be seen $\frac{5}{32}$in. of length of the rod are untouched and that for $\frac{13}{32}$in. of length the rod is turned down to $\frac{3}{32}$in. diameter (i.e. until the screw thread just disappears), and for the remaining $\frac{15}{16}$in. of length the rod is filed down to $\frac{1}{16}$in. diameter. The thin end should be filed to a fine point.

From an old battery plug or aerial plug retain the plastic portion. In the author's case this was an h.t. plug from a very old battery portable receiver. However, any such insulating piece that can be found in the junk box may be used but it must be of the correct shape, i.e. cylindrical, hollow inside and closed at one end. It must be $\frac{9}{16}$in. in length and have an external diameter of $\frac{11}{32}$in. Any piece of the correct shape could be sawn and filed to these dimensions and the hole can be drilled in the centre of the closed end. This hole should be just big enough to pass the screwed end of the brass probe.

The inside of this insulating piece should be reamed out with a round file until it just completely fits over the capacitor C1 which is protruding from one end of the main chassis.

Now round off the corners of a flat 4B.A. nut until it just snugly fits right inside the insulating piece. The thread of the brass probe is then passed through the small hole in the closed end of this insulating piece and screwed into the rounded-off nut inside. A locking 4B.A. nut is screwed into the probe tip outside the insulating piece, so rigidly fixing this brass probe tip to it.

From an old polystyrene ink cartridge (of the type used in many makes of ballpoint pen) cut off the portion $\frac{3}{8}$in. from the smaller diameter end. The "stepped" portion so cut off should then be slipped over the brass probe. (These ink cartridges are easily obtainable from any stationery store and cost only 4d.)

The finished probe assembly is now attached to the torch casing as follows: Unscrew the plastic nose cone of the penlight casing, exposing the end of C1 and the small spring attached to it. Slip the insulating piece of the probe assembly over C1 such that it slides inside the penlight casing. The plastic nose cone of the torch is then slipped over the probe tip and screwed on to the torch casing. Fig. 8 shows the probe assembly correctly fixed inside the penlight casing.

The input signal to the tracer is applied across the probe tip and the torch casing (positive battery line) and so a lead must be made to connect the torch casing to the earth line of the piece of apparatus being investigated by the signal tracer. This lead should be of thin plastic-covered flex, about 18in. long, and should have a crocodile clip attached at either end. The crocodile clips used by the author were the miniature type, which seemed more fitting for such a miniature piece of apparatus. One end of this lead is connected to the casing by clipping it on to the pocket clip fixed to the screw cap of the torch and, of course, the other end of the lead should be attached to the earth line of the piece of equipment being tested.

USING THE TRACER

The signal tracer is now complete and it ma be switched on by screwing the screw cap of th torch right on gently as far as it will go. It thus switched off by unscrewing this cap abo half a turn or so in the opposite direction.

Insert the earphone and switch the tracer unit on. A slight click should be heard in the earphone when the probe tip is touched with a metal object.

If no click is heard in the earphone then it is probably due to either—

(i) The positive battery terminal is not connecting properly to the rivet at the inside end of the screw cap when the cap is fully screwed on;

(ii) The contact spring fixed to chassis not making good electrical connection with the inside of the torch casing (This is remedied by withdrawing chassis and scraping inside of casing some more with a round file.);

(iii) The probe tip is not making good contact with the spring attached to the end of C1.

These points should thus be checked in turn and any poor contact remedied where found.

It is unlikely that the circuit wiring is at fault, since this should have been thoroughly checked before the chassis was initially inserted into the casing.

The signal tracer may be further tested by connecting its casing to the positive battery line of a transistor receiver, which is switched on and tuned to a station, and touching the probe tip on to the diode detector of that set and finding whether a signal is heard or not. In fact a signal should be heard at the base or collector leads of all transistors in the set except perhaps at the base of the mixer (where, of course, the incoming signal has received no amplification).

INSULATING THE CASE

Although originally this device was intended to be used for tracing signals and thus faults in transistorised equipment it can, of course, be equally well used in mains operated valve receivers. However, it should be remembered that since the casing of the tracer must be connected to the chassis of the receiver this casing may be live and the user may suffer a serious shock. This risk, however, can be alleviated by binding the tracer casing with insulating tape before using it (first switching the tracer on, of course), after which it should be perfectly safe to handle.

After the servicing has been completed the binding of the insulation tape can be taken off and the tracer switched off.

The high d.c. working voltage of C1, of course, protects the diode if the probe tip accidentally touches a high voltage point when servicing mains operated receivers.

ULT LOCATION

This signal tracer was primarily designed to termine how far a signal is going through a ılty receiver and thus to ascertain the location the fault. To do this the receiver dial pointer st be placed to a position where a strong known ıal comes in (such as the Light or Home pro-mmes). Then connect the casing of the tracer to the positive battery line of the receiver (if ansistorised receiver) or to the earth line (if a e operated receiver). Then, starting from the aerial end of the set, place the probe tip first on the base and then on the collector (if a transistorised set) or control grid and then anode (if a valve receiver) of each stage in turn, working forward towards the loudspeaker until one point is reached where no signal can be obtained. One then knows that the fault lies between this point and the point just previously tested. Further probing at positions between these two points should narrow the fault down until its exact location or nature is realised.

Low-emission valves may be found using this instrument, since the signal heard at their control grid should be quite strong and yet very weak or non-existent at their anode.

Transistors that for some reason have suddenly lost their gain, however, are a different matter, since a transistor, being a completely "solid state" device, does afford a good electrical connection between base and collector, and although the transistor is faulty in this way an equally strong signal sometimes may be louder at the base of and base.

With the transistor receivers the signal heard in the earpiece of the tracer doesn't necessarily increase progressively in strength as one moves successively from base to collector, stage by stage throughout the set. This will probably be due to mismatching between the transistor and the probe assembly at certain test points and as a result the signal sometimes may be louder at the base of some transistors than at its collector, and this may prove misleading when trying to detect a transistor which is not amplifying properly for some unknown reason. However, for locating open circuits in printed circuitry or resistors and capacitors in transistor receivers the device is very useful indeed.

TRACER AND INJECTOR USED TOGETHER

The author, of course, constructed this signal tracer for use with the "Pocket Signal Injector" which was covered in a constructional article in the July, 1963, edition of PRACTICAL WIRELESS. This being so, servicing of faulty receivers is made even easier by employing the two devices together.

The signal injector is switched on and its signal injected into the aerial socket of the receiver which is faulty. This is done by placing its probe tip into the aerial socket of the receiver (if that receiver requires an external aerial) or placing the probe tip of the injector near to the ferrite rod (if the receiver is portable and has its own internal aerial). In either case a signal is successfully injected into the set and may be followed through the receiver, using the signal tracer as previously explained, until the spot where the injected signal fails to pass through is found.

The two units being constructed in identical penlight torch containers make a very useful "pen and pencil" type of set for the service man and, of course, take up very little room. The author has also added to this pair a torch of similar type, since such a pocket torch is often very useful when trying to ascertain where leads or components are connected to in the more inaccessible parts of a radio receiver chassis, especially in the more miniature receivers found today. ■

Modifications to the Local Station F.M. Receiver

By J. G. Ransome

ALTERING THE COVERAGE OF THIS P.W. DESIGN

SINCE the publication of constructional details for the "Local Station F.M. Receiver" (*Practical Wireless*, July 1963), several enquiries have been received concerning conversion details for using this receiver on frequencies other than those encompassed by the original design. In particular, conversion details have been requested for the 70Mc/s, 144Mc/s and 190Mc/s bands—the latter being required for the sound part of Continental and Irish television f.m. signals. This article, therefore, is presented to give details of suitable conversions to the original circuit in order that the above bands may be received.

70Mc/s Band

The 70Mc/s band is extensively used by commercial stations, (taxis, control of mobile services, etc) and by certain mobile amateurs. The modification necessary to receive 70Mc/s transmissions is extremely simple and merely involves alteration to the tuned circuit around L1.

In the original circuit the oscillator ran at about 80Mc/s, this beating with the incoming signal at 90Mc/s to produce the i.f. at 10·7Mc/s. Thus if we have an r.f. signal at 70Mc/s the local oscillator being at 80 Mc/s will again produce an i.f. of 10·7Mc/s. Not only is it convenient to leave the oscillator unmodified but it is preferable from the point of view of possible interference, since if the oscillator were modified to run at 60Mc/s i.e. *below* the signal frequency, there may be interference to television signals in the 60Mc/s band (Band I, channel 4).

There are two ways of modifying the input circuit for 70 Mc/s. We can either reduce the resonant frequency of the circuit by padding L1 with a capacitor or by rewinding L1 to the appropriate inductance. Of the alternatives the latter is more elegant from the theoretical standpoint, but the former is more convenient and works quite well.

The converted circuit is shown in Fig. 1 this shows the padding capacitor Cp as being switched —which is useful in that it makes the receiver tunable over both the 70Mc/s and 90 Mc/s bands. If the set is to be used only on 70Mc/s then, of course, the switch is omitted. The set now tunes the 70Mc/s band, L1 being tuned for optimum results.

If the alternative of rewinding L1 is preferred, then L1 is wound with 6½ turns of 20s.w.g. wire wound on a $\frac{5}{16}$in. diameter iron dust cored former, each turn being spaced from the next by a distance equal to the diameter of the wire. The aerial tap is three truns from the earthly end of the coil. L1 is peaked for maximum signal at 70Mc/s.

Either of the modifications will ensure satisfactory reception of 70Mc/s signals.

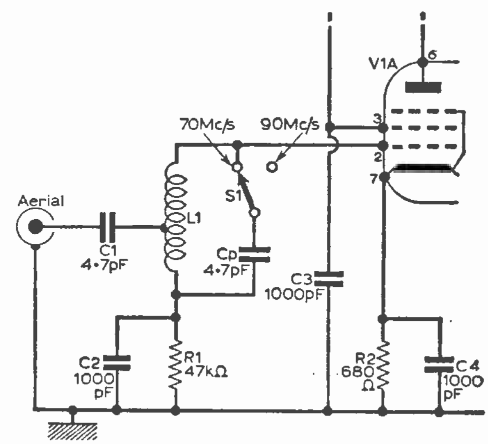


Fig. 1: The modified circuitry of V1 (see Fig. 1, page 220 of the July 1963 issue).

TABLE 1 (Coil details)

All coils are wound on 0·3in. dia. iron dust cored Aladdin formers with 22 s.w.g. enamelled wire, each turn being spaced from the next by a distance equal to the diameter of the wire.

	144 Mc/s	190 Mc/s
L4	5½ turns Tap 2 turns from earthly end.	4½ turns Tap 2 turns from earthly end.
L5	4 turns.	4 turns.
L6	6 turns. Tap 2½ turns from high tension end.	5 turns. Tap 2½ turns from high tension end.

144Mc/s and 190Mc/s Bands

For those readers who are well within the primary service area of transmitters operating on 144Mc/s or 190Mc/s the conversion is almost as easy as that for 70Mc/s just described.

All that is required is that L1 and L2 are rewound to the specifications shown in Table 1; in all other respects the original circuit remains the same. Unfortunately the modified circuit as it stands is not very sensitive. The great difficulty here is that as we increase the frequency there is a tendency for the r.f. signal to decrease at the grid of V1A owing to losses due to stray capacitive

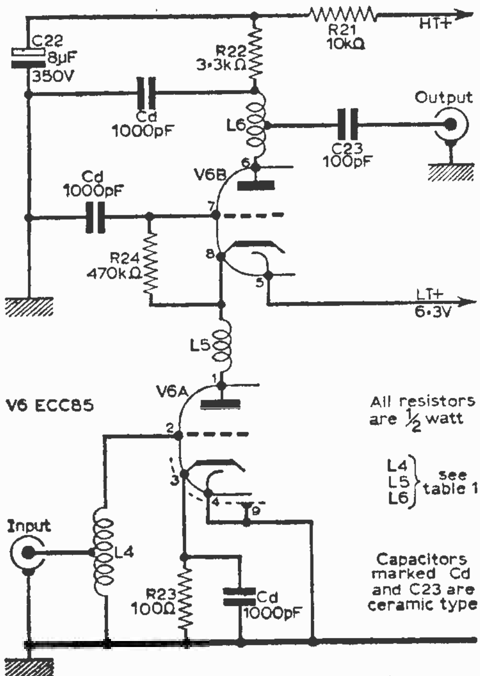


Fig. 2: The circuit of the pre-amplifier for 144Mc/s and 190Mc/s.

and other effects. It is therefore necessary to fit an r.f. amplifier.

An r.f. amplifier is to be preferred to an extra i.f. amplifier (which would be much more convenient) under these conditions for reasons of noise. Most of the noise (noticeable as a general hiss) is generated in the mixer and r.f. stage, (V1A in the original). Now the more we amplify after this first stage the more we increase the noise level in the a.f. signal.

However, if we increase the signal to the grid of V1A the effect of the noise is reduced. Thus we need to have an r.f. amplifier in areas where the signal strength is anything less than strong. It is suggested that the coils L1 and L2 be modified first and the set checked for reception quality and sensitivity, and if these are unsatisfactory the pre-amplifier should be constructed.

Pre-amplifier

It was found the insufficient room could be made on the original chassis to accommodate the r.f. amplifier and so it was decided to construct the amplifier as a separate unit.

In the prototype the chassis used was that of a redundant television turret tuner which had been purchased in a brand new condition (less coils) for 2/6d., and since these are quite readily available at many surplus shops the writer would commend to the reader the use of such a chassis as they contain most (if not all) of the components required, together with suitable coil formers.

The circuit of the pre-amplifer is shown in Fig. 2 (mod) and suitable coil-winding details are given in Table 1.

There should be little difficulty in constructing the r.f. amplifier for those who have successfully undertaken the building of the original receiver. As before, the wiring must be kept as short as possible and an additional desirable feature would be the use of ceramic capacitors for the decoupling capacitors Cd as the lowest possible inductance is required in this part of the circuit.

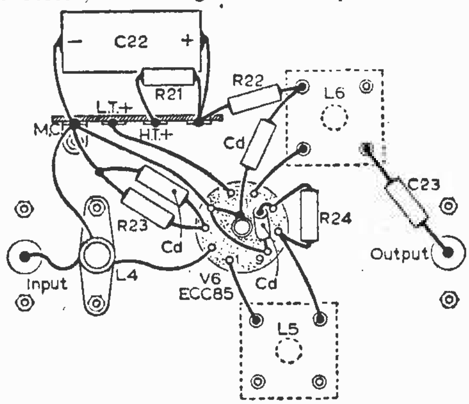


Fig. 3: The pre-amplifier wiring.

COMPONENTS LIST

Resistors:

R21	10kΩ	R23	100Ω
R22	3·3kΩ	R24	470kΩ

All ½W 10% carbon

Capacitors:

C22 8µF electrolytic 350V
C23 100pF ceramic
Cd 1,000pF ceramic

Coils:

L4, 5, 6 see Table 1

Valve:

V6 ECC85

Aligning the Circuit

The peaking of the circuit is extremely simple as L4 and L5 are fairly broadly tuned and so are peaked last. The procedure is as follows:

Switch on the main set and pre-amplifier, and connect the output of the amplifier to the main receiver input by means of a length of coaxial cable. If a suitable signal generator is available inject a 145Mc/s (or 190Mc/s as appropriate) signal at the grid of V6A (pin 2) and adjust L6 for maximum output and then likewise adjust L5. It may then be necessary to readjust L6 again for maximum response. The signal generator is then removed from V6A grid and transferred to the aerial input at the tap on L4 and this is adjusted for maximum response. The aerial may now be connected and L4 readjusted for maximum output.

If no signal generator is available the unit must be aligned on the aerial. A suitable aerial is connected to the set and the coils adjusted in the same manner as above, using a signal which is as strong as possible.

These then are the modifications which may be made to the original set and since they have all been tried and tested the constructor may undertake them with every confidence. ■

WOW AND *FLUTTER*

by H. W. Hellyer

Tape recorder and gramophone faults likely to cause these audio imperfections in the reproduction.

