PRACTICAL WIRELESS

AUGUST 1964

2/-

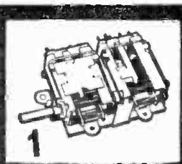
TRANSISTOR TUNER/CONVERTER

1,2 or 5 TRANSISTORS

OPTIONAL I.F. STRIP

PLUG-IN COILS

Just a few of our BARGAINS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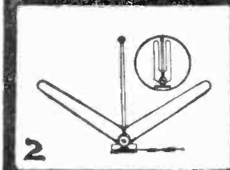
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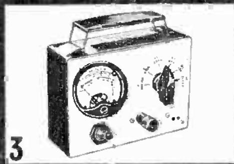
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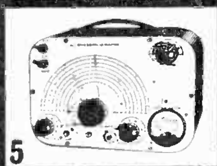
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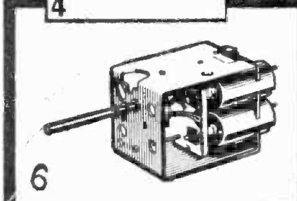
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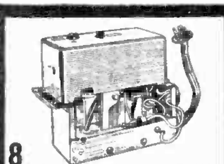
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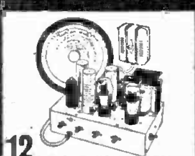
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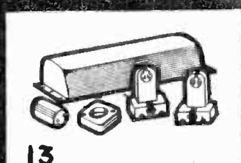
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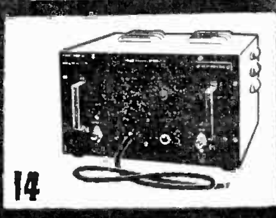
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FREE OFFER
ELECTRIC SOLDERING IRON with the POCKET MULTI METER
See item No. 7 for further details

1. **CYLDON A.M. F.M. PERMEABILITY TUNER FOR ALL TRANSISTOR OPERATION.** Size 2½ x 2¼in. approx. By famous manufacturer. A.M. I.F. 470 Kc/s. F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1620 Kc/s-525 Kc/s. F.M. coverage 108 Mc/s-88 Mc/s Circuit diagrams 2/6. FREE with Tuner, 25/-, 1st. 2nd, 3rd A.M. I.F.'s. 12/6 set. 1st, 2nd 3rd and 4th F.M. I.F.'s 12/6 set. V.H.F. Osc. choke, 1/-. A.M. I.F. trap, 1/6. A.F. 114 and A.F. 115, 5/- each. All the above are the RF end of an AM/FM receiver car radio, etc. The above six items purchased together, £2.10.0.
2. **625 INDOOR AERIAL.** Complete with stand, fully extendable can also be used for 405, ITV, BBC and FM, 19/6, plus 1/- P. & P.
3. **A.C./D.C. POCKET MULTI-METER KIT.** 2in. moving coil meter scale calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0-50. 0-100, 0-250, 0-500. Milliamps 0-10. 0-1000. Ohms ranges 0-10,000, 0-100,000, 19/6. P. & P. 2/-. Wiring diagram 1/-, free with parts.
4. **SIGNAL GENERATORS:** Cash £7.5.0 or 30/- deposit and 6 monthly payments of 21/6. P. & P. 1/6. Coverage 100 Kc/s to 100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics. Case 10 x 6½ x 5¼in. Three miniature valves and Metal Rectifier. A.C. mains 200/250v. Internal modulation of 400 c.p.s. to a depth of 30 per cent. Modulated or unmodulated R.F. output continuously variable 100 multivolts. C.W. and mod. switch, variable A.F. output. Magic eye as output indicator. Accuracy 2 per cent.
5. **SIGNAL GENERATORS.** Cash £5.5.0. P. & P. 6/6. Coverage 120 Kc/s to 84 Mc/s. Case 10 x 6¾ x 4¼in. Size of scale 6½ x 3½in. 2 valves and rectifier. A.C. mains 230-250v. Internal modulation of 400 c.p.s. to a depth of 30 per cent, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch variable A.F. output and moving coil output meter. Accuracy ±2 per cent.
6. **CYLDON PERMEABILITY TUNER** medium and long wave Tuner. Size 3 x 2 x 1¾in. approx. Coverage 190-540 Metres. 1250-2000 metres I.F. 470 Kc/s. Price 19/6. P. & P. 1/6.
7. **POCKET MULTI-METER.** Size 3¾ x 2½ x 1¾in. Meter size 2¼ x 1¾in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts. 0-15. 0-150. 0-1,000. D.C. current 0-150 mA. Resistance 0-100KΩ. Complete with test prods. battery and full instructions. 35/-. P. & P. 1/6. FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.
8. **CHANNEL TUNER I.F.** 16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—PCF80 and PCC84 (In series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker, 10/-. P. & P. 3/-.
9. **The MOTORISTS' REV. COUNTER.** Kit of parts comprising 270 degree 3in. moving coil movement. Manufacturer's present price of this movement would be at least £7. Complete with full instructions and circuit diagram. Scale calibrated up to 8000 r.p.m. Can be used with any 4 or 6 cylinder car. 29/6, plus 3/6 P. & P.
10. **B.S.R. MONARCH UA14 WITH FULL-FI HEAD.** 4-speed, plays 10 records, 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour brown. Dimensions: 12¾ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Full-Fi turnover crystal head, £5.19.6. P. & P. 6/6.
11. **50 MICRO-AMP METER** movement by world famous manufacturer. Size 3 x 2¾in., 50/- post free.
12. 8-watt **PUSH-PULL 5 VALVE AMPLIFIER plus METAL RECTIFIER.** A.C. mains 200-250 v. Size 10¾ x 6¾ x 2¾in. 5 valves. For use with all makes and types of pick-up and mike. Negative feed back. Two input. mike and gram. and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 kc/s. 2 dB down to 20 kc/s. Output 8 watts at 5 per cent total distortion. Note level 40 dB down all hum. Output transformer tapped for 3 and 15 ohms speech coils. For use with Std. or L.P. records, musical instruments such as guitars, etc. Suitable for small halls, £3.19.6. P. & P. 7/-. Crystal mike to suit, 15/-. P. & P. 2/-. 8in. P.M. Speaker to suit, 12/6, P. & P. 2/-.
13. **FLUORESCENT LIGHT KIT.** 40 watt fluorescent lighting kit comprising Siemens Choke, 2 Bi-pin holders, starter holder and starter. 11/6, plus 3/- P. & P.
14. **FIXED FREQUENCY SIGNAL GENERATOR.** Crystal control in metal case, size 10 x 6 x 6in. Incorporating two FC13 valves, mains transformer, metal rectifier, choke, indicator lamp, crystal and numerous components. Modulated and unmodulated output socket. Originally used for I.T.V. frequencies. Brand new. 39/6. plus 6/- P. & P. A.C. Mains 200-250 volts.