WHILE the pundits pontificate and fail to agree on a definition for the term "high-fidelity", it is as well to remember that there are other terms, in as general use, that still remain vague and inconclusive. But whereas every audiophile has his personal reservation about the "highness of fi", the terms of our title are very real, measurable, and can be quite disturbing.

Time is the essence of audio matters and rhythm the most vital factor. A sound with no rhythm we dismiss as noise. The physiologists tell us our lives are based on the fundamental rhythms of nature. Regularity is the yardstick by which we judge the audible word. Pitch and intensity can vary by fairly large amounts before our imperfect ear protests. Under ideal conditions, the healthy person can detect a difference of 1% in pitch variation of a signal rich in harmonics, but a pure tone slightly higher than mid-range that is varied only one tenth of this and at a regular rate of variation is immediately apparent.

Intensity enters here, for a note seems to decrease in pitch as it gets louder. This effect is very marked at frequencies below 100c/s.

Since the pitch of the note we hear reproduced by a gramophone or tape recorder depends on the speed at which the disc revolves or the tape passes the head gap, it is obvious that variations in speed are extremely important, and must be avoided. But the dependence upon rhythm makes our ear very intolerant not only of plain changes of pitch but also of the short-term variations caused by cyclic irregularities of the mechanism.

Distinction Between Wow and Flutter

At low periods of change (as distinct from low frequencies) the effect becomes most disturbing, and the brain registers the sensation of discord. Thus, a pure tone of, say, 1,000 cycles, which varies only 0·04% in pitch regularly every five seconds gives rise to a feeling of greater discomfort than a signal varying twice the amount but at twice the speed of variation; while a signal varying in pitch and intensity with rapidity allows a tolerance of quite wide limits before the ear takes note.

These relatively low changes of pitch, up to about ten times a second, are called "wow", and variations at a higher rate are known as "flutter". There is no hard and fast division: some German engineers regard cyclic variations up to 20 cycles as wow; some American engineers use the term flutter for all cyclic variations.

The effect of wow, or cyclic variations below 10 cycles, is to impose a tremolo effect upon the signal. This is especially noticeable on a sustained note, such as the playing of a piano or organ. Flutter has the effect of roughening the tone, and is often mistaken for other forms of distortion, and consequently difficult to diagnose and trace. Because of its nature, it may be less regular, thus increasing the difficulty. What sounds like an overloaded amplifier can often be the result of a flutter effect between 40 and 100 cycles which frequency modulates the signal and gives what really amounts to intermodulation distortion.

Acceptable Standards

There is no standard determining the acceptable amounts of wow and flutter. Indeed British

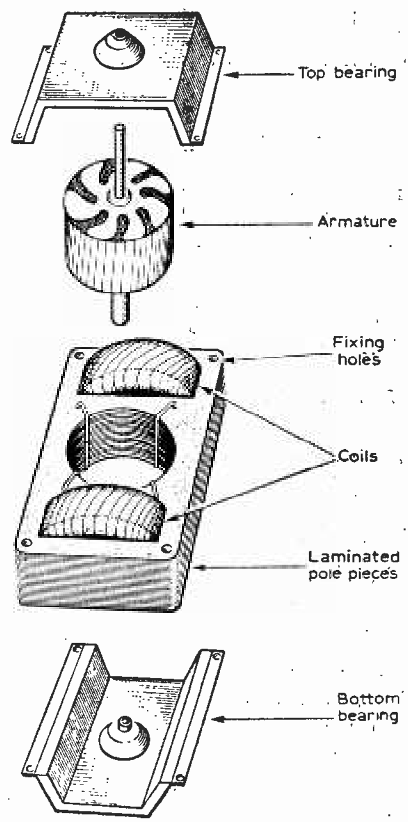


Fig. 1: The construction of an induction motor.

Standard 1988:1953, which deals with these frequency and speed variations, states that it is "not possible to stipulate . . . standards. As a rough indication, 0·05% r.m.s. is considered good, while 0·5% is bad". (This should not be confused with the speed tolerance laid down in BS1568:1960, which recommends a ±2% maximum speed tolerance for domestic tape recorders. As a matter of interest, very few modern machines are as poor as this, and professional machines are often within ±0·5% of the nominal speed.)

Wow is caused by irregular rotation of drive mechanisms. This may originate at the motor, belt or idler, flywheel (or turntable, in the case of the gramophone), capstan or pressure wheel. The rhythm of the wow is often a clue to its origin.

Possible Motor Defects

The modern induction motor is considerably more efficient than its forerunners and, when correctly loaded, runs at a constant speed determined by the mains frequency. The type widely used for turntable drive of gramophone mechanisms, and some of the simpler tape recorders, is the 4-pole shaded-pole variety, as shown in the "exploded view" of Fig. 1. Here, the armature is a solid unit, the laminations form a rigid structure and the bearings are "self-oiling".

This last property is the result of research into metals and plastics which has made possible the use of materials with oil-retaining properties, yet with sufficient hardness to resist the normal wear

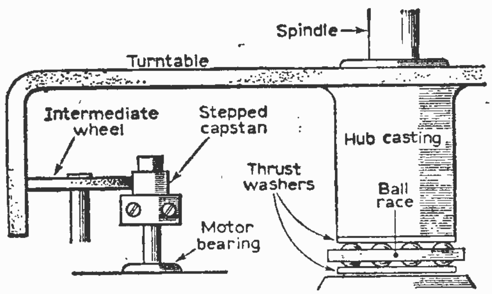


Fig. 2: The usual method of turntable drive for a gramophone.

of a spindle rotating at speeds up to 3,000 r.p.m. when loaded. Nevertheless, excessive heating will cause a drying-out of bearings and, in extreme cases, could result in motor seizure. So the first check must be the correct lubrication of bearings. One or two drops of light oil are generally sufficient at these points—and care must be taken to avoid excess oil being thrown off, in case this surplus should contaminate the rubber of idler wheels or belts. The final state will be worse than the original fault if over-enthusiastic oiling takes place.

Next, ensure that ventilation is sufficient to maintain the motor at a normal and constant temperature. If overheating has occurred, check the insulation of the fine lead-out wires of the field coils, especially where these pass through the coil cheeks. Where plastic coil formers are employed, see that heat has not distorted these. Check also the lamination clamps—loose laminations are a source of obscure noises, hum and heat. See that the blades of the fan are not distorted, that the bearings are correctly centred and there is no side-thrust. Some bearing clamps use rivets, which tend to work loose. Where this has happened, it may be advisable to drill out the rivets, replacing them with bolts, shakeproof washers and nuts.

Bent motor spindles are a possible source of wow, the frequency being in the order of 20-25c/s with a loaded, synchronous motor. Check by observing the free rotation of the uncoupled motor under a bright, directional light. Little can be done to rectify this fault, apart from motor replacement, unfortunately.

The Drive System

The usual arrangement for turntable drive is as shown in Fig. 2, where the motor has a stepped capstan fixed to its spindle by compression spring

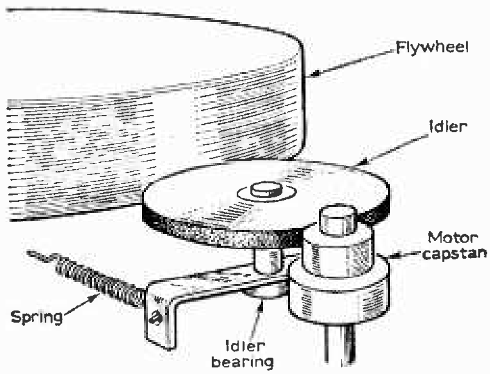


Fig. 3: Providing the drive for a tape recorder flywheel.

or grub-screws. A slipping capstan caused by loose screws is another possible source of irregularity, as is a vertical displacement which results in the rubber intermediate (idler) wheel being driven by the correct diameter step but rubbing on the next largest step of the capstan. The idler itself may become distorted, and here it must be stated that by the most prevalent reason for this fault is a mechanism being left in engagement when switched off. (A similar stricture applies to the idlers and pressure rollers of tape decks.)

Incorrect engagement of the idler with the turntable rim can be caused by the spring that operates the idler arm becoming weak or distorted, and by the arm itself binding, usually as a result of grit between sliding members. The remedy is cleaning and lubrication where appropriate with a medium grease. But take care at this point, also, for some mechanisms use graphite grease only, and any other medium will accentuate the binding.

Correct Seating of Turntable

The turntable itself must sit correctly on its bearing, and the thrust washers should always be replaced when turntables are removed for service. Bearings, especially the brass ring of the ball-race, should be kept clean, and a close watch should be kept for burrs or grit in the hub cavity. Ensure that the hub is not binding on spindle housing, and

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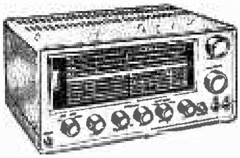

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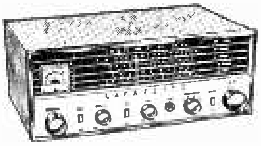

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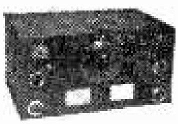

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1mA	22/6	1A. DC	22/6	50V. AC	22/6
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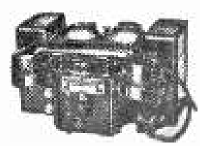

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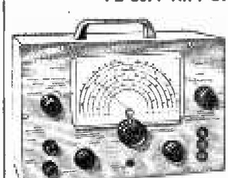

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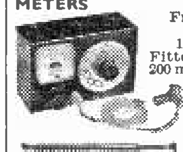

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that the circlip has its own stand-off washer in place.

Tape Recorder Drives

A similar arrangement of drive is sometimes found in tape recorder mechanisms, as shown in Fig. 3. The flywheel is driven by an idler which locates a stepped capstan for speed change. Again, care should be taken in the setting of the capstan, and the bearings of motor, idler and flywheel. Where belt drive is employed, check for hardened portions of rubber or plastic belts, which can cause "bumps" and irregular drive. If a machine has been unused for some time, the belts may tend to harden into their "shape" and can sometimes be cured by slight heating. Perhaps the best method, if the belts can be removed without too much trouble, is to allow them to recover pliability in a bowl of hot water, remembering to dry them thoroughly before replacement, then running the machine for a lengthy test period.

Some causes of wow and flutter on tape mechanisms are not so obvious, and Fig. 4 points out a few of the possible trouble spots. Binding pressure pads can cause irregular tape transport, as can incorrectly aligned guides, pressure rollers

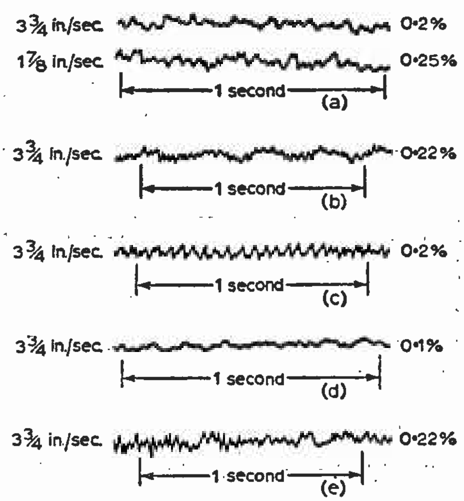

Fig. 5: A selection of "fluttergrams"—see text.

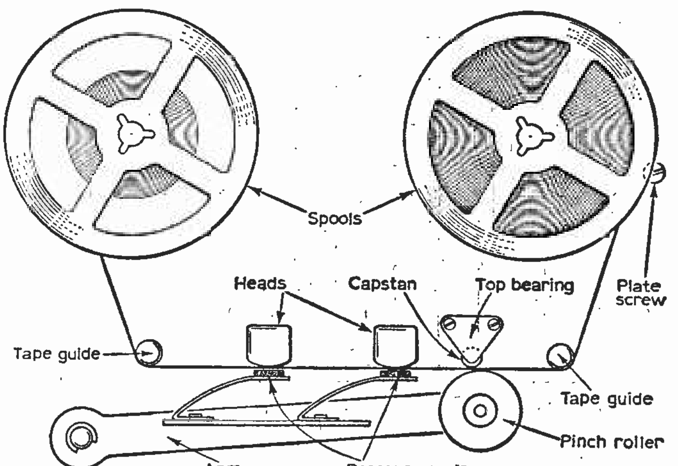

Fig. 4: Possible points on a tape deck where wow or flutter may originate.

The laboratory method of measurement is to record a steady tone, say 3kc/s, then play back this recording, feeding the output into a "flutter-bridge" which consists of a limiter and f.m. discriminator circuit. This converts the frequency variations into amplitude changes, and these are used to operate a high-speed pen recorder. The result is a very informative record of the continuous output against a time scale. Reduced to one second sections, these fluttergrams give an immediate indication of both the low-periodic wow and the high-speed flutter, as shown in Fig. 5. (The author is indebted to technical consultant A. Tutchings for these fluttergrams. which were prepared for reviews of new equipment in "The Tape Recorder.")

and spool carriers. Check that spool carriers are not fouling such things as deck plate screws, that the top plate is firmly in position, that the pressure arm engages cleanly, and the top bearing of the flywheel is in alignment, clean and lubricated.

Flutter is sometimes caused by excessive take-up tension, usually the outcome of a hardened clutch felt or wrongly set spindle, where the inner carrier type of clutch is fitted. Similarly, a braking action of the feed spool, either by excessive reverse torque of the feed brakes can give rise to irregularity.

Laboratory Measurements

Testing for wow and flutter has become an exact science in the laboratory, and quite elaborate "fluttergrams" are prepared for the reviews in the specialist magazines. If it is remembered that these faults are a form of frequency modulation, the difficulty of making measurements of the percentage of wow will be realised.

Study of the Fluttergrams

Fig. 5(a) shows the random effect of speed variations at 3¾ and 1in/sec of a high quality machine. There is hardly any periodic content of wow and the amount of high-speed flutter would be unnoticeable, even on a sustained piano note.

As a contrast, Fig. 5(b) demonstrates the effect of a 5c/s capstan wow, Fig. 5(c) has an 18c/s wow due to the idler of the machine under test being out of true, and a fair amount of high-speed flutter. Although Fig. 5(d) shows a 7c/s wow, due to the capstan, the total integrated wow and flutter for this machine was as low as 0·1%, and the fluttergram shows an almost total absence of high-speed variation. Fig. 5(e) is included to show the cancelling effect of the 50c/s flutter from a drive motor rotating at 3,000 rev/min where the variation adds

—continued on page 1090

an advanced metronome

A five valve instrument with provision for accenting the number of beats to the bar.

BY G. J. POPE

THIS article describes a novel metronome circuit evolved by the writer a short time ago. Many readers with musical interests will no doubt find this a useful design to develop into a practical model.

voltage drop across the common cathode resistor is much lower when V2A is triggered.

Diodes D1 and D2 in conjunction with the capacitors C3 and C4 form a diode pump circuit, the voltage across the 2μF capacitor C4 rising in a series of steps whose height will be roughly proportional to the input pulse from the multivibrator reduced in the ratio $\frac{0{\cdot}02}{2 + 0{\cdot}02}$.

Thus the voltage across the 2μF capacitor will rise positively until the potential on the grid of V2A just exceeds the standing cathode voltage due to V2B current. V2A will then switch on, and the cathode voltage will fall to a low value. Thus C4 will be discharged to near earth potential. (See Fig. 2). V4 remains cut off whilst the charge on the 0·1μF (C5) between V2A anode and V2B grid leaks away through the 270kΩ resistor, R7.

A pulse at V2B anode is of considerably lower amplitude than that at the output of the multivibrator, so that a booster amplifier is required to operate V5A and V5B. These latter two triodes operate as a second flip-flop circuit, and are brought into operation via a further staircase circuit from the first flip-flop output.

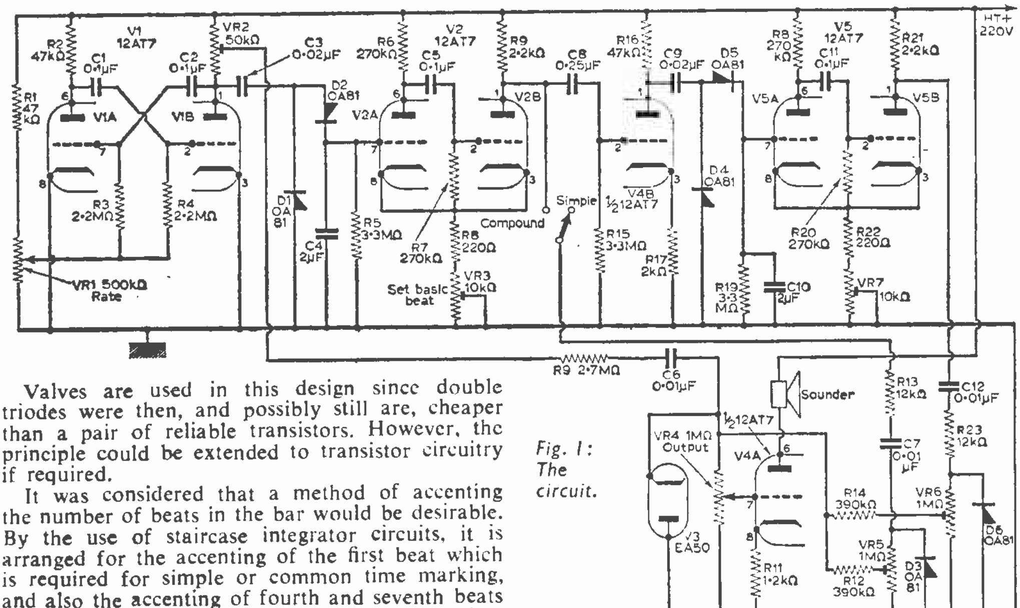

Fig. 1: The circuit.

Valves are used in this design since double triodes were then, and possibly still are, cheaper than a pair of reliable transistors. However, the principle could be extended to transistor circuitry if required.

It was considered that a method of accenting the number of beats in the bar would be desirable. By the use of staircase integrator circuits, it is arranged for the accenting of the first beat which is required for simple or common time marking, and also the accenting of fourth and seventh beats which is required in the case 6/8 and 9/8 time respectively.

Referring to the circuit diagram (Fig. 1) it will be seen that the two triodes V1A and V1B form a multivibrator and this produces the basic beat measure. The rate of this basic beat can be varied by means of potentiometer VR1, thus the time can be adjusted for *Lento*, *Andante* or *Presto*, and for the basic note value—crotchet, quaver or semiquaver etc.

Valves V2A and V2B form a flip-flop circuit, where V2B is normally conducting. The current in V2B is much greater than in V2A, so that the

V1A and V1B produce a basic note beat, and the 10kΩ potentiometer VR3 in V2 cathode circuit may be varied so that either two, three or four pulses are counted to V2A grid before this valve triggers. If the potentiometer VR7 in V5A and V5B cathode is set so that V5 also triggers when V2 triggers, then a large coincident pulse will be applied to V4A grid and the waveform will appear as either 2/4 time (Fig. 3a) or 3/4 (Fig. 3b), or as 4/4 time (Fig. 3c).

Compound times are counted by varying the potentiometer VR7 in V5 cathode circuit. Potentio-

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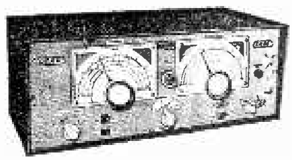

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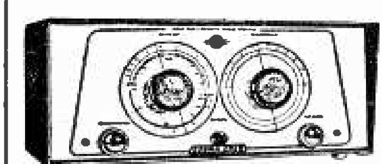

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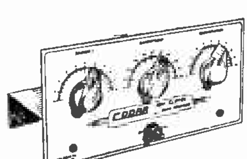

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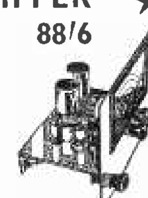

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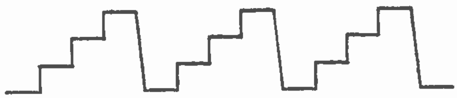

Fig. 2: The voltage waveforms at the grids of V2A and V5A.

meters VR5 and VR6 are adjusted so that the appearance of the pulses on a cathode ray tube screen would be as indicated in Fig. 4.

In the 9/8 time case shown above, both V2A and V2B fire on the arrival of a multivibrator pulse. On the receipt of the 4th pulse V2 enlarges this pulse to one of medium height (or loudness).

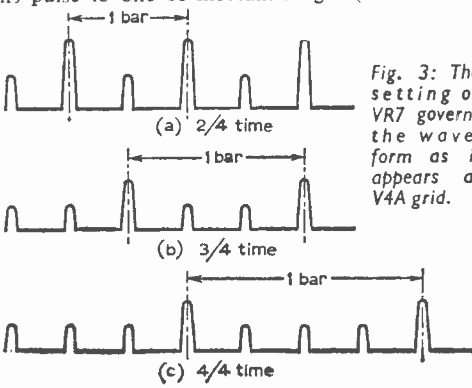

Fig. 3: The setting of VR7 governs the waveform as it appears at V4A grid.

The same thing occurs on the arrival of the 7th pulse; the 10th pulse causes both V2 and V5 to fire.

It was found necessary to connect a diode (V3) across the grid circuit feed of V4A in order to remove the negative-going component of the pulses before amplification.

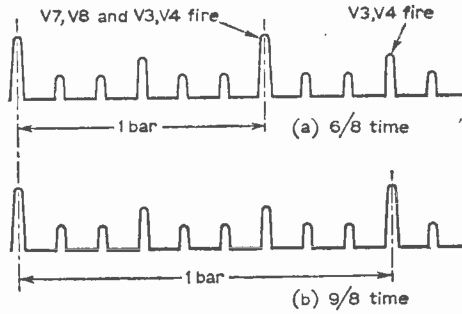

Fig. 4: The waveforms of compound times.

In a finished practical model, tapped resistor chains switched as required would be used to adjust the triggering potential of each flip-flop circuit.

A final point, in order to get reliable operation and a clean waveform (pulse trains as shown were obtained on an oscilloscope) it was found necessary to use a low impedance power supply. ■

In April last year, the author of this article had a Letter to the Editor published in which he mentioned his home-constructed stereo tape equipment, and in response to requests from many readers, Mr. Hawkins now gives details of the tape recorder he assembled from standard units at low cost.

An Inexpensive Stereo Tape Recorder

BY R. C. HAWKINS

THERE is now a wide choice of mono and stereo commercial tape recordings and after having experimented for some years with stereo disc equipment I became dissatisfied, for several reasons, with the results. Firstly discs, unless treated with elaborate care both in themselves and in the tracking mechanism have a limited "high quality" life, secondly there is a falling off in response as the speed reduces towards the centre and thirdly it is difficult with L.P.'s to select those items which are "favourites". Another reason is the rather abstract feeling that disc reproduction is only an extension of the horn and sound box era, and that tape has a more versatile future.

Apart from technical reasons there are the obvious advantages of being able to record one's own experimental stereo, to take recordings of the BBC stereo transmissions and to simplify recordings for home cine work.

Facilities Required

Commercial stereo tape recorders cost from about 85 guineas upwards—well beyond my modest means. Although I have done my "stint" in radio and television construction, I am today a lazy constructor and prefer to take advantage of printed circuits and to use proven and tested designs. In resolving to build my own recorder I decided it must have the following facilities:

1 At least two speeds—3¾ and 7½in./sec. (to take advantage of all the commercial tape recordings available at present).

2 Four-tracks (i.e. two per channel on stereo) to give maximum tape economy and again to cover all present commercial recordings (two-track stereo will reproduce on a four track machine without apparent loss of quality).

3 Monitoring devices (almost essential on stereo recording).

4 Ability to feed larger separate stereo amplifiers when required.

5 Be sufficiently portable to use in outside locations.

A stereo tape recorder is basically two mono units feeding one deck and it is therefore perfectly feasable to use two standard units with suitable adaptation. After much searching I contacted Martin Recordakits and found this firm extremely interested and helpful (they had already made up a stereo recorder using their standard units). Martins supplied me with two Type 8311 Amplifiers with "ganged" potentiometers instead of the single ones. Loudspeaker monitoring operates with these amplifiers and "record" level is shown by the "magic eye" method. There is no reason why similar units by other manufacturers could not be used.

I chose the Collaro Studio Deck (operating at three speeds) and fitted with Reuter four track record and erase heads. Provided the heads are four track no special "stereo" heads are required. The manufacturers of the amplifiers must be notified of the type of head used so that any mismatch can be avoided.

The Portable Cabinet

It is now necessary to make the suitcase type cabinet. This is surprisingly easy using the new adhesives. A frame is first made in 1in. by 1in. timber (20in. wide by 19in. and 6½in. deep—slightly larger than really necessary to facilitate servicing and to give room for possible later modifications). The top and sides of this frame are filled with 6mm ply and the whole covered in self adhesive plastic cloth. One now has a bottomless box ready for fixing the units. The bottom (screwed on later when the recorder was complete) consists of ½in. timber cut 2in. short each side to allow for ventilation: contemporary style legs are fitted to the bottom and these can easily be unscrewed when the recorder is used for outside locations. The lid can be made up of 6mm ply (no framing being necessary although it should be "blocked" at each inner corner for strength).

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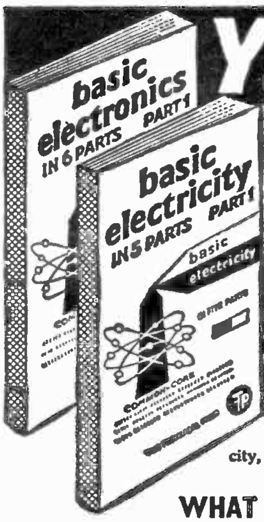

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The tape deck is fitted next. A template is provided with the Collaro deck so that the aperture may be cut to correct size and fixing holes drilled. More heat is obviously generated with stereo equipment than mono and it is very advisable to mount the deck slightly raised from the baseboard by rubber grommets—this gives good air space for ventilation.

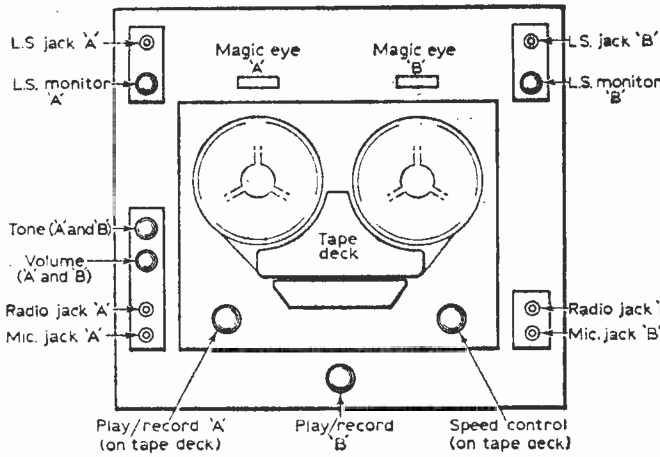


Fig. 1: A top view of the recorder showing the separate and common controls and sockets.

Stick-on "decorative" templates are provided by Martins for the controls but it must be remembered that only one ganged volume control and one ganged tone control is used. A ganged loudspeaker monitor control was also supplied but for reasons I will give later this was discarded and two separate controls used. There are, of course, two "mike" inputs, two "radio" inputs and two magic eye escutcheons.

The general layout is shown in Figs. 1 and 2.

Wiring the Equipment

It is not proposed to describe the amplifiers in detail: they are fairly conventional and a circuit diagram and point to point wiring instructions are supplied with each kit. Wires are already attached to the printed circuit baseboard of the amplifier although it may be necessary to extend these for the stereo set up. Provided one considers a single amplifier at a time it is quite possible for the completely non-technical to wire up the recorder.

It is best to consider the amplifiers as Channels A and B and to remember that Channel A occupies the left-hand side of the cabinet and is connected to the top connections in the erase and record heads. This will give the correct "phase" of playback on stereo tapes, provided the speakers are similarly placed.

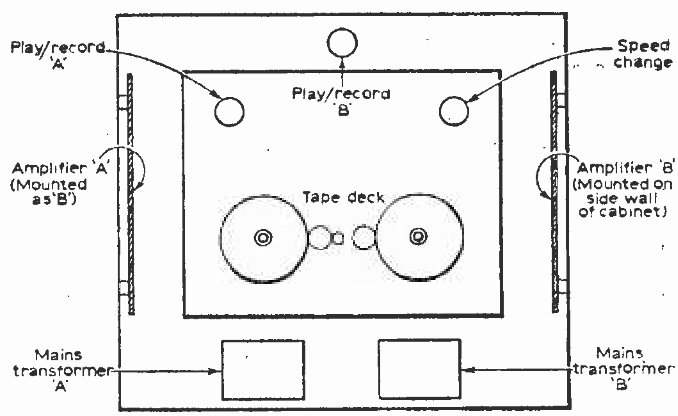


Fig. 2: An under side view showing the positions of the amplifiers and mains transformers.

A switch wafer is supplied with each amplifier which is designed to slip on to the speed change control on the Collaro deck. This wafer gives circuit compensation in the amplifier at the various speeds. With spacers ample room will be found to fit both wafers on to the spindle of this speed control.

Wiring can now be completed as per the instruction booklet with the usual care exercised on soldering the leads to the heads (it being essential to provide heat insulation from the heads with a pair of pliers whilst this operation takes place).

Loudspeakers

It will be noted that no internal speakers are fitted as my already existing pair of wall mounted speakers provided a far better system for reproduction. The wiring for the amplifiers does provide for an internal speaker (these being connected when the external speaker jack plug is removed). For immediate playback on outside locations two small $2\frac{1}{2}$in. speakers could easily be fitted on each side of the cabinet although stereo effect with these speakers would be less evident because of the narrow spacing.

The ganged volume control can be taken out of gang by a pull upwards on the spindle, and is used for "balancing". I achieved this by switching both amplifiers to "record" and feeding a radio signal to each amplifier in turn (this should obviously be done on a tuning signal or an audio signal generator can be used, if available). It is then only necessary to balance on the magic eye shadow. Once balanced the control should be left in gang (apart from a periodic check) and any further balance compensation for particular commercial recordings carried out by decreasing volume to the appropriate speaker on the "monitor" control.

It was found initially that a "whistle" was recorded and this was traced to a beat note between the two erase oscillators. To cure this, switch to record on both channels and adjust the tuning slug on either one of the erase oscillator coils until the whistle disappears. The oscillators are remarkably stable as I have only had to carry out this operation once and no reappearance of "beat" has manifested in 18 months.

Mono Operation

For mono operation one amplifier at a time can be used—the other amplifiers being muted by the appropriate "monitor" control (or separate mains switches can be inserted). Ample volume is available for ordinary domestic purposes with only one channel used. Full track mono use is available by this method and "head" switching is avoided.

On home recordings it was found that a disappointing amount of bass was evident. Compensation is made in the circuit to level out the characteristic of the amplifier in the record position; this was altered by removing C16 (in the Martin circuit) from the record/play switch and placing a short across this connection: C16 was then placed in series with the sliding contact of this switch and the cathode of V2A (thus reducing bass feedback). An immediate improvement was evident and I reported this to Martins assuring them I was not a "boom" addict: they replied that technically I had "messed" up the response and they could not explain the apparent improvement. Constructors may like to try this modification if they are similarly disappointed.

Stereo Operation

The subject of stereo recording is an enormous one and outside the scope of a constructional article. For some really demonstrative instruction I would recommend the purchase of a four-track stereo tape called "Stereo Confidential" issued by Music on Tape and available in either a $3\frac{3}{4}$ or $7\frac{1}{2}$in./sec. version.

To feed an external stereo amplifier the outputs from the pre-amplifier in the tape recorder can be taken from the "radio" sockets. Stereo discs can be directly recorded by providing two jack plugs from a stereo pickup (red to Channel A) using the Radio sockets (remember, however, the re-recording of commercial discs is prohibited by the usual copyright regulations).

Quality is extremely good and adjudged superior to quite expensive console stereograms. With the internal output stages it would not be good enough for the hi-fi purist but this recorder is, by comparison, portable and very much cheaper. Cost of the deck and units was about £36 but "careful" buying could possibly reduce this price. ■

The "7-20" Stereo Amplifier

—continued from page 1029

other one too, in exactly the same position and to the same extent. It is of paramount importance to maintain absolute symmetry between the two channels.