RADIO & T.V. COMPONENTS (ACTON) LTD.

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COMBINED PORTABLE & CAR RADIO

The Radio with the STAR features

4½" SPEAKER

★ 7-transistor superhet. Output 350mW.
★ Two-tone grey wooden cabinet, fitted handle with silver coloured fittings. Size 12¼ x 8½ x 3½in.
★ Horizontal tuning scale, size 11¼ x 2⅝in. in silver with black lettering.
★ All stations clearly marked.
★ Ferrite-rod internal aerial.
★ I.F. 470 Kc/s.
★ Operated from PP9 battery.
★ Full comprehensive instructions and point-to-point wiring diagrams.
★ Printed circuit board, back printed with all component values.
★ Fully tunable over medium and long waveband.
★ Car aerial socket.
★ Full after-sale service.

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Plus 5/6 P. & P. Parts list & circuit diagram 2/6. FREE with parts.
Goods not despatched outside U.K.
All enquiries S.A.E. Terms C.W.O.

RADIO & TV COMPONENTS (ACTON) LTD 21C High St., Acton, London W3

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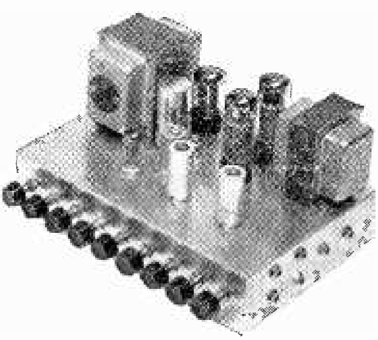
GUITAR AMPLIFIERS WITH TREMOLO

HIGH FIDELITY UNITS WITH ULTRA LINEAR PUSH PULL OUTPUT

We believe these amplifiers to be the most comprehensive to be offered at such reasonable prices.



Five jack socket inputs, four with separate mixing volume controls, and one input "straight through". All inputs are of very high sensitivity, only 10 millivolts input is required for full output, making them suitable for all types of guitars and microphones. Separate Bass and Treble controls, giving a wide range of lift and cut. Separate master gain control. Tremolo speed and depth controls. Jack socket for remote tremolo switching. Outputs for 3 and 15 ohms speakers. Valves used in the 30 watt amplifier ECC83, ECC83, EL34, EL34, GZ34. In the 15 watt amplifier ECC83, ECC83, EL84, EL84 EZ81. An extra valve ECC83 is used in the tremolo circuit. Supplied as a kit or factory built. The kit includes full step by step instructions and all parts, with fully punched chassis. The chassis is complete with baseplate and is solidly made of 18 gauge steel, finished silver grey hammer. Size 12 x 8 x 6½ inches high.

PRICES—

30 watt with tremolo.	Kit **£12.10.0.**	Factory built **£15.10.0.**
30 watt, less tremolo.	Kit **£11.10.0.**	Factory built **£14.10.0.**
15 watt with tremolo.	Kit **£9.10.0.**	Factory built **£12.10.0.**
15 watt less tremolo.	Kit **£8.10.0.**	Factory built **£11.10.0.**

Add carriage 10/- any amplifier. Send for free descriptive leaflet.

STROUD AUDIO, Paganhill Lane, Stroud, Glos. Stroud 783

BARGAINS FROM BROADWAY ELECTRONICS

12in. ALTHAM SPEAKER with built-in tweeter, 3 ohm or 15 ohm, 7,000 Gauss Magnet. Only **29/6**, postage **3/6**.

THE FAMOUS BM3 XTAL MICROPHONE with neck lanyard, **32/6**; table stand **9/6** extra. Xtal insert **7/3**.

GUITAR PICK-UP complete with clip and screened lead, **15/-**.

3-WAY PUSH-BUTTON UNITS, each button operates a 4-pole, 2-way switch, **4/6**.

BARGAINS IN TRANSISTORS. Mullard complete RF Packs OC44, two OC45, **12/6**; AF packs OC81d, two OC81, **12/6**; OC44, **3/6**; OC45, **3/-**; OC71, **2/6**; OC72, **3/-**; OA81 diode, **2/3**; AF114, **6/6**; AF115, **6/6**; ORP12 Light Cell, **7/6**; OC29, **12/6**.