Adjustments of frequency response in the main amplifier should be carried out such that subjectively correct reproduction, with ample bass and treble, results from stereo records over SK4, with VR2 and VR3 set at mid-track. If this does not lead to sufficient speech clarity from a microphone over SK1 (too much bass), reduce the value of C5 until satisfactory performance is obtained. Much will depend upon the type of microphone used. A certain amount of treble boost in the microphone preamplifier, V1, alone is also obtainable by replacing C6 with a paper capacitor of about 0·1μF capacity.

Wherever grid stoppers are specified (resistors directly in series with control grid connections) these must be wired hard up against the respective valveholder pins.

Loudspeakers

As already mentioned, speakers, or speaker groups, of adequate power rating are essential. The circuit as shown in Fig. 1 is for 4 to 6Ω speakers or groups.

If 15Ω units are to be used, the output transformers must be obtained with the appropriate secondaries and the components in the main amplifier negative feedback loops must be changed. The correct values for R70, R71 are then 3·9kΩ, for R72, R73 1·8kΩ and for C30, C31, 0·15μF. If original values were altered during frequency response adjustments, the above values for 15Ω speakers require alteration in the same *proportion*.

There is no objection to the use of series-parallel combinations of smaller speakers at different locations, provided that the total power rating remains adequate and the normal rules of matching are observed. Furthermore, with such multiple speaker positions, care should be exercised that stereophonic reproduction (if used) is not thereby confused.

Final Checks

Upon completion of the amplifier, even if it appears to be working satisfactorily, voltages at all points shown on Fig. 1 should be compared with the prototype figures entered in Fig. 1. A meter of at least 20kΩ per volt sensitivity must be used, or a valve voltmeter.

If a meter of lower sensitivity is used, readings may in some cases be falsified (indicate low). Slight departures from prototype figures are possible, and may be ignored. But large differences—especially if different for corresponding points of the two channels, indicate faulty components or wiring errors, and should be traced and removed. It is advisable to check all wiring very carefully before first switching the completed amplifier on. ■

Trade News

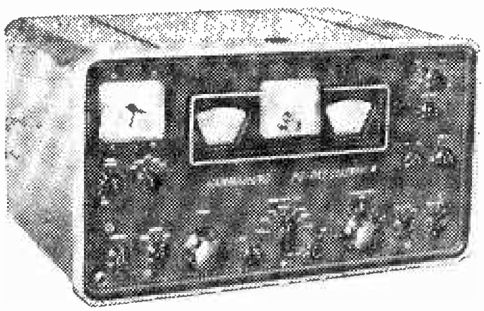
Sound Effects Tapes

THE recently issued series of Castle sound effects records is now available as pre-recorded tapes. These tapes have been made of all the Castle records so far released and will be made of future discs.

The tapes are recorded direct from the masters at a speed of 3¾in.p.s., full track, and are accommodated on standard 3in. spools. This means the tapes can be replayed on all standard full track, half track or quarter track recorders, irrespective of track selection.

The tapes have the same coding as the records and follow exactly the effects and timings of the respective discs. The price of a tape is 18s. 6d.

Produced by F. C. Judd (Sound Recording) Limited, the tapes are distributed by *Recorded Tuition Limited, 174 Maybank Road, South Woodford, London, E.18.*



The Hammarlund HQ-170A triple conversion receiver.

Triple Conversion Receiver

IN the familiar style of Hammarlund receivers, the HQ-170A makes its first appearance with claims of improved stability and overall performance on previous models. The many refinements of this new receiver make for optimum reception of ssb/c.w. and a.m./mcw, and vernier tuning, adjustable band-width, etc, help to make the HQ-170A an attractive set for the amateur.

The 17-valve circuit incorporates an automatic noise limiter and allows triple conversion for i.f. frequencies of 3035kc/s, 455kc/s and 60kc/s. The circuit front end provides tuning over the 6, 10, 15, 20, 40, 80 and 160m bands. *K. W. Electronics Limited, Vanguard Works, 1 Heath Street, Dartford, Kent,* are the U.K. agents for Hammarlund equipment.

Transistor Tester

A NEW portable transistor tester is being marketed by the Irongate (M.O.) Company Limited, which is capable of accurately testing both general and power transistors and diodes. The tester (model AT-1) is battery-powered and measures only 7½in. x 4in. x 3in.

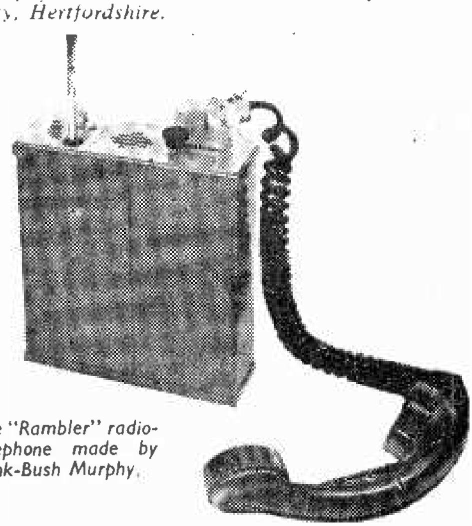
A large, easy-to-read meter is a feature of the panel of this instrument, as well as the quick-release spring sockets for holding the component under test. The price of the model AT-1 is £9 17s. 6d. and the makers are the *Irongate (M.O.) Company Limited, Irongate Wharf Road, Praed Street, London, W.2.*

Radio-telephone

ONE of the new radio-telephone equipments recently announced by Rank-Bush Murphy Electronics, is the "Rambler". This is a portable receiver/transmitter designed for two-way communication between fixed or mobile stations.

It employs a fully transistorised circuit and takes its power from a small mercury battery, which provides more than 50 hours operating life.

Amplitude modulation is employed in the Rambler, which operates in the range 50 to 140Mc/s. A small built-in loudspeaker and telescopic aerial are features of the equipment and provision is made for using either a microphone or lightweight handset. The price of the Rambler is 80 guineas and the manufacturers are *Rank-Bush Murphy Limited, Bessemer Road, Welwyn Garden City, Hertfordshire.*

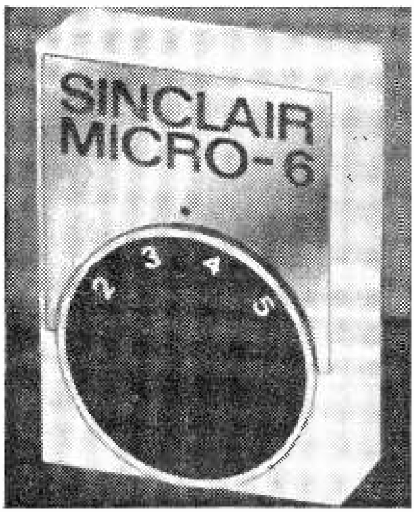


The "Rambler" radio-telephone made by Rank-Bush Murphy.

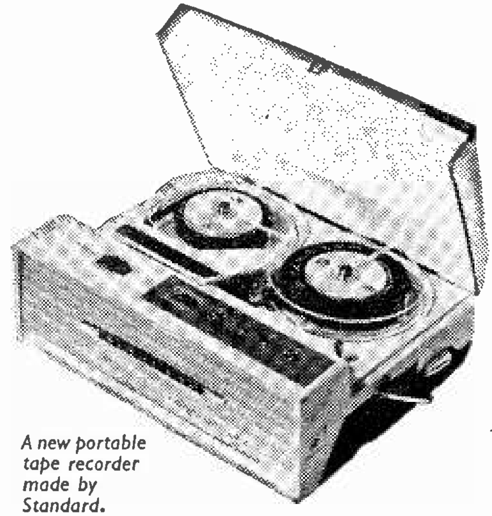
Miniature Transistor Receiver

A NEW six-stage transistor receiver kit has been announced by Sinclair Radionics Limited. Known as the "Micro-Six", this receiver, when fully assembled, measures only $1\frac{4}{5}$in. x $1^3/_{10}$in. x $\frac{1}{2}$in.

Power to operate the receiver is provided by a mercury cell which will last several months. Using an internal ferrite rod aerial, the receiver tunes over the medium wave band and delivers its output through an earpiece which comes complete with the kit of parts. Micro-miniature components and a printed circuit are employed in the construction, and building instructions accompany each kit. The Micro-Six may be obtained from *Sinclair Radionics Limited, 69 Histon Road, Cambridge,* at a cost of 59s. 6d.



This illustration shows, larger than life-size, the Sinclair Micro-Six.



A new portable tape recorder made by Standard.

Mains Battery Tape Recorder

THE Unicorder model SR-F6IRT is a portable tape recorder made by Standard which will operate from a mains supply or from ten torch-type batteries. Despite its small size—8in. x $6\frac{1}{2}$in. x 3in.—the Unicorder features two-speed, twin-track operation. The recorder takes $3\frac{3}{8}$in. tape spools and incorporates most of the facilities of standard-size machines. One unusual feature, however, is its facility for remote-control operation.

The SR-F6IRT employs two internal loudspeakers, each $2\frac{1}{4}$in. in diameter, although a socket for an extension speaker is provided. It is possible to operate the recorder in its leather carrying case which is included in the price—36 guineas. The U.K. agents for Standard products are *Denham and Morley Limited, Denmore House, 173/175 Cleveland Street, London, W.1.*

PORTABLE TRANSISTOR RADIOS

BACKED BY SUPER AFTER SALES SERVICE

ROAMER SEVEN Mk III

● 9 stages—7 transistors and 2 diodes

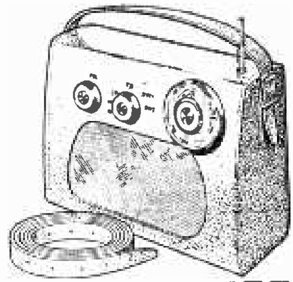
Covers Medium and Long Waves, Trawler Band and two Short Waves to approx. 17 metres. Push-pull output for room filling volume from rich toned heavy duty 5in. speaker. Ferrite rod aerial for M & L waves and telescopic aerial for S Waves. Air spaced ganged tuning condenser ensures wonderful stations selection. 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

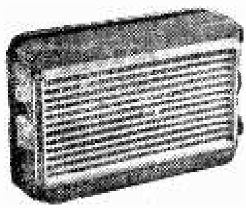
Total cost of parts now only **£5.19.6** P. & P. 5/6

Parts Price List and easy build plans 3/-.



TRANSONA FIVE

"Home, Light, AFN, 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 6¼ x 4½ x 1½in. 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/-

TRANSONA SIX NEW!

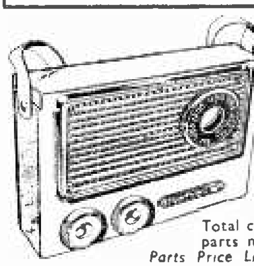
● 8 stages—6 transistors and 2 diodes.

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 6¼ 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

SUPER SEVEN



● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves and Trawler band. The ideal radio, can be fitted with carrying strap for outdoor use. Completely portable—has built in aerial for wonderful reception. Push-pull output, 3in. speaker (will drive larger speaker). Size 7¼ x 5¼ x 1½in. (Uses PP6 battery available anywhere.)

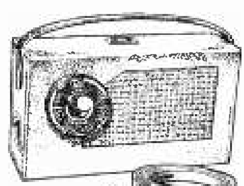
Total cost of all parts now only **£3.19.6** P. & P. 3/6

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

FREE! *Miniature Earpiece, plug and socket (value 9/6) and details of conversion to private listening.*



● 8 Stages—6 transistors and 2 diodes.

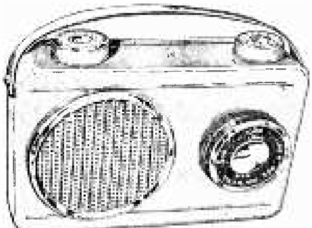
Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¼ x 3¾ x 1½in. 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/-

ROAMER SIX

FREE! *Miniature Earpiece, plug and socket (value 9/6) and details of conversion to private listening.*



● 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 6¼ 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/-.

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 supersensitive 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 1289 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. 9 to 5 p.m. 10—1 p.m. Sats.

Short Wave One

A simple, dry battery operated receiver, suitable for the beginner.

BY C. J. MITCHELL

THIS is a simple one-valve regenerative receiver which any beginner should be capable of building. The circuitry is quite standard but a novel form of construction is incorporated. This little set produced quite remarkable results when used with a short aerial (22ft.). Even Radio Australia has been heard at reasonable strength at the author's location (Epsom, Surrey).

The receiver is built on a standard two ounce tobacco tin with removable lid (not hinged type). This tin is extremely easy to make soldered connections to, and even a lightweight iron will suffice. The lid is removed and bolted to the upturned tin. The front can be painted, if desired.

Major Components

The coil used in the prototype was the Osmor type SWQ2, which covers 3·5Mc/s to 12Mc/s. Alternatively the type SWQ1 which covers 11Mc/s to 30Mc/s could be used. These coils have adjustable dust cores which will slightly vary the band covered.

An acorn triode type 955 was used, however an acorn pentode type 954 with anode, grid 3 and grid 2 strapped together would also be suitable. The author managed to purchase a valve base for the 955. This particular item may prove difficult to obtain, but it is stocked by some surplus dealers. On the other hand it is possible to solder the wires directly to the pins of the valve, and this is the obvious remedy.

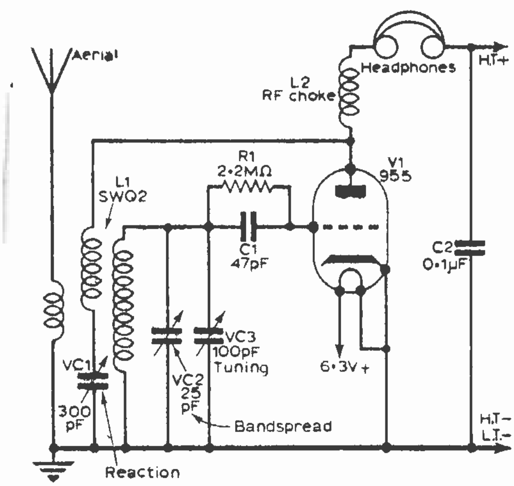
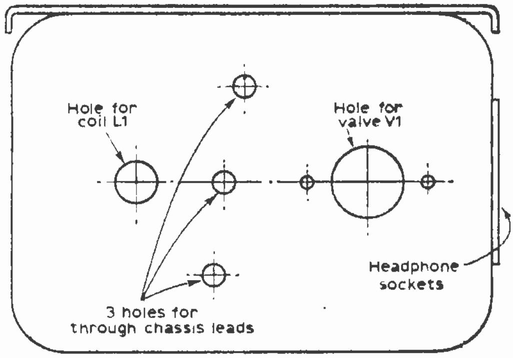


Fig. 1: The circuit of the receiver.



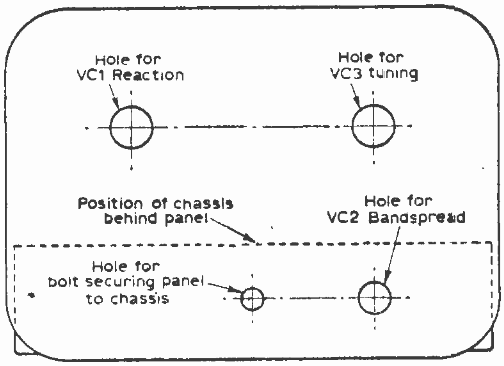


Fig. 2a (above): The tobacco tin chassis; b (below): the tin lid used as the front panel.

Tuning is performed by means of a 100pF solid dielectric variable capacitor VC3. A 300pF *small* solid dielectric capacitor VC1 suffices for reaction, and for bandspread a 25pF panel mounting trimmer VC2 was used.

This receiver is powered by dry batteries, and is especially convenient for beginners. Two 3V cycle headlamp batteries will be required for the heater and a 90V high tension radio battery for the h.t.

The two 3V batteries are connected in series (positive to negative) to obtain a 6V supply.

*Beginners should note that in its existing form this receiver is not suitable for use with **an a.c.** mains power unit.*

Construction

Having drilled the chassis and lid, as shown in Fig 2, bolt the front panel in position and mount the three controls—tuning, reaction and bandspread.

COMPONENTS LIST

R1	2·2MΩ carbon
C1	47pF ceramic or mica
C2	0·1μF paper
VC1	300pF solid dielectric variable
VC2	25pF air dielectric trimmer
VC3	100pF solid dielectric variable
L1	Coil 3·5 to 12 Mc/s (Osmor SWQ2)
L2	R.F. choke 2·5mH
V1	955 or 954

Next mount the valve holder (if used), using suitable stand-off insulators if necessary. Then follow with the headphone socket, coil and grommet for power lead.

Now start on the soldering by earthing the moving vanes of all the variable capacitors, the cathode and one side of the valve heater, and also the appropriate tags of the coil. Next connect up the tuning, bandspread and reaction capacitors to their respective parts of the coil: then wire the grid leak resistor R1 and capacitor C1 and finally the r.f. choke and the power lead.

Operating

Connect an earial and earth to the set and plug in a pair of medium or high impedance headphones.

Connect up to the l.t. and h.t. batteries and switch on. Adjust the reaction control until the set is *almost* into oscillation then rotate the tuning controls to bring in the signals. The bandspread capacitor is used for fine tuning. The reaction

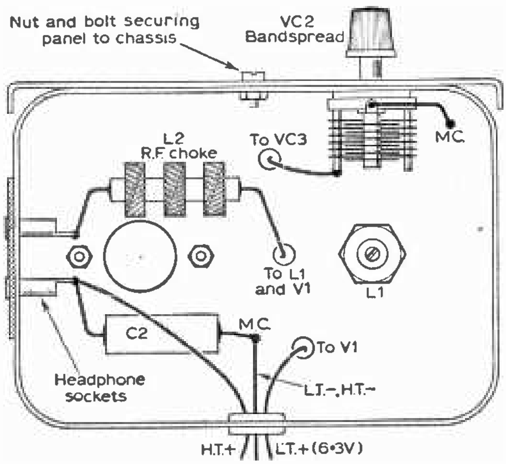
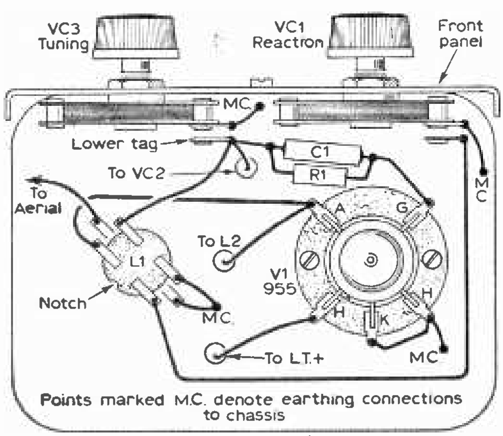


Fig. 3a (above): The underside wiring; b (below): the wiring on the top of the chassis.



Tobacco tin used as chassis and lid as front panel

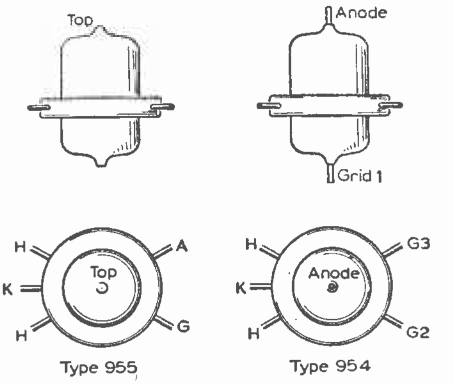


Fig. 4: Connections to two types of acorn valves which may be used in this set.

control will need adjusting occasionally during the tuning as its optimum setting varies from one end of the scale to the other.

If no signals are heard then it is most likely that the connections to the reaction coil need reversing.

Using the reaction control carefully so that the receiver is always operating at the point of maximum sensitivity, it should be possible to receive signals from all parts of the world. ■

● **SCOOP ! Hi-Fi 10 watt Amplifier £7.10.0** complete. Carr. 5/6. Branded manufacturer's model (cartoned). Very latest high efficiency valves. Push-pull output. Separate bass-treble controls, dual input for "mike". 3 or 15 ohm speakers. High sensitivity. Fully guaranteed.

● **SCOOP ! Baby Alarm or Intercomm. Kit.** Complete set of parts with diagram, etc. Housed in Two beautiful moulded plastic cabinets of pleasing design. High sensitivity, Fully Controllable. Only **4 gns.**, carr. 5/-, or Assembled Ready for Use, **£5.**

● **SCOOP ! 17in., £11; 14in. £7.** 12 months' fully written guarantee. Channels for all areas. Insured. Carr. 14in. 20/-; 17in. 30/-. These TV sets are ex-Rental, already well maintained. We regun tubes ourselves. Valves and parts are manufacturers' surpluses. ALL SETS have a written guarantee covering valves, tubes and components.

● **SCOOP ! Set of 6 Transistors and Diode.** Brand new. Beautifully Boxed. Complete with Circuit, 15/0, P.P. 1/-.

DO IT YOURSELF

Build a Record Player and save Pounds

The Cheapest Way The L.K. Way

Famous Autochanger or Single Player Units supplied with brand new, two-tone, de-luxe portable cabinets. 17 x 15 x 8¼in. Strong carrying handle, gilt finish clips and hinges as used by famous make for 22 gn. model. Ready cut out motor board. 14 x 13in. Front baffle 7 x 4in. High flux loudspeaker and 3 watt amplifier. Amplifier ready built on metal chassis with output transformer, volume and tone controls. All items fit together perfectly. Special instructions enable assembly in 30 minutes. Only 5 wires to join. 12 month's written guarantee. Available separately or package deals as below.

L.K. PRICES FOR COMPLETE KITS:

Autochanger Kits as above

B.S.R. U.A.14	£11. 0.0	P.P. 5/6
Garrard Autoslim	£11.10.0	P.P. 5/6

Single Player Kits as above

Garrard S.R.P.10	£10.15.0	P.P. 5/6
E.M.I. Autostop	£11. 0.0	P.P. 5/6

Individual Prices for those who wish to purchase separately.

Record Player Cabinet with Cut-out Board	£2.15.0	P.P. 3/6
Amplifier with 7 x 4in. speaker	£3.10.0	P.P. 2/6

Auto-changers

B.S.R. U.A.14	£5.10.0	P.P. 5/6
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Single Players

E.M.I. Auto-Stop	£5. 7.6	P.P. 4/6
Garrard S.R.P.10	£5. 7.6	P.P. 4/6
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Transcription Units—Stereo—Mono

Garrard 4 H.F.	£16. 0.0	P.P. 5/-
Philips A.G.10/16	£12. 0.0	P.P. 5/-
Garrard A.T.6	£10. 5.0	P.P. 5/-

● **SCOOP ! 10in. Speakers by W. B. of Mansfield.** A beautiful H-Fi Speaker in maker's cartons. Fully guaranteed. Our price, **42/-.** P.P. 1/10.

● **SCOOP ! A First-Class 2 Wave-Band Superhet Chassis, 6 Transistor.** By world famous manufacturer. Fully built, tested, aligned, boxed, guaranteed. Our price only **£4.4.0.** Suitable speaker 35 ohms, **10/6.** A cabinet can be supplied for **22/6** only. Hurry while stocks last. P.P. 2/3.

● **SCOOP ! Record Player Amplifier.** 2 valve, A.C. mains. Output 3 watts. Ready built, tested, guaranteed. Complete with valves, output transformer and speaker. Our price 50/- only. Product of national manufacturer. P.P. 1/6.

● **SCOOP ! B.S.R. U.A.14 Auto-changers.** Brand new and wired for stereo. Note **OUR** price **£5.10.0** only. P.P. 5/6.

● **SCOOP ! A Short Wave Receiver.** Speech and music from all over the world, covering 40-100 metres. Conversion for 10-100 metres if required. This is not a toy but a receiver fully built, tested and guaranteed. Our price **62/-**, in kit form **42/-.** P.P. 2/3.

● **SCOOP ! Personal Radio.** Built in ferrite rod aerial. Medium wave only. Wonderful volume. Size 2¼ x 3¼ x 3¼in. Fits in the palm of the hand. In kit form only, **32/-** complete in every detail. P.P. 1/9.

● **SCOOP ! Top Quality Recording Tape** (1/- per tape, 6 or more post free).

4in.	600ft.	12/6	5¾in.	1200ft.	17/6
5in.	600ft.	12/6	5¾in.	1800ft.	35/-
5in.	900ft.	17/-	7in.	1200ft.	17/6
5in.	1200ft.	30/-	7in.	1800ft.	26/6
5¾in.	850ft.	15/-	7in.	2400ft.	45/-

A reduction of 6d. per reel for all Hospitals and Professional Users. This tape is fully guaranteed.

● **SCOOP ! The Wiltonia—Pre-assembled for only 75/-,** P.P. 2/6 extra. Real calf carrying case and earpiece included free of charge. Six transistor superhet miniature personal radio. Ferrite rod aerial. I.F. frequency 470 Kc/s. 3in. speaker. Printed circuit 2¼ x 2in. Slow motion drive. In beautiful plastic case, size 4 x 2¼ x ¾in. In order to ensure perfect results the Wiltonia is supplied to you with R.F. and I.F. stages. Driver and output stages ready built with all compartments mounted on the printed circuit. The Wiltonia pre-assembled can be completed in half an hour with no soldering and tools whatsoever.

● **SCOOP ! 1964 Radiogram Chassis, 3 wave bands, 5 valves.**

S.W. 16M to 50M.	Five Valves.
M.W. 200M. to 550M.	Latest Mullard.
L.W. 800M. to 2000M.	E.CH.81, E.F.89, E.B.C.81, E.L.84, E.Z.80.

12 months' guarantee.

A.C. 200-250 v. 4-way switch, short to medium, L/gram, ferrite aerial A.V.C. Negative feedback, 3 ohm output, 5 watts, glass dial, horizontal wording, size 13in. x 4in. Aligned and calibrated. Isolated chassis, size 13¼in. x 9in. high x 5¼in. deep. Our price **£8.15.0.** Carr. 4/6 extra.

● **SCOOP ! "NOTON" Seven Transistor 2 wave-band.** Brand new design. For car radio and general purpose giving 1 watt output when connected to any standard 3 ohm speaker. All parts available separately. Size 7 x 5 x 1¼in. Building plans **2/6** (Free with kit).

This versatile units has been designed to fit into a variety of cases, and all components down to control knobs and battery clips are supplied together with clear illustrated plans. It gives a superb performance with dozens of stations including Luxembourg when connected to a 9-volt battery and speaker. Only **£6.15.0** complete. P.P. 2/-.

● **SCOOP ! "NOTON" Mains Power Pack Kit for Transistor Radios.** Boosts and generally extends life of old batteries, in attractive two-tone plastic case. Assembled in one hour. Miniature size, 4 x 2 x 1¼in. Normal output 9 v. 100mA. Full mains transformer. Full wave germanium diodes. Cartridge fuse. Runs radio direct from mains.
Complete kit with plans, **33/-.** P.P. 1/6.
Ready Assembled **42/-.** P.P. 1/6.

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TEST GEAR accessories

Part 2

BY C. MACKAY

CONTINUED FROM PAGE 931 OF THE FEBRUARY ISSUE

LAST month, the construction details for a dummy aerial unit were given. This month the construction of a diode detector probe will be described and some of the applications of such a probe discussed.

THE DIODE PROBE

The circuit diagram of this diode detector probe is given in Fig. 4, and the unit was built inside a Denco coil screening can as was the dummy aerial.

The probe section (Fig. 5) consists of a length of 16s.w.g. copper wire inside an equal length of 2mm "Systoflex" insulated sleeving. Both were then placed inside a 4in. length of copper tubing of 6B.A. inside diameter size. A metal wire retainer was used for clamping the lower end (as tightly as possible) and a right-angled bracket is used to bolt this whole sub-assembly to the underside of the screw-on lid so that only the probe part projects through a suitably drilled hole in the centre of the lid (Fig. 6).

A solder tag should be fitted under both sides of the fixing bolt so that a short length of flex with a crocodile clip can be used for making a "chassis" connection, and for an internal "chassis" connection.

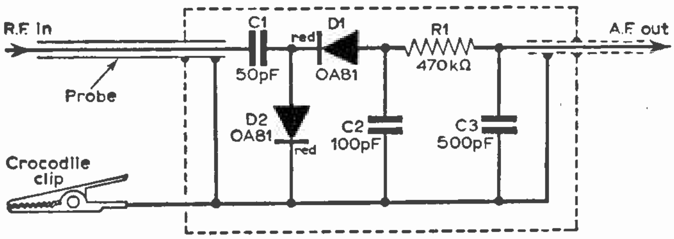


Fig. 4 (above): The circuit of the diode probe unit.

WIRING UP

Originally a tag strip was used in a manner similar to that used for the dummy aerial, but since things became rather crowded, it was decided that the tagstrip was too much of a liability. Because of this the components were made completely self supporting on their connecting wires as shown in Fig. 6.

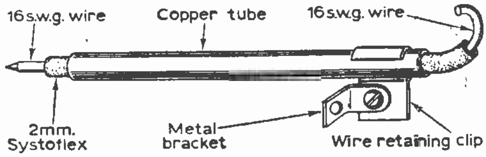


Fig. 5 (right): Details of the probe.

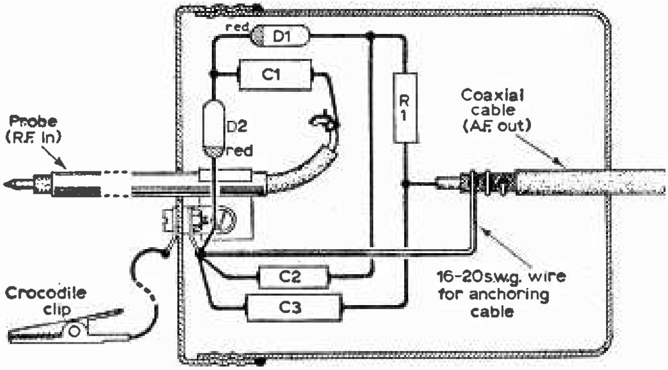


Fig. 6 (below): Construction of the probe unit.

Next a hole was drilled in the centre of the base of the can to take the connecting cable. This cable is connected as shown in Fig. 6 and is supported by the cable outer conductor.

The detector probe is used for removing the high-frequency carrier from a modulated wave, and, as will be explained, it can be used for signal tracing in receivers, tracing resonance curves by means of a wobbulator and an oscilloscope, and for the testing of modulators.

USE WITH A SIGNAL TRACER

One of the quickest and easiest methods of tracing a fault in a receiver is by means of the "signal-tracer" method.

In this method, only the working part of the receiver next to the aerial is used, the rest of the set being by-passed and temporarily replaced by the signal tracer. Thus, if the fault occurs in an audio stage, only another audio amplifier is required. The audio amplifier need not be be very elaborate, and a simple two-valve plus rectifier type is perfectly sufficient. The circuit of a suitable signal tracer is shown in Fig. 7 with component values. Note that all input leads should be completely screened in order to avoid any hum pick-up.

USING THE PROBE

If the fault occurs in a stage handling carrier or intermediate frequency signals, the reader might think that it would be necessary to provide a tuned high-frequency amplifier. This would be, however, rather costly, and instead, the signal is detected and fed into an audio amplifier. This is where the diode detector probe is used.

COMPONENTS LIST FOR DIODE PROBE UNIT

R1	470kΩ carbon 1W
C1	50pF ceramic
C2	100pF ceramic
C3	500pF ceramic
D1	OA81 Mullard
D2	OA81 Mullard

Miscellaneous:
16 s.w.g. wire (about 6 inches). 2 mm Systoflex (about 6 inches). 4 inches of copper (or brass) tubing to take 6 B.A. studding. 2 yards coaxial cable. 2 feet flex. 1 crocodile clip. 1 screening can (Denco (Clacton) Ltd.). 1 wire retaining clip. 1 Meccano right-angled bracket.

number of faults have somehow occurred simultaneously, they can all be systematically detected and cured.