TRANSISTOR ELECTROLYTICS. 1μF, 2μF, 4μF, 5μF, 8μF, 10μF, 16μF, 32μF, 50μF, 100μF, all at 15V, **1/3** each.

McMICHAEL TELESCOPIC TV AERIAL. 23in. extends to 45in. Fitted with Co-ax Plug, will suit any set, Only **7/6**.

CARTRIDGES. Will fit most pick-ups, Acos GP67 2G, medium output, **15/-**; GP 59-5 high output, **15/-**. BSR Stereo, **£1**.

EARPIECES. With cord and 3-5 mil plug, 8 ohm magnetic, **3/-**; 250 ohm, **4/-**; Xtal, **4/-**; 180 magnetic with clip, **6/6**; 3-5 mil plugs with nice long shank, **3/-**; screened, **4/-**.

ATTRACTIVE TWO-TONED CABINET, 11 x 6 x 5, room for small amplifier, fitted with ex TV 5in. speaker. Only **19/6**, post **2/6**.

TOGGLE SWITCHES. Single pole with on-off plate, **2/6**, with screw terminals, **2/9**.

TERMS: C.W.O. OR C.O.D.

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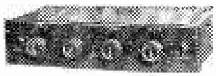
SEE FOLLOWING PAGES FOR ADDRESSES AND OTHER ITEMS ▶

STERN-CLYNE

Electronics Centres throughout Great Britain

MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

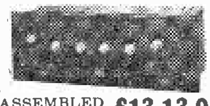


Employing two EF86 valves and designed to operate with the Mullard AMPLIFIERS but also perfectly suitable for other makes with input up to 250 m/V.
★ Equalisation for the latest R.I.A.A. characteristics. ★ Inputs for Crystal Pickups and variable reluctance magnetic types. ★ Input (a) Direct from High 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 kits) available separately at 2/- Post Free.

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 11¼ x 4¼ x 4¼.

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 **£13.13.0**

(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.

COMBINED PRICE REDUCTION

MULLARD 5-10 Main amplifier and 2 valve Pre-Amp. Kit £15.15.0. C. & I. 8/6. Built and tested. £21.10.0. C. & I. 10/-.
MULLARD 5-10 Main Amplifier and 3 valve Pre-Amp. Kit £19.10.0. C. & I. 8/6. Built and tested. £25.10.0. C. & I. 10/-. With Patrtridge Transformer £1.6.0 extra.

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 600mV. Specified components and new MULLARD VALVES. Includes PARTRIDGE MAINS TRANSFORMERS and choice of PARMEKO or PARTRIDGE Output Transformers. Surplus power available for Tuner

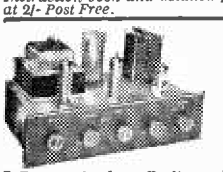
COMPLETE KIT **£12.0.0**

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** (Carr. & Ins. 6/6).

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

Instruction book and detailed price list (free with kit) available separately at 2/- Post Free.

TAPE PRE-AMPLIFIER MULLARD Type "C"

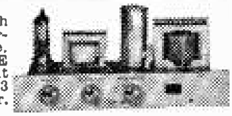
Suitable for most ½ track. Mono Tape Decks. Incorporates Ferrox-cube Push-Pull Oscillator. Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit.

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.

SEE PRECEDING PAGE FOR OTHER STERN-CLYNE PRODUCTS

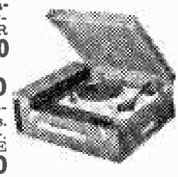
THE "MONO-GRAM"



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** (Carr. & Ins. 3/6). ASSEMBLED **£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 £4.10.0) 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**

MODEL CR3/S TAPE RECORDER

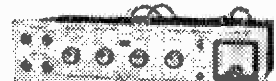
MODEL CR3/S incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin-Track 3-speed Deck operating at 1⅞in., 3¾in. and 7½in. speeds. Complete with microphones and 1,200ft. tape.

KIT OF PARTS **£33.8.0**

ASSEMBLED AND TESTED **£43.0.0**

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

STEREO TAPE PRE-AMPLIFIED

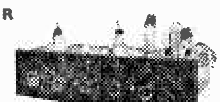


MODEL STP-1. For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ½ and ¼ track Stereo Decks. Incorporates Ferrox-cube Oscillator. 4-speed Equalisation Signal Lever Meter and separate Gain Control. Includes separate Power Unit.

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.

MULLARD TAPE AMPLIFIER



MODEL HF/TR3/MK. II

Based on Mullard's Type "A" design and suitable for most ½ 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. £53.13.0.		

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

SEND FOR CURRENT PRICE LIST OF ALL LEADING RECORDING TAPES AND ACCESSORIES

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MARTIN RECORDAKITS

		Dep.	&	Mthly. pmts. of
HALF TRACK				
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	58/-	12	48/2
QUARTER TRACK				
COLLARO STUDIO DECK fitted with Marriott "X" heads	£17.17.0	37/6	12	29/5
TAPE AMPLIFIER FOR STUDIO DECK as described above but quarter track	£12.12.0	27/-	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

BRENELL TAPE EQUIPMENT

Item	Price	Dep.	&	Mthly. pmts. of
DECK Mk. 5 Series 2, half track, 4 speed	£32.11.0	66/-	12	54/-
AMPLIFIER for above with power pack	£26.0.0	52/-	12	43/2

MARTIN AUDIOKITS

The new Martin All Transistor Ten Watt Amplifier Kits represent excellent value for money. Each unit is complete, requiring only to be connected to the next. We show the most popular units here. Others are available. Leaflets on request.