WARNING

If any tests are going to be made on "live" chassis sets, care should be taken to ensure that the chassis is connected to the "neutral" side of the mains, and that all test instruments are isolated from the mains and also are NOT earthed.

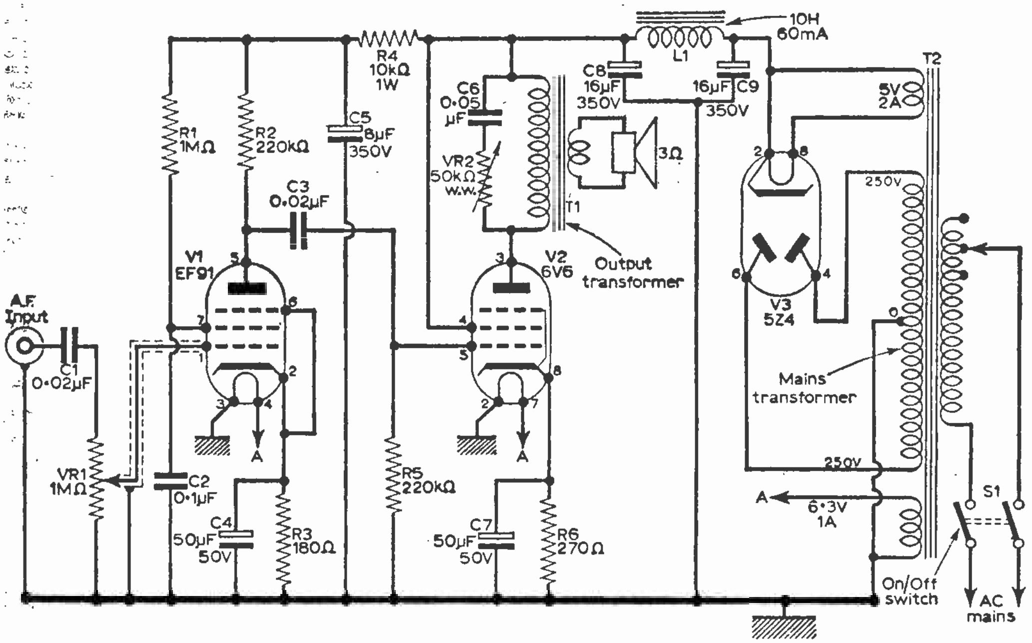
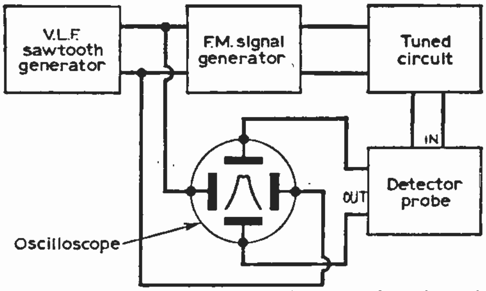


Fig. 7: The circuit of an inexpensive signal tracer.

The modulated carrier is fed into the probe. and the audio output is taken to the amplifier. If the audio signal is heard clearly in the loudspeaker. then that part of the receiver between the aerial and the point where the tapping was taken for the probe must obviously be working properly. By applying this method to various points in the receiver, the faulty region may be quickly found, and the fault eliminated. It can be seen that if a

WOBBULATION

Wobbulation is the varying of the frequency of an oscillator above and below its basic frequency at some definite rate. This frequency modulated signal is fed into the apparatus to be examined. The ouput is detected and rectified by means of the detector probe unit and fed into the Y-amplifier of an oscilloscope, while the



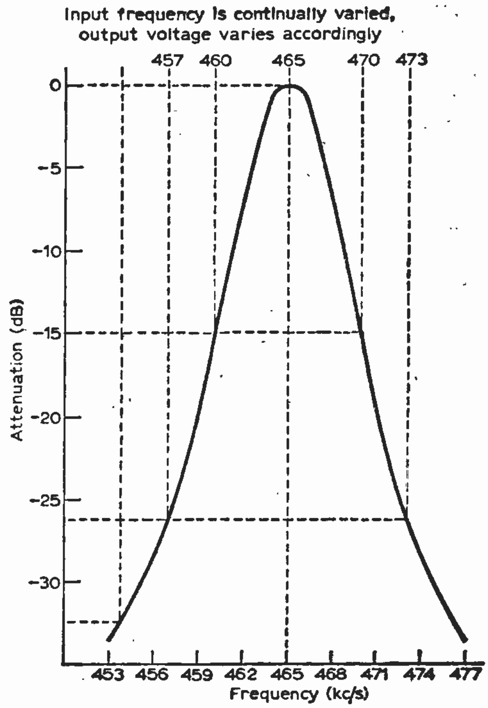


Fig. 8a (above): Using the probe in conjunction with an oscilloscope.
Fig. 8b (right): A graph of attenuation against frequency—see text.

modulating signal is fed into the X-amplifier Thus a trace is produced on the screen of the oscilloscope which gives a graph of amplification (or attenuation) against frequency. (See Figs. 8a and 8b.)

TESTING MODULATORS

The detector probe may be used for testing modulators as follows.

The output of the modulator is rectified and detected by the probe unit, and the output is fed into an audio amplifier. The modulating signal should be faithfully reproduced in the loudspeaker if the modulation is working correctly. Care should be taken not to overload the probe.

Part 3 appears next month.

Audio Testing with the P.W. "Sixteen"

—continued from page 1047

This h.f. bias is supplied by an oscillator, which may be a dual-purpose valve, or section of a valve, doubling as an output stage for playback.

Modern tape recorders also use this circuit as a source of current for erasure. The erase head is fundamentally a power device, and the current is the important factor. The multimeter, switched to the 250V a.c. range, will give an indication of bias by connecting it between chassis and the "live" side of the head connections, on the medium and high impedance heads used on the majority of popular tape recorders.

The actual reading of voltage is not important unless specification tests are being made—in which case a valve-voltmeter is usually stipulated. Fortunately, on the majority of models, it is sufficient to check that a.c. is present: only on the semi-professional machine will an adjustment for frequency be found, and the preset resistor or concentric capacitor found on many other popular models is simply set for near maximum amplitude of bias.

Low Impedance Heads

On machines that employ low impedance heads it will be difficult to obtain a satisfactory indication. and a better method of assessing efficiency is to read the current. The model "Sixteen" Multirange Meter is not adapted for a.c. current readings—they are seldom required—and a quite simple way of overcoming this is to insert a small resistor, 10-100Ω in the earthy lead of the head being tested and measure the a.c. voltage developed across it.

It is sometimes necessary to check the phase connection of a matched input, such as a stereo tape head or pick-up crystal. This can occur when a four-connection head, for example, has been disconnected and there is some doubt about tag sequence. A meter between the "live"—non-earthy—terminals of the output of each channel should indicate zero volts when phase is correct. In practice there may be some small standing voltage.

To sum up—each user of the "Sixteen" Multirange Meter will have a number of applications to add to the foregoing. A meter is an "individual" instrument, and a good one is invaluable.

PURCHASING THE COMPONENTS

All components required for building the PRACTICAL WIRELESS "Sixteen" Multirange Meter should be obtainable from radio component dealers. If any difficulty is experienced in obtaining these items readers are advised to contact Lasky's Radio, 207 Edgware Road, London W.2, who are the main distributors for PRACTICAL WIRELESS "Sixteen" components.

It is again emphasised that the various manufacturers concerned do not normally supply direct to individuals.

CLUB NEWS

COVENTRY AMATEUR RADIO SOCIETY
Hon. Sec.: A. J. Wilkes, G3PQQ, 141 Overslade Crescent, Coundon, Coventry, Warwickshire.

To encourage members to attend meetings more frequently, the Society's committee has organised an interesting and varied programme of lectures and events for 1964. Added incentive for members to make regular attendances is provided by the new and more desirable club room at the T.A. headquarters, where the Society has permission to erect whatever aerials it requires and has already taken advantage of this by erecting 2m and 160m aerials.

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

At the open evening of January 8th, the Treasurer collected members' subscriptions for 1964. A film show was given for the meeting of January 15th and a week later, some "Practical Hints and Tips" were given for beginners and junior members of the Society.

The Annual General Meeting was held on February 5th, when a new committee was elected for the forthcoming year.

GOSPORT COMMUNITY ASSOCIATION AMATEUR RADIO CLUB
Hon. Sec.: R. E. Daw, Troodos, 34 Anglesey Road, Alverstoke, Hampshire.

R.A.E. lectures are currently being given at the Monday evening meetings of this Club and beginners to the hobby can be sure of receiving assistance with their constructional projects from the more learned members.

At most meetings the Club transmitter is on the air.

GRAFTON RADIO SOCIETY
Hon. Sec.: A. E. Bristow, 37 Tyndale Mansions, Upper Street, London N.1.

All future "Worked All London Town" (WALT) awards—which are made available by this Society—will be made under revised rules. Certificates are awarded to radio amateurs throughout the world who can provide proof of two-way communication—in compliance with set rules—with London amateurs in 65 of the 118 London Postal Districts, and because of the recent increase in mobile activity, a limit on the number of /M contacts acceptable in applicants' lists of contacts claimed has been introduced.

Copies of the revised rules may be obtained on request, from the Society secretary.

INTERNATIONAL SHORT WAVE CLUB
Sec.: Arthur E. Bear, 100 Adams Gardens Estate, London S.E.16.

As its title suggests, this Society has members in many countries throughout the world and it is pointed out that any readers interested in joining the ISWC can obtain a copy of the Club's news bulletin (International Short Wave Radio) on application to the above address.

MID-WARWICKSHIRE AMATEUR RADIO SOCIETY
Hon. Sec.: T. Inkester, 13 Dormer Place, Leamington Spa, Warwickshire.

The first event in this Society's calendar of meetings for 1964, was the Annual General Meeting held on January 13th.

MITCHAM AND DISTRICT RADIO SOCIETY
Hon. Sec.: A. Thurley, 50 Bruce Road, Mitcham, Surrey.

Recent attendance figures have given promise of continued growth for this Society in 1964.

January's meeting was devoted to a junk sale which was held on the 17th.

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

This Society's committee met on January 15th, which for other members remained as an informal evening. The film show which was given on January 29th was well received by all present.

February began with a ragchew meeting on the 5th.

READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook Road, Reading, Berkshire.

The Dinner and Social evening held on January 18th was enjoyed by the many members who attended this, the first Club event of 1964.

Another important event in January was the Annual General Meeting held on the 25th. At this meeting the Treasurer's report and a review of the Club's activities during the past year were given. This meeting also saw the election of a new committee of Club officers and a discussion of the programme of events for 1964.

RODING BOYS' SOCIETY: RADIO SECTION
R. Marchant, 154 Essex Road, London E.10.

This Society's active efforts to increase membership have been aided by demonstrations at recent exhibitions. As well as a number of new members, this Society has recently obtained its own call-sign; G3SRE.

SPEN VALLEY AMATEUR RADIO SOCIETY
Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Leeds.

The display of members' gear, which was held on January 9th, was attended by members of the Leeds, Bradford, Halifax and Northern Heights Radio Societies. Later in the month, members heard a talk on "Modern Methods of Weather Forcasting", which had been arranged by the Met. Office of the Church Fenton R.A.F. Station.

On February 4th a group of members paid a visit to the Halifax Radio Society and on February 6th, Mr. W. Dougherty lectured on "Noise Problems."

STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: R. A. G. MacIntosh, 50 Field Lane, Oldswinford, Stourbridge, Worcestershire.

The January meeting of this Society was held on the 14th when Mr. G. Woolfenden gave the first of two talks on v.h.f. and hi-fi entitled "Hi-fi Without Tears."

UXBRIDGE RADIO SOCIETY
Hon. Sec.: A. Duell, "Treetops", Bakers Wood, Denham, Buckinghamshire.

The first meeting of the New Year was held on January 6th, but the main meeting of the month—the Annual General Meeting—was held on the 13th.

WEST KENT AMATEUR RADIO SOCIETY
R. Trevitt, 28 Dales Avenue, Tunbridge Wells, Kent.

The meeting for January 10th was devoted to discussions on audio subjects with demonstrations of some audio equipment. On January 24th, members heard the third of H. F. Richards' talks under the title "100 Years of Wireless", his topic this time being "Broadcasting and TV."

The Society was represented in the Affiliated Societies' Contest (February 1st and 2nd) by a number of members who turned out to help with and operate the station.

THE AMATEUR RADIO CLUB, BANGALORE
Post Box 53, Bangalore-1, India.

Any radio society might envy the record of the Amateur Radio Club of Bangalore, India, which although only three years old, has more than 100 members and claims to be the Country's leading society. The Club's membership includes many licensed amateurs and the Club station—VU2TT—is an active user of South India's amateur bands. It also boasts SWL and YL sections and has its own library.

As impressive as its rapid growth is the Club's quarterly magazine SIRAN (South India Radio Amateurs' Newsreel). This publication has the familiar duplicated style of many British society bulletins, but has the distinction of being eighteen foolscap pages in length and full of Club news, comments, letters, constructional articles, etc.; an admirable production for a completely amateur society.

The Amateur Radio Club, Bangalore is obviously going to continue to be an important factor in the spread of amateur radio in India and we wish it every success.

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Note to Customers

FOLLOWING a number of complaints concerning the non-delivery of goods ordered by post (due to non-arrival of correspondence) between November 10th and December 31st, the Post Office Special Investigation Department have since discovered, and dealt with, the cause of the losses.

Customers so affected are asked to claim for the loss of postal orders and re-order if necessary.

The Post Office and Henry's Radio Ltd. regret any inconvenience caused to customers by this unfortunate episode.

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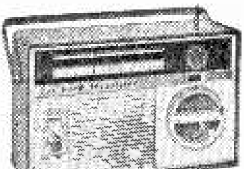

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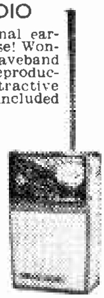

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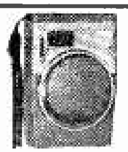

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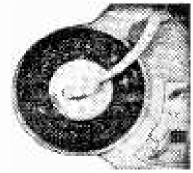

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Acos G.P.67/1	14	0
STEREO Acostereo 73/1, with 2 sapphires	25	0
Acostereo 73/2 with diamond LP/Stereo and sapphire std.	29	6
Collaro type C Turnover with 2 sapphires	19	11
Collel S.C.I. Turnover, with 2 sapphires	19	11
Collel S.C.I. Turnover with diamond LP/Stereo and sapphire std.	25	0
Ronette Stereo O.V. Turnover with 2 sapphires	25	0
Ronette Stereo types 105 and 106 with 2 sapphires	35	6
Ronette Stereo types 105 and 106 with diamond LP/Stereo and sapphire std.	39	6

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2,400ft. Double Play on 7in. spool	25	0

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LETTERS TO THE EDITOR

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

DECEPTIVE VOLTAGE MEASUREMENTS

SIR,—There must be many high resistance meters (20,000Ω/V or more) now in use by amateurs and, of course, they are particularly suited for measuring voltages in high resistance circuits. However, when it is necessary to determine the voltage of a small dry battery, a lower resistance meter is preferable, as this is likely to give a more exact indication of the condition of the battery.

A high resistance meter will show the correct voltage, if the battery is new, with a low internal resistance: but when the battery is partially or nearly exhausted, the voltage registered will be higher than that obtained under ordinary working conditions.

As an example, a nearly exhausted 3V battery gave a reading of about 2·5V on a high resistance meter, but with a lower resistance meter, the voltage was shown to be only a fraction of 1V. This was due to the fact that it only requires a minute current to operate the high resistance meter, and a battery tested by it may be passed as being up to standard when it is actually of no practical use.—H. IVOR JENKINS (Bridgend, Glamorganshire).

TAPE ACCESSORIES

SIR,—I should like to pass on a useful tip regarding broken drive belts of tape recorders. A suitable replacement for such a drive belt, if a new one is not available, can be manufactured by neatly cutting the wrist end off a rubber household glove.