Item	Price	Dep.	&	Mthly pmts. of
UNIT 1—FIVE INPUT SELECTOR. Size 3¼ x 3in. Mag. PU, Crystal PU, Radio, Mic., Tape head, 9-15 Volts. Must be used with unit 4	£2.7.6	—	—	—
UNIT 4—PRE-AMPLIFIER AND CONTROL. 6¾ x 2¼in. Volume on/off, bass and treble controls, 9-15 volts. Must be used with unit 1	£3.2.6	—	—	—
UNIT 7—MAIN AMPLIFIER 10 WATTS 6 transistor transformerless push-pull output. Mounted on heat sink. 15 ohms output. 24 Volts	£6.12.6	—	—	—
UNIT 8 POWER SUPPLY. 24 and 9 Volts. Heavy duty transformer, rectifier and smoothing	£2.15.0	—	—	—
CONTROL PANEL for units 1 and 4	10.6	—	—	—
ALL FOUR ABOVE UNITS WITH PANEL. 15 ohms output	£15.8.0	33/3	12	25/3
UNIT 5 MAIN AMPLIFIER as Unit 7, 3 ohms output. 24 Volts	£5.12.6	—	—	—
UNIT 6 POWER SUPPLY as Unit 8 for use with Unit 5	£2.12.6	—	—	—
ALL FOUR UNITS (1456) WITH PANEL. 3 ohms output	£14.5.0	28/3	12	23/7

STEREO VERSIONS NOW AVAILABLE. DETAILS ON REQUEST.

GRAMOPHONE UNITS, MOTORS, PICK-UPS

Item	Price	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 Mono cartridge, single player	£5.9.11	—	—	—
B.S.R. UA14 with TC8 Mono Cartridge, 4-speed changer	£16.19.6	20/-	6	23/3
Garrard Autoslim. Mono cartridge, 4 speed changer	£7.17.0	20/-	7	22/6
Garrard AT6 Autoslim de Luxe, TC8 Mono cartridge	£11.9.0	26/6	9	24/9
Garrard 4H/F with Mono cartridge	£17.0.0	34/-	12	28/2
Garrard Lab Type "A" Transcription auto-changer, with Mono cartridge	£19.14.9	39/6	12	32/9
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	£17.1.9	36/-	12	28/2
Goldring GL70 with arm, no cartridge	£27.9.4	55/-	12	45/8
Goldring "88" Transcription, no arm	£18.18.5	41/-	12	31/1

ARMSTRONG - NEW TUNER AMPLIFIERS

MONO

Item	Price	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
227M A.M./F.M. Radio chassis, 10 watts	£33.18.0	70/6	12	56/1
223 A.M./F.M. Self-powered (Tuner only)	£28.15.0	57/6	12	47/9
224 F.M. only, Self-powered Tuner	£22.10.0	45/-	12	37/4

STEREO

Item	Price	Dep.	&	Mthly. pmts. of
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, Stereo gram, 10 watts each channel, Filter, Magnetic pick-up, etc.	£56.0.0	112/-	12	93/2

OTHER TUNERS

Item	Price	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—VARIOUS

Item	Price	Dep.	&	Mthly. pmts. of
Armstrong 222 Integrated, 10W per channel	£27.10.0	55/-	12	45/8
Dulci GA505, Integrated	£18.18.0	40/6	12	31/1
Rogers Cadet Mk. 2 with pre-amplifier, 4 ECL86 valves	£26.15.0	53/6	12	44/5
Leak Stereo 20 Main amplifier	£30.9.0	64/6	12	50/3
Leak Varislope 2 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

Item	Price	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 cover	£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.	£26.5.0	52/6	12	43/6
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	23/1
Leak Varislope Mono 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 TUNER KITS

Item	Price	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/-	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 switched 3/6.				
JTV/2 ready built, state channels	£22.5.0	44/6	12	36/11
Monitor, ready built as Mercury II	£16.15.6	33/6	12	27/9

LOUDSPEAKERS

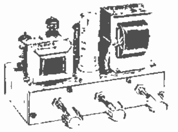
Item	Price	Dep.	&	Mthly. pmts. of
Goodmans Axiette	£5.5.7	—	—	—
Goodmans Axiom 10	£6.5.11	—	—	—
Goodmans 5K/20/XL	£7.7.0	—	—	—
Goodmans XO 5000 cross-over	£2.0.11	—	—	—
Goodmans Axiom 201. 12in. unit	£10.17.4	22/5	12	17/11
Goodmans Axiom 301. 12in. unit	£15.4.6	30/6	12	25/3
Wharfedale Super S/RS/DD	£6.14.2	—	—	—
W.B. HF1012 10in.	£4.7.6	—	—	—
FANE 12in. Unit, 20 watt	£5.5.0	—	—	—
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

EASILY REACHED BY FREQUENT FAST TRAINS FROM WATERLOO TO SURBITON

SURBITON PARK RADIO LTD. Phone KIN 5549
48, SURBITON ROAD, KINGSTON-UPON-THAMES, SURREY

- Order for Cash, C.O.D. or Terms
- Hours 9 a.m.-6 p.m. (1 p.m. Wed.)
- Open ALL DAY Saturday
- Established 30 years

3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83, EL84, EZ80 valves, heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 5/-

TAPE DECKS

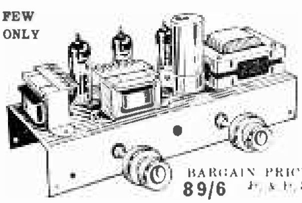
COLLARO STUDIO DECK. £10.10.0 plus 5/6 carr. and ins.

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.)

STEREO AMPLIFIER

Incorporating 2 ECL82s and 1 EZ80 heavy duty double-wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.

FEW ONLY



BARGAIN PRICE **89/6** P. & P. 5/-

Also available complete with two 8 x 5in. speakers for only **£5.10.6.** P. & P. 6/6.

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 wavebands transistor supherhet ● 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** 3¼in.. **12/6**; 5in.. **17/6**; 7 x 4in.. **21/-**. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9¼ x 6¼ x 3¼in. Suitable for above using 3¼in. 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). **32/6** complete, post 1/-. 6 transistor printed circuit board to match. **8/6.** Post 9d. Circuit diagram 1/6 extra.

SPECIAL TRANSISTOR BARGAINS

ALL BRAND NEW

GET 15 (Matched Pair) **15/-**

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

Set of Mullard 6 transistors, OC44, 2—OC45, OC81D matched pair, OC81. **25/-.**

EDISWAN MAZDA

R.F.1 Pack: 1—PXA102 Mixer: 2—PXA101 I.F. Amp.: (Equiv. OC44 and OC45)..........**10/6**

R.F. 2 Pack: 2—PXA101 I.F.—PXA102 Osc.; 1 PXA102 Mixer..........................**12/6**

L.F.6 Pack: Consisting of PXB113 Driver. Matched pair PXC171, mounted complete with heat sinks (Equiv. OC81D and OC81)........**12/6**

ALL TRANSISTORS POST FREE

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. Ready built and tested.

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

ALSO AVAILABLE. Mounted on board with output transformer and 6in. speaker, ready to fit into cabinet below. **PRICE 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/-.

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/-.

4-SPEED PLAYER UNIT BARGAINS

All Brand New in Makers' Original Packing

SINGLE PLAYERS

B.S.R. TU/12........... **£3.10.0.** Carr. 3/6.

B.S.R. GU7 with unit mounted pick-up arm **£4.18.8.** Carr. 4/-.

AUTO CHANGERS

B.S.R. UA14......................**£5.19.6**

Latest B.S.R. UA16.................**£6.19.6**

Garrard AT6 Mono...................**£10.10.0**

LATEST GARRARD AUTO-SLIM. With heavy duty, 4-pole motor. FEW ONLY **£7.7.0.** (Standard Auto-Slim **£6.10.0**). Carr. 5/- on each.

NEW CARTRIDGE BARGAINS!

B.S.R. TC8S. High output compatible **Stereo Cartridge.** Brand new. Complete with Stereo/LP/78 sapphire stylii and universal mounting bracket. Original price 44/11. OUR PRICE **22/6.** P. & P. 1/-.

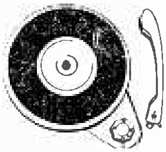
RONETTE STEREO 105 CARTRIDGE. Stereo/LP/78. Complete with two sapphires. Original list price **67/9. OUR PRICE 24/-.** P. & P. 1/-.

COLLARO HI-FI STEREO T/O CARTRIDGE. Type "C". Complete with universal bracket and stylii for Stereo, LP and 78. Original list price **59/8. OUR PRICE 25/-.** P. & P. 1/-.

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

THE NEW HARVERSON KIT FOR THE HOME CONSTRUCTOR

A really excellent all purpose A.C. mains 200/240v.

AMPLIFIER KIT TYPE HSL 'FOUR' 3 VALVE, 4 WATT USING ECC83, EL84, EZ80 VALVES

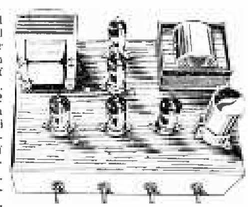
Special features include:

● Heavy duty double-wound mains transformer with electrostatic screen. ● Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss. ● Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor ● Suitable for use with guitar, microphone or record player ● Provision for remote mounting of controls or direct on chassis. ● All this builds onto a chassis size only 7½in. wide x 4in. deep. Overall height 4¾in. ● All components and valves are brand new ● Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success ● Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder etc. (No extras to buy)

PRICE **79/6** P. & P. 5/-

Comprehensive circuit diagram, practical layout and parts list 2/6 (Free with Kit).

10/14 WATT HI-FI AMPLIFIER KIT

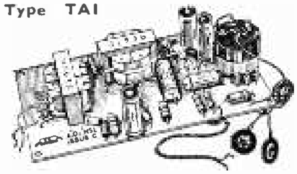


A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram. allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 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 separatey. ONLY **£6.19.6** P. & P. 6/6.

Also available ready built and tested complete with standard input jack sockets. **£8.15.0.** P. & P. 6/6.

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



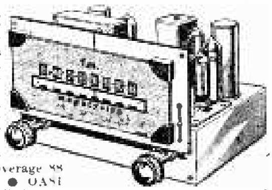
● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p) ● 9 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.

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 5¼in. ● All parts sold separately. Set of parts if purchased at one time **£5.19.6.** plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version as above** but complete with magic eye, front panel and brackets. **£6.12.6.** P. & P. 8/6.