This will prove to be a very serviceable substitute and one which I fitted to my tape recorder last May has so far not slipped nor stretched as was the tendency of the original belt. — R. W. CRAIG (Bexley, Kent).

CHROME TAPE SCREENING AGAIN

SIR,—Mr. Evans ought really to have checked his facts before writing his letter (December issue) in which he refutes a previous suggestion that chrome tape could be used for screening wires. This tape is, admittedly, made of plastic, but the chrome finish is given by a thin coating of aluminium deposited on the tape under vacuum. The coating is electrically continuous and exactly the same type of coating is used in the manufacture of capacitors.

There is, therefore, no reason why chrome self-adhesive tape should not be used for screening purposes, provided the practical difficulty of connecting the aluminium to earth (the coating is sandwiched between the body of the tape and the adhesive layer) can be overcome. — C. E. A. SWINDIN (Wick, Gloucestershire).

A LACK OF COURTESY HERE

SIR,—On a number of occasions I have replied to requests for back numbers of P.W. appearing on the Letters to the Editor page, and I would like to inform you of some of the results of my efforts to help other readers.

One recipient in Glasgow returned the issue I had sent saying he was over-supplied; another returned two copies a week later saying he no longer needed them and a third returned the copies informing me that he had received what he wanted a month previously through a request he had placed in another magazine!

I have done my best to help these readers and have spent a couple of shillings on postage without recompense. After this I think I shall keep my copies of P.W. to myself and let those who are interested *buy* the magazine, rather than *borrow* it. —W. W. PERRIN (Penarth, Glamorganshire).

CONVERTING CONVERT

SIR,—Radio construction has been my hobby for about three years and from the pages of your magazine I have built several pieces of equipment which have, on the whole, operated well. In common with most other constructors I know, the first step I make in building any unit is to collect all the components required. Next the chassis has to be drilled, the components mounted and wired up, any necessary adjustments made and finally a cabinet built. Now your excellent publication provides detailed instructions through all of these stages for each piece of equipment described and although it may provide a good deal of satisfaction when finished, the thought that it was necessary to follow step-by-step plans somewhat dampens the spirit when the latest box-of-tricks is demonstrated before admiring friends. To design one's own equipment would provide an answer to this frustration, but for myself, at least, this presented too many problems. I have, however, struck upon an outlet for my whims which I recommend to other readers who now and again feel the need for independence.

The idea is by no means new, for radio amateurs have been relying on it to provide their equipment for many years. I refer to the conversion of second-hand commercial and service equipment. For the ham, ex-government equipment is a boon, but for those, like myself, merely seeking amusement from repairs and modifications, it has many disadvantages when it comes to tracing information on which the constructor may base his experiments. Far more satisfaction can be obtained, in my opinion, from second-hand television and radio receivers, radiograms and record players, which may be obtained in their hundreds for ridiculous prices, some in working order. I have bought magnificent specimens of equipment selling for a few pounds in good working order, their only fault being their age, and I have enjoyed many happy hours repairing and converting such equipment, with no feeling of "cheating" by having all the information to hand.—D. G. JENKINS (Guildford, Surrey).

Sir—I would be grateful if any reader could sell or loan me . . .

. . . the issues of P.W. giving mains conversion details of the No. 19 set.—T. E. JONES, Red Cow Inn, Penybryn, Wrexham, Denbighshire.

. . . the circuit of the CR.100 communications receiver.—W. EDMONDSON, Arundale, Barrington Road, Letchworth, Hertfordshire.

. . . the manual or any information on the Eddystone model B.34 receiver.—Yap Pah Tho, c/o Ministry of Education, Federal House, Kuala Lumpur, Malaysia.

. . . the August and September 1959 issues of P.W. —F. GRIFFIN, 8 Speke Road, Speke, Liverpool 24.

. . . the handbook for an ex-R.N. R/T. pattern 4660.—R. LITTLE, 19 Waterfield Road, East Sleekburn, Bedlington Station, Northumberland.

. . . the February 1963 issue of P.W.—D. M. BILSBY, 31 Hainge Road, Tividale, Tipton, Staffordshire.

. . . the circuit or any data for the R.1515 receiver. —R. G. W. BARTOCK, 38 Bittell Road, Barnt Green, Birmingham.

. . . the circuits and manuals of the recording bridge type R.B.150 and the receiver R.206.—R. S. MARTIN, 41 Mayfield Road, Northfleet, Kent.

. . . the circuit and data for the R.1155 receiver— H. BRUNKER, 104A Bethune Road, Stoke Newington, London, N.16.

. . . the Air Ministry pamphlet AP2879AF.— S. G. JONES, 393 Manchester Road, Lostock, Northwich, Cheshire.

. . . the service manual for the No. 38 Mk. II transceiver.—H. HUMPHRIES, The Old Vicarage, Gazeley, Newmarket, Suffolk.

. . . the circuit and other data on the R.109 receiver. —D. G. VAUGHAN, c/o The London School of Flying, The Aerodrome, Elstree, Hertfordshire.

. . . the May 1962 issue of P.W.—A. MILBURN, 27 Chequerfield Road, Pontefract, Yorkshire.

. . . the circuit and/or manual for the Murphy model SA104R receiver.—W. G. PRICE, 228 The Broadway Dudley, Worcestershire.

. . . any circuit details of the R.1132A communications receiver.—A DIPPER, 50 St. Cuthberts Avenue South Shields, Co. Durham.

Wow and Flutter

—continued from page 1061

and subtracts as the record and replay periodic peaks come into and out of phase. As an example, a pressure roller that has a deformation causing a wow twice per revolution could have a resultant effect on replay that varies between one and three peaks per revolution, and this random cancelling greatly reduces the aural effect of the fault.

Peak-to-Peak Values

It will be noted that percentage figures are given with each fluttergram. These are integrated readings, at r.m.s. values, and where a machine has a specification of ± a certain figure, this must be multiplied by 0·707 to reduce it from the peak-to-peak value.

In certain cases, where a peak-to-peak specification is stated, it is necessary to interpret this to obtain a fair comparison with other machines. Thus, the Grundig TK40, an excellent domestic model, has a specification of ±0·12% at 3¾in/sec, which becomes the much more revealing figure of 0·085% r.m.s. For a really pessimistic view of wow and flutter specifications, it may be necessary to multiply the peak reading by $\sqrt{2}/2$, or 0·35, where the waveform is sinusoidal, and allowance has to be made for the most stringent conditions.

From the above it can be seen that wow and flutter is a real problem. Its elimination exercises the utmost ingenuity of designers. That the specifications of current models should be so low is a tribute to their labours. ■

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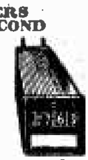

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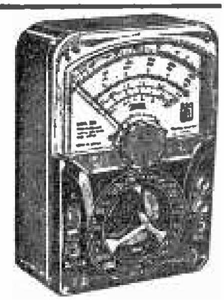

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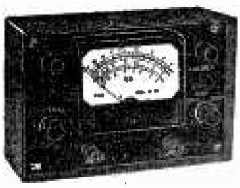

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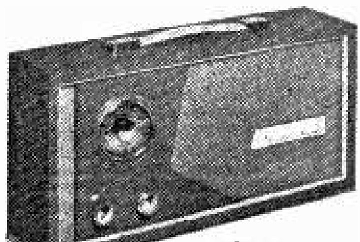

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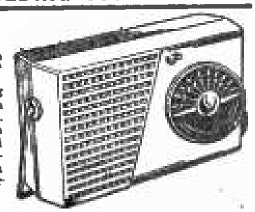

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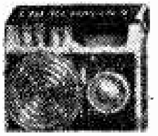

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Stock No. 116—ANOTHER TYPE RADIO CABINET, horizontal. 2/6 each, plus 6d. P. & P.

Stock No. 125—BRAND NEW MAGNETIC DEAF AID TYPE EARPIECES, complete with Plug and Socket. 300 ohms. OUR SPECIAL PRICE 5/-, plus 6d. P. & P.
Stock No. 126—BRAND NEW CRYSTAL DEAF AID TYPE EARPIECES. Our price 4/- plus 6d. P. & P.

Stock No. 127—DECORATIVE SPEAKER GRILLS 2in. diameter, 3 for 1/-, plus 6d. P. & P.
Stock No. 128—4in. PLASTIC CARRYING HANDLES with fixing screws, 6d. each, plus 6d. P. & P.
Stock No. 135—93 ONLY STANDARD PLASTIC CEILING SWITCHES, two way, cord operated Clearance price 2/6, plus 1/- P. & P.

AMAZING NEW INVENTION

AUTOMATIC CAR LIGHTER

ONLY 10/-

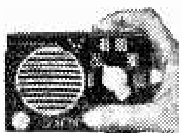
We have been lucky enough to purchase 1,500 only of these fully automatic Car Cigarette Dispenser/Lighters because of a frustrated export shipment. Originally made to sell at about 45/-! Robust and ingeniously designed in heavy chromium. Holds packet of cigarettes (any make and size) you reach out with one hand, press a button and a lighted cigarette is in your hand! Can be fitted by anyone in 2/3 minutes. For 6 or 12 volts, full connecting details—only one wire to connect! Each one in own coloured box, brand new and untouched. Only 10/-, add 2/- P. & P. (C.O.D. 2/6 extra).

Stock No. 117—477 SUB-MINIATURE TRANSISTOR RADIO CASES (Plastic undrilled). Size only 1¾ x 1¼ x ⅝in. to Clear 1/- each, plus 6d. P. & P.
Stock No. 118—SPRING TERRY CLIPS for holding Miniature Valves. Price for 3, 1/-, plus 6d. P. & P.
Stock No. 119—72 ONLY MINIATURE 6 TAG COILS covering Medium Wave and Long Wave with reaction winding. Price to clear 3/- each, plus 6d. P. & P.
Stock No. 120—SIMILAR TO ABOVE but Medium Wave only 2/- each plus 6d. P. & P.

Stock No. 169.

"VOLKSRADIO" POCKET VALVE RADIO

ONLY 15/-



Take - Over Bid makes this Fantastic Offer possible—the beautifully compact "5 Star Volksradio" measuring 4½ x 2¾ x 1⅜in. receives perfectly—in the bedroom, office, garden—over all medium waves (incl. Luxembourg). Under 1d. hour running cost. Anyone can assemble it in 1 or 2 hours, using our simple A B C plan. Complete set of parts. Only 15/-, plus 1/6 P. & P. C.O.D. extra. (Parts can be bought separately.)

Stock No. 137—BRAND NEW TRIMMERS "CYLDON" 250 pF. To clear 1/- each, plus 4d. P. & P.
Stock No. 138.—MINIATURE ACORN VALVES. Type 954. 9d. each plus 6d. P. & P.
Stock No. 139—6K7G BRAND NEW VALVES, 2/9, plus 9d. P. & P.
Stock No. 140—6V6G VALVES. 4/6, plus 9d. P. & P.
Stock No. 141—1L4 BRAND NEW VALVES, 1/9, plus 6d. P. & P.
Stock No. 142—BRAND NEW B7G VALVE HOLDERS, 6d., plus 4d. P. & P.

THE MINUTE TRANSISTOR RADIO MIAMI

ONLY 17/6

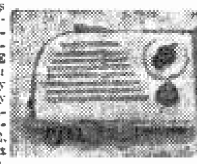
Unbelievably small—outrageously cheap. You will be amazed at the fine quality of tone and volume of this great little radio. Only a fantastic entertainment for months on an 8d. battery. 3½ x 2¼ x 1⅛in. the MIAMI will bring you great simple assembly plan with each set. ONLY 17/6. YES 17/6. Plus 2/6 P & P. (C.O.D. 2/- extra). Satisfaction Guaranteed. Demonstrations given daily. Parts available separately if required.

TERMS OF BUSINESS

C.O.D. 2/6 extra, regret No C.O.D. under £1. Add extra postage for overseas. Special prices for quantity and the Trade. All goods guaranteed. Components technical books, Hi-Fi by Leak, Jason, Lorenz Quad, etc. Send S.A.E. for quotation or with any enquiry.

Stock No. 121—MEDIUM WAVE LOOPSTICK COILS with Variable Tuning Core, 73 only. To clear 2/9 each, plus 6d. P. & P.
Stock No. 122—FEW ONLY VARIABLE TUNING CONDENSER (Mica Dielectric)—.0005 mfd. 3/6, plus 6d. P. & P.
Stock No. 123—173 RADIO DIALS. Printed Medium and Long Wave, Square Shape. Size 4¾ x 3¼in. with central hole. Price 1/6. plus 3d. P. & P.
Stock No. 124—SUB-MINIATURE DIODES all brand new and tested. Clearance price 3 for 1/- plus 3d. P. & P.

OUR NEW 4-STAGE MINUETTE



Build this newly-designed "MINUETTE" 4-STAGE transistor set in very strong ready drilled ULTRA-MODERN CASE. Size only 6 x 3¼ x 1in. Uses three transistors and diode and SELF-CONTAINED LOUDSPEAKER. Very sensitive, ideal for office, bedroom, holidays, etc. Months and months of listening off an 8d. battery. Can be built FOR ONLY 30/- including PROPER CASE, miniature speaker, etc. SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS etc., plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.

Stock No. 163—BRAND NEW ASSORTED CONDENSERS 30pF to .01 mfd., 25 for 7/6, plus 1/- P. & P.
Stock No. 164—SPECIAL OFFER OF HOME CONSTRUCTED RADIOS NEEDING ATTENTION. Filled with components in good condition.
Stock No. 164b—TYPE (B) 2/3 Transistor. Size 4¼ x 3 x 1⅜in. Price 5/- each plus 1/- P. & P. Brand new 2½in. Miniature Coil Speakers, worth 14/-, given free with every order for five.
Stock No. 164d—TYPE (D) Miniature Valve Radios in plastic case. Size approximately 5 x 3 x 1⅜in. Price 5/- plus 1/6 P. & P.
Stock No. 164e—TYPE (E) 20 only. Valve Radios in small Fibre attache cases. Size 7 x 5 x 2¾in. Price 22/6, plus 2/6 P. & P.
Stock No. 165—SURPRISE PARCEL TYPE (a). Assorted components. Price 5/- plus 1/6 P. & P.
Stock No. 167—GIANT SURPRISE PARCEL TYPE (c). Price 15/-, plus 2/- P. & P.
Stock No. 132—WANDER PLUGS. New and unused. 2/- doz., plus 6d. P. & P.
Stock No. 134—5in. MOVING COIL LOUDSPEAKERS. Brand new, 3 ohms. 10/-, plus 2/6 P. & P.

Stock No. 168—SPECIAL CLEARANCE OF FULLY GUARANTEED BRAND NEW "GOLD FRONT" 6 TRANSISTOR SUPERHET RADIOS. Complete with real leather carrying case. Personal earpiece, battery. All in beautiful presentation boxes. Only 75/- plus 2/6 P. & P. 74 only. Advertised at £6.6.0 recently. Last 74—no more available.

Stock No. 143—265 ONLY! MINIATURE PRECISION "MINETTA" SPY CAMERAS complete with 6 rolls of film and real leather carrying case. Size 2¼ x 1¼ x 1⅛in. Price to clear 20/- each. Post Free.

Stock No. 144—BRAND NEW 2½in. MOVING COIL LOUDSPEAKERS. SPECIAL PRICE 8/6, plus 1/6 P. & P. 30 ohms.

Stock No. 145—BRAND NEW ASSORTED RESISTORS in packets of 100, 8/-, plus 6d. P. & P.

Stock No. 151—BRAND NEW "PLESSEY" MOVING COIL SPEAKERS, 2¾in. 60 ohms. Matches Transistor Direct—No O.P.T. needed. Special prices 8/6, plus 1/6 P. & P.

CONCORD ELECTRONICS (Dept P.W.5) 210 Church Road, Hove, Sussex

PERSONAL CALLERS WELCOME — Open 8.30 a.m. until 1 p.m. and 2 p.m. until 5.30 p.m. Saturdays! 8.30 a.m. to 1 p.m. Demonstrations Daily.

HERE'S A LOW COST WAY TO GET INTO T.V. SERVICING FAST!