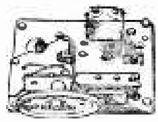
Mark III Version as Mark I but with output stage (ECL82) and tone control. **£7.7.0.** P. & P. 8/6.

Handsome Metal Cabinets. Choice of Grey, Black or Green. To fit Mark 1, **25/-.** P. & P. 2/6. To fit Mark 11. **17/6.** P. & P. 2/6.

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



Tuning range 88-100 Mc/s. 10.7 Mc/s I.F. A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) and drum and spindle. **18/6,** plus 1/9 P. & P. Valve **8/6** extra. Drum and spindle **3/6** extra.

GORLER F.M. TUNER HEAD

88-100 Mc/s. 10.7 Mc/s I.F. **15/-,** plus 1/9 P. & P. (ECC85 valve. **8/6** extra.)

SEE LEFT HAND PAGE FOR MORE ITEMS

HARVERSON SURPLUS CO. LTD.

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

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

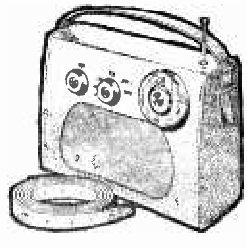
A few minutes from South Wimbledon Tube Station *(Please write clearly)*

PLEASE NOTE: P. & P. CHARGED QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES.

Why NOT BUILD ONE OF OUR PORTABLE TRANSISTOR RADIOS...

BACKED BY OUR SUPER AFTER SALES SERVICE



ROAMER SEVEN Mk III

5 WAVEBAND PORTABLE OR CAR RADIO

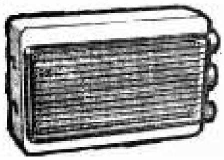
Amazing performance and specification

● **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. Air spaced ganged tuning condenser. Ferrite rod aerial for M & L waves and telescopic aerial for S Waves. 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).

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

Parts Price List and easy build plans 3/-.



TRANSONA FIVE

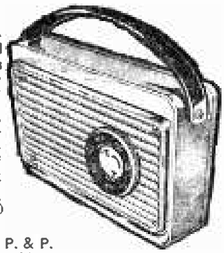
"Home Light A.F.N., Lux. all at good volume" G.P. Durham.

● **7 stages—5 transistors and 2 diodes**

Fully tunable over medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic 2½in. speaker etc. Attractive case. Size 6¼ x 4¼ 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



● **8 stages—6 transistors and 2 diodes**

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade Ferrite 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 4¼ x 1¾ in. (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 for home, car, or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 RF Stages, push-pull output. 3in. speaker (will drive large speaker). Size 7¼ x 5¼ x 1½in. (Uses 9v battery, available anywhere).

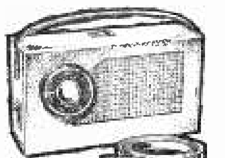
Total cost of all parts now only **£3.19.6** P. & P. 3/6 *Parts Price List and easy build plans 2/-*

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 fixed prices stated.

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.*



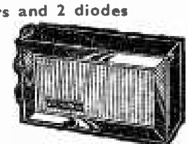
● **8 stages—6 transistors and 2 diodes**

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 6¾ x 3¾ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

Parts Price List and easy build plans 2/- Total cost of all parts only **£4.9.6** P. & P. 3/-

POCKET FIVE

● **7 stages—5 transistors and 2 diodes**



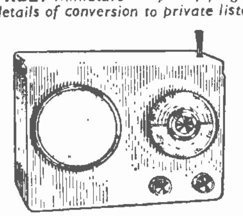
Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5½ x 1½ x 3½in. (Uses 1289 battery available anywhere).

Parts Price List and easy build plans 1/6

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

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. Tuneable 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 7¼ x 5¼ x 1½in.

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RADIO EXCHANGE CO.
61, HIGH STREET, BEDFORD. Phone: 2367

Callers side entrance Barratts Shoe Shop
Open 9—5 p.m.
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AUDIOTRINE HI-FI TAPE RECORDER KIT $25\frac{1}{2}$ GNS. Carr. 17/6

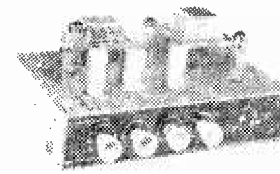
REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

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 tastefully covered in contrasting shades of Rexine and Vynair, size 14½ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately **£40.** Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS. Deposit £2.13.9** and 12 monthly payments of **44/-.** Cash price if settled in 3 months.

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 30-20,000 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. GRAM. AMPLIFIER KIT. 3 watts output. 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.**

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

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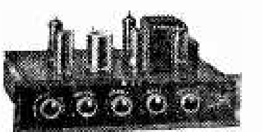
GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2-3 ohm speaker. For 200-250 v. A.C. mains. Size 11½ x 2½ x 2½in. Controls: Vol. and Tone with Switch. Only **59/6.**

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.

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

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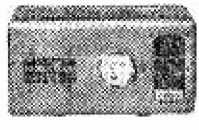
R.S.C. BATTERY CHARGING EQUIPMENT Guaranteed 12 months,

All for A.C. Mains 200-250v., 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.

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

6 v. or 12 v. 1 amp **22/9**
As above, with Ammeter .. **23/9**
6 v. 2 amps **19/9**
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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, 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.

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

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

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250-0-250v. 70mA. 6.3v. 2a, 0-5-6.3v. 2a .. **17/9**
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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**
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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. 0-5-6.3v. 3a **27/11**
300-0-300v. 130mA. 6.3v. 4a. C.T. 6.3v. 1a. for Mullard Amplifier **33/9**
350-0-350v. 100mA. 6.3v. 4a. 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. 1a. 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**
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Standard Pentode 5,000Ω to 3Ω **5/9**
Standard Pentode 7,000Ω to 3Ω **5/9**
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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**
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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**
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Both above size 2½ x 2½ x 2½in.

FILAMENT TRANSFORMERS

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

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150mA. 7-10 H. 250 ohms **11/9**
110mA. 10H. 200 ohms **8/9**
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60mA. 10H. 400 ohms **4/11**

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AUTO (Step up/Step down) TRANS. 0-110/120-230/250v. 50-30 watts. **13/9**; 250 watts, **39/9**; 150 watts, **27/9.**

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

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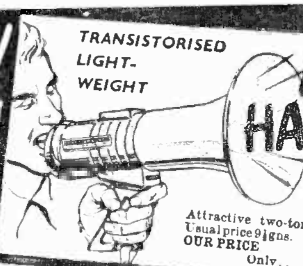

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Ideal for the Beach! Rallies, Sports & All outdoor Events, etc.

Attractive two-tone finish—Usual price 9½gns.
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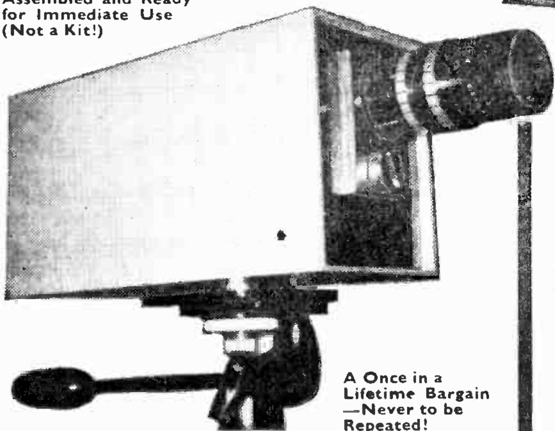
T.V. CAMERAS

Assembled and Ready for Immediate Use (Not a Kit!)



A Once in a Lifetime Bargain —Never to be Repeated!

New—may need slight adjustment. 405 line for operating on your own television set, on any channel from 1 to 5. 210-240 volt A.C., 50-60 cycle.

Usual price £79. Limited quantity to clear at the ridiculously low price of only—

Complete with E.M.I. "M" Grade Vidicon Tube. Instructions and circuitry supplied.

£38.10 (Carr. and ins- 24/-).

Lenses available as advertised opposite. These cameras are highly recommended for experimental purposes and enthusiasts, security and home entertainment.

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THE HIGHLY SUCCESSFUL

NEW 'CYCLOP' MK. III
TRANSISTORISED CLOSED-CIRCUIT
TELEVISION CAMERA

Imagine! View round corners, through walls, and into dangerous or inaccessible places. Invaluable for mass industrial instruction. Unseen observation. Security, etc. No technical knowledge whatsoever required to install or operate. Plug in, focus and view. Designed for standard 405 line, attaching directly into your own Television set. Excellent picture quality. ONLY

£68.10

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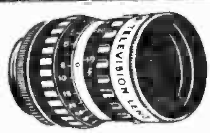
Full details on request.

JAPANESE! 'COSMICAR' 1" TELEVISION LENS



'Click-stop' Aperture F/1.9 to F/22. 4 element lens construction. Aperture F/1.9 varying to F/22. 4 element lens construction, C Mount fitting. Full focusing adjustment from infinity to 24". Bloomed lenses complete with lens caps and finished in an attractive black and stainless alloy, at the ridiculously low price of only................ p. & p. 3/6. **£9.16.6**

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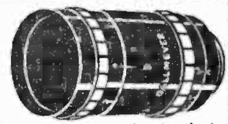

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2-Wave-Band 6-Transistor

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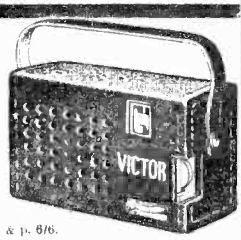
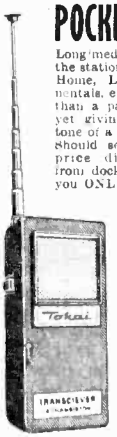


Long/medium wave. Gets all the stations you want; Light, Home, Luxembourg, Continentals, etc. Not much larger than a packet of cigarettes, yet giving the volume and tone of a radio twice its size. Should sell at 7½ gns. our price direct from docks to you ONLY .. **89/6** p. & p. 6/6.

Complete with batteries and leather carrying case. Ideal for holidays, picnics, garden, bedside and in the car.



TWO-WAY RADIO-TELEPHONE
'TRANSCEIVERS'

28.5 Mc/s Crystal controlled 9 transistor, volume control, etc. Range approx. 0.5 mile in city—2-3 miles sea and country. With smart leather case, standard pencil batteries, etc. Ready assembled for use. Limited quota. Usually 45 guineas. OUR PRICE **£34.10** per pair.

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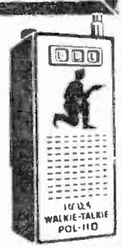

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35/-

Leaflet S.A.E.

PLASTIC RECORDING TAPE

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Double Play	7in. reel, 2,400ft. 42/-		
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Long Play	7in. reel, 1,800ft. 22/6	3in.	1/6
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"EASISPLICE" Tape splicer 5/-. Leader tape 4/6; Splicing tape 3/-.