If you are a man who wants to get ahead in television, you will probably be interested in this new revolutionary type television training programme now being introduced for the first time.

Knowing that early success will usually spur a man on to greater achievement you learn how to make the easiest T.V. repairs first. Since the easiest T.V. repairs are the ones most often found on service calls, you are ready to make money right after the first lesson. Then as you progress you will discover how to handle every kind of trouble found in all makes of T.V. set!

Here for example are some of the items covered in the course:

1. **Simple adjustments to correct poor pictures.**
2. **Circuit faults indicated by a poor pattern.**
3. **Finding bad valves by observing picture faults.**
4. **Antenna principles and practices.**
5. **Facts about the T.V. signal to help you in repair work.**
6. **All about Cathode Ray tubes.**
7. **How to tell what is at fault.**
8. **Explanation of television circuits.**
9. **U.H.F. converters and tuners.**
10. **Television test equipment and alignment.**
11. **Advanced trouble shooting by picture analysis.**

This is a real home study course that has been bound into one giant 8 x 11in., 192 page manua to reduce cost.

Compares favourably with some courses costing very much more! By creating a mass market through large volume sales and eliminating individual letter writing we are able to pass on these savings directly to you!

The course features over 325 different line drawings, circuits, servicing charts and illustrations to simplify the text and make your study more enjoyable. Soon you will be well on your way to becoming a first-class television repair technician!

YOU TAKE NO CHANCES WHEN YOU DEAL WITH SIM-TECH

You must be convinced that this is the best value you have ever seen in television training, otherwise you can return the course (or have your money refunded if sent with order) after you have examined it in your own home for a period of seven full days.

The price? Only 36/- per course, plus postage and packing, 1/6.

Free 71-page book on Television Faults will be included if you send cash with order.

FREE TRIAL OFFER

Terms only 5/- per week if you wish.

To SIM-TECH BOOK COMPANY Dept. BT.4
West End, Southampton, Hants.

☐ Please send your Television Course for a full seven days' free trial. If not delighted I may return the course post-paid without further obligation on my part. Otherwise I will pay cash price of 37/6 or 5/- weekly until 37/6 plus 2/6 service charge, total 40/- is paid.

☐ Tick here if enclosing full price of 37/6. (Same 7-day money back guarantee). NOTE: Customers who send cash with order get in addition a 71-page book on TELEVISION FAULTS.

Overseas customers please send full amount (including Ireland).

Name ....

Address ....

....

City .... County ....

STAR DXER S.R.-40 £24.15.0

General purpose superhet communications receiver for A.C. mains, 220-240 volts, covering 550 Kc/s to 30 Mc/s in four switched bands. Slide rule tuning dial, electrical bandspread, internal speaker, panel "S" meter, noise limiter, B.F.O., phone jack, Ferrite and whip aerials. Handsome grey crackle cabinet 13¼ x 8¼ x 5¼in. Wt. 12 lb. Full instruction manual. BRAND NEW CURRENT MODEL.

PCR-3 RECEIVERS. 3-wave bands, medium wave and 2 short wave, from 120-13 metres. Good condition, tested, **8 gns.** Carr. 10/-. A.C. mains internal power supply £2 extra.

SILICON RECTIFIERS. Type 1EA2 (¼ x ¾in.) will handle 250 volts at up to 500 mA. Replaces any TV metal rectifier, 7/6.

AR-88 VIBRATOR PACKS. For 6 v. operation. Complete with vibrator and OZ4 rectifier. BRAND NEW in original cartons, 17/6. P. & P. 5/-.

MOVING COIL PHONES. Fines quality Canadian with Chamois ear muffs and leather covered headband. With lead and jack plug. Noise excluding, supremely comfortable. BRAND NEW .... 22/6 post 1/6.

AVO WIDE RANGE SIGNAL GENERATORS. Six turret operated ranges covering 50 Kc/s to 80 Mc/s. For use on standard A.C. mains. Packed in original transit cases with accessories. Post-war type in new condition **£15.** Carriage 10/-. REAL BARGAIN.

CRYSTAL CALIBRATOR. As used in Canadian No. 52 set. Incorporates twin 1Mc/s and 100Kc/s crystal and a multivibrator circuit to give 10Kc/s marker pips. Requires 12V 1 amp. L.T. and 150V. H.T. Complete with 3 valves, circuit of 52 set and operational notes. BRAND NEW **37/6,** plus 2/6 P. & P.

AR88 SPARE VALVES. Complete Set of BRAND NEW individually boxed original valves (14), **50/-,** plus 2/6 P. & P.

MULLARD CRYSTAL CALIBRATOR. In neat grey metal case 9 x 7 x 6½in. Gives 1 Mc/s, 100 Kc/s, and 10 Kc/s, marker pips and harmonics as selected. Optional 400 c/s modulation. Complete 6 valves [1T4 (5), 1R5 (1)], and 1 Mc/s B7G glass crystal. Requires 60 V. H.T. and 1.5 V. L.T. In original transit case. BRAND NEW, **£4.19.6,** carr. 7/6.

MICRO-AMMETER. 0-500μA. Made by R.C.A., Weston Westinghouse, and other famous American manufacturers. Circular 2½in. flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the "19 SET". TESTED AND GUARANTEED 15/-.

CHARLES BRITAIN (RADIO) LTD., 11 UPPER SAINT MARTINS LANE, LONDON W.C.2.
TEMple Bar 0545 *Shop hours 9-6 p.m. (9-1 p.m. Thursday). Open all day Saturday.*

PADGETTS RADIO STORES

OLD TOWN HALL, KNOWLER HILL LIVERSEDGE, YORKS.
Telephone: Cleckheaton 2866

New Boxed Tube Unit Type 7301. With two EF52, three EF91, five 6J6, two CV4025, one 6V6GT. Also Tube Type VCRX 263 with mu-metal screen. Fitted with dimmer unit and lamps Part 7302. A fine unit for only **45/-.** Carr. B.R.S. 8/-. No details on this unit.

New Boxed Drive Unit Type 114. Complete with 5U4, 6L6 valves, housed in a very nice case. 15/-. Carr. B.R.S. 7/6.

New Boxed 12 Volt Vibrator Pack with Spare Vibrator. Type P.C.R. 250 volts at 150 mills. **18/-.** Carr. 7/6.

New 12in. Speaker with Built-in Tweeter. 28/6.

ARMY SET TYPE 19. Complete sets **32/-.** Less transmitter and valves, **20/-.** Less valves for spares, but with 500mic-amp. meter **12/6.** Used, but have no dry rot, all untested. Carr. B.R.S. on any set 10/-.

P.M. Speakers, Guaranteed ex T.V. sets. 6in. round, 6 x 4in. Rola and Plessey, Philips 5in. round, all at 3/- each. Post 2/-, 6 for **20/-.** post paid. **Goodmans** 7 x 4in., **5/-,** post 2/-. 8in. round, **6/-,** post 2/-.

Valves Removed from T.V. sets. Tested on a Mullard Valve Tester, and are 100% as new. Three months' unconditional guarantee. POST FREE.

ECL80	2/-	10P13	5/-	PL81	5/-
ECC82	3/-	10P14	5/-	PL82	5/-
EY51	2/6	20D1	3/-	PL83	5/-
EBF80	4/6	20L1	5/-	PL33	4/-
EB91	9d.	20P3	5/-	PL38	8/-
EF91	9d.	20P4	8/6	PY80	5/-
6SN7	2/6	20P1	5/-	PY81	4/-
6F1	1/-	U801	8/6	PY82	5/-
6F14	5/-	U281	5/-	PCF80	4/6
6F15	5/-	U282	5/-	PCC84	4/6
6LD20	5/-	U329	5/-	B36	4/-
10C2	5/-			N37	5/-
10F1	1/-	KT36	5/-	6U4	5/-

EF80 **1/6,** or **10/-** per doz. Grade II EF80 for test purposes, **4/-** per doz.

New Valves Ex Units. POST FREE. 6K7 **1/6,** doz. **12/-.** 6K8 **2/6,** doz. **22/-.** 6V6 **2/6,** doz. **22/-.** 807 U.S.A. **6/-.** PP3/250 (PX4) **5/-.** AC2PEN (PENA4) **2/6.** 5U4 **3/-.** 6SN7 **3/-.** 6V6GT **4/6.** EF91 **1/9.** EL91 **1/9.** 6F6 **2/-.** 5Z4 **5/6.** 5Y3 **4/6.** 6X5 **4/6.** EF50 **1/-,** 6/- doz. ARP12 **1/6,** 6 for **5/6,** box of 50 **19/-.** KT66 **8/-.** ARTP2 **2/-.** ART4 **2/-.** APP37 **2/-.** AR8 **2/-.** IT4 **2/-.** 954 new boxed **1/3.**

13 Channel T.V. Sets. 14in. untested **30/-.** Carr. 10/-. 17in. sets untested, **50/-.** Carr. 10/-. Well packed sent at owner's risk.

T.V. Tubes. Completely rebuilt & refaced. 12 months guar. Sizes up to 17in. Special trade price of **75/-.** Carr. and Ins. 7/6.

Reclaimed Tubes. 14in., **30/-.** Carr. 7/6. **6 months guarantee.**

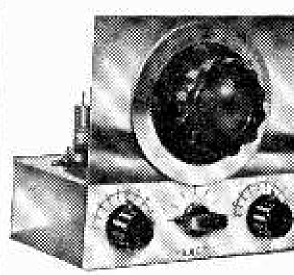
RES/CAP. BRIDGE 39/6 p. & p. 2/6

Checks all types of resistors, condensers
6 RANGES
Built in 1 hour. Direct reading
READY CALIBRATED
Stamp for details of this and other kits.

RADIO MAIL (Dept. PV)
Raleigh Mews, Raleigh Street, Nottingham

FAMOUS FOR THIRTY YEARS for SHORT-WAVE EQUIPMENT of QUALITY

H.A.C. SHORT-WAVE KITS



H.A.C. were the original suppliers of Short-Wave Receiver Kits for the amateur constructor. Over 10,000 satisfied customers—including Technical Colleges, Hospitals, Public Schools, Hams, etc.

NEW 1964 RANGE NOW READY

1-Valve model "CX", complete kit, Price 34/6

Customers say: "Definitely the best one-valve S.W. kit available at any price." This kit contains all genuine Short-Wave components, a drilled chassis, accessories and full instructions. Ready to assemble and, of course, as all our products, fully guaranteed. FULL RANGE of other kits still available including the famous model "K", price 77/-.

Before ordering call and inspect a demonstration receiver or send for a descriptive catalogue and order form to:—

"H.A.C." SHORT-WAVE PRODUCTS
(Dept. T.H.), 44 Old Bond St., London W.1

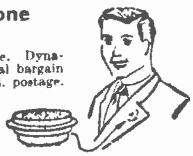
Infra-Red Heaters

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.

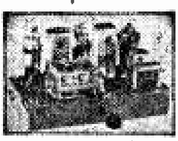
Microphone Inserts



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—Ideal 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.

Copper Clad Element

Plant this under a reflector to make ideal infra-red heater, also suitable for building into convector, blower heater, drying cabinet etc. 230/240 v., 1250 watts. 12 ins. long but can be bent to almost any shape. 7/6, plus 2/6 post and insurance.

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

1 pole, 6 way incremental shorting, 3/6

Please add 1/- post and packing for all orders below £3.

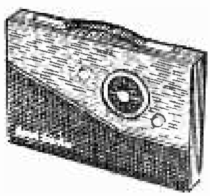
Meter Bargains

2in. Moving Coil 500 micro-amp. f.s.d. Brand new, 17/6, plus 1/- Packing and Insurance.

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.

GOOD COMPANION Mark III



The 6 transistor set with the 8 transistor performance. Incorporating all the latest requirements. Anyone who can solder can make it. Many thousands already in use all over the country. Full coverage of Long and Medium wavebands. Fine looking cabinet, size 11" x 8" x 3". Q.P.P. Output approx. 750 mW. Excellent reception of difficult stations like 208. Variable feed back gives excellent tone. ONLY £5.19.6
3/6 Post and Insurance.

THIS MONTH'S SNIPS

FLUORESCENT LIGHTING FITTINGS. All complete and ready to work as soon as tubes are fitted. Unused and guaranteed in perfect working order.

THE TWIN 20 (Plug in model). This very popular fitting is two feet long and approx. five inches wide. This makes it ideal for corridors, hallways, kitchens, toilets, etc. Being plug-in it can be quickly changed from room to room as desired, light output approx. same as 100 watt lamp. White enamel. Brand new and perfect. Uses standard tubes. 19/6, plus 3/6 post and insurance.

THE TWIN 20 (Batten model). Similar to above but intended for mounting directly to ceiling or hanging by chains. 18/6, plus 3/6 post.

THE FOUR FOOT 40. A white enamelled batten type fitting, extremely popular as a kitchen light but equally suitable for bedroom or office, etc. Complete ready to work when standard bi-pin tube is fitted. 14/6, plus 4/6 carr. and insurance.

THE FIVE FOOT 80. Similar to above but for 5 foot 80 watt tube. 27/6 plus 7/6 carr. and insurance.

CIRCLE-LITE (plug in model). Straight fittings may look a little plain in some positions but the circular types are just as efficient and have the very modern look. They are ideal in living rooms, shops and offices, in fact anywhere, and being plug-in they can be fitted in a jiffy at no extra expense. Whole shops and offices can be re-lit in minutes and as something like three times the light quantity for the same current is achieved additional wiring is not necessary to create a tremendous light increase. 40 watt circular fitting. Complete, requiring only tube. 19/6, plus 2/6 post and packing.

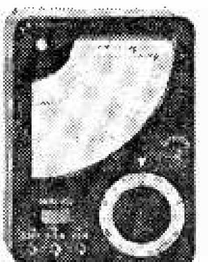
CIRCLE-LITE (surface mounting). As above but intended for direct to the ceiling. 27/6, plus 3/6 post and packing.

NOTE: Tubes are available to callers from 7/6 each but can only be dispatched in minimum quantities of 6 owing to damage risk.

"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 Plessey tuning condenser incorporating wave change switch. Overall size approximately 4½ x 2½ x 1½in. 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 69/6. Carriage and insurance 5/-.

Electric Blanket Spares

We carry a good stock of elements, thermostats and switches etc. for Electric Blankets. Send S.A.E. for list.

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.

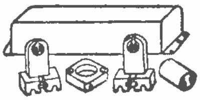
5000 mFd Condensers

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

Fluorescent Light Bargain

For pelmet or window lighting, etc.

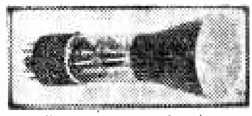
Kit of parts comprising: choke, two lamp holders, starter holder and starter.



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.

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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.

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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/-.

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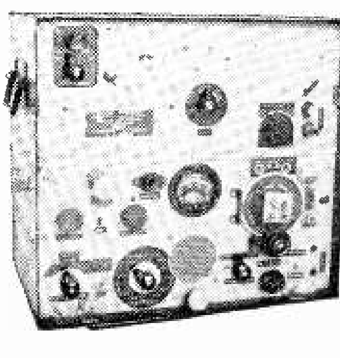

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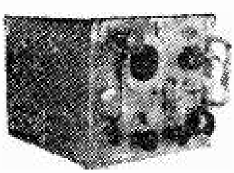

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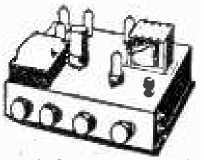

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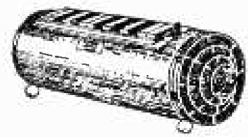

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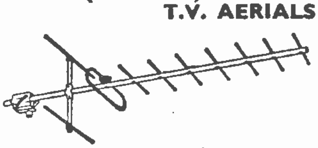

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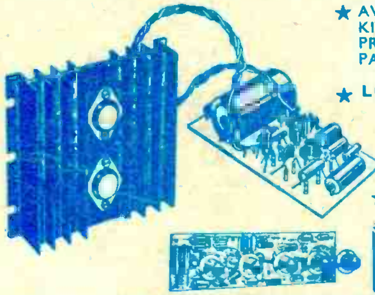

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