CRYSTAL SET BOOKLET. 1/-.
CRYSTAL DIODE G.E.C. 2/-. **GEX34**, 3/-. **OA81**, 3/-.
HIGH RES. PHONES. 4,000 ohms, 15/-. 2,000 ohms 12/6. **MOVING COIL PHONES**, 100 ohms, 10/-.
SWITCH CLEANER. Fluid squirt spout, 4/6 tin.

"6+1" TRANSISTOR RADIO

First class components to make a 6 transistor 2 waveband superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, *with car aerial coil*, printed circuit, 8¾in. x 2¾in., but EXCLUDING Speaker and cabinet. **£4.5.0**
Speakers, 35 ohms, 7 x 4in., 21/- 5in., 17/6; 3¼in., 15/6. Cabinet 27/6.

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 6/6
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JACK PLUGS. English, 3/-; Screened, 4/-; Grundig, 3-pin, 3/6; Phono Plugs, 1/-; Sockets, 6d.
ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in., 10d. 0.3in. **FORMERS.** 5937 or 8 cans TV1 or 2. ⅜in. sq. x 2½in., or ⅜in. sq. x 1¾in., 2/- with cores.
SLOW MOTION DRIVES. 6:1, 4/3; 36:1, 10/6.
SOLON IRON, 25W, 200V or 230V, 24/-.
ANTEX SUB-MIN. IRON. 15w, 200 or 240v., 29/6.
BENCH STAND for above, 12/6. Spares in Stock.
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Miniature Contact Cooled Rectifiers, 250V, 60mA, 7/6; 250V, 85mA, 9/6. **Selenium Rect.**, 300V 85mA, 5/-. K3/25, 600V, 5mA, 5/-. RM4, RM5, 14A100, 14A116, 10/- each. FC31, 20/-. **TV etc. Silicon Sub-Min. Rectifiers**, 250V 450mA, 10/-; 250V 150mA, 5/6.

465 kc/s. SIGNAL GENERATOR
Price 10/6, ready made with valve 1S5. **POCKET SIZE** 2½x4½x1in. One resistor to change, full instructions supplied. Battery 8/6 extra. Details Free.

Coils Wearite "P" Type, 4/- each.
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T.R.F. Coils, A/HF, 7/- pair; HAX, 3/6.
Screwdriver, 5in., 6d. **Test Prods**, 2/9 ea.
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Multicore Solder, 4d. yd. **Dispenser**, 2/6.

Blank Aluminium Chassis, 18 s.w.g. 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7 x 4in., 4/9; 9 x 7in., 5/9; 11 x 7in., 6/9; 13 x 9in., 8/6; 14 x 11in. 10/6; 15 x 14in., 12/6.
Aluminium Panels, 18 s.w.g., 12 x 12in., 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3; 8 x 6in., 2/-; 6 x 4in., 1/6.

MARTIN TAPE PRE-AMPLIFIERS & DECKS (PLAY-BACK THROUGH YOUR OWN AMPLIFIER)

Collaro 2 track Pre-amp. £8.8.0	Collaro Studio tape deck £10.15.0

COMPLETE RECORDING & PLAY-BACK AMPLIFIERS
Collaro amplifier £11.11.0

MAINS DROPPERS. Midget adjustable sliders 0.3A, 1,000 ohms, 6/-; 0.2A, 1,200 ohms, 6/-; 0.15A, 1,500 ohms, 6/-; 0.1A, 2,000 ohms, 6/-.
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
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Long and Medium aerial—RA2W 6in. rod 208 pF tuning, with car earial coil.	12/6
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Med. wave kit, 2 transistors, 2 diodes, earphone, ferrite aerial. Cabinet 3 x 1¾ x ⅝in. 49/6, batt. 3/6.

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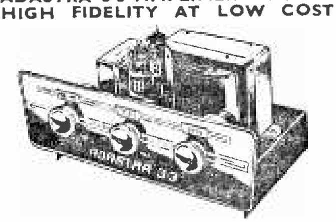

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With 2-stage Amplifier; 3 watt; 2 valves, UCL82, UY85; High-flux 5in. speaker; 4-speed E.M.I. Turntable, 16, 33, 45 78 r.p.m.; Crystal Pick-up for LP/STD. Records, 7in., 10in., 12in.; Cut out Mounting boards 12¾ x 9¾in.

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D240, 8.5:1 Driver, ¾in. x ½in. x ½in.	11/6
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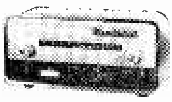
HI-FI F.M. TUNER. Tuning range 88-108 Mc/s. Tuning unit (FMT-4U) with 10.7 Mc/s. I.F. output (**£2.15.0** inc. P.T.) I.F. Amp. (FMA-4U) complete with cabinet and valves. (**£13.3.0**). Total kit **£15.18.0** Assembly can be arranged.



AMATEUR BANDS RECEIVER. Model RA-1. Covers all Amateur Bands from 160 to 10m. Special features incl. half lattice crystal filter, 8 valves, signal strength "S" meter, tuned R.F. amplifier stage. ... Kit **£39.6.6** Assembled **£52.10.0**

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HI-FI A.M. F.M. TUNER. Covers F.M. 88-108 Mc/s. A.M. 16-50, 200-550, 900-2,000 m. Tuning heart (**£4.13.6** inc. P.T.) and I.F. Amp. **£21.16.6.** Printed circuit board. Total ... Kit **£26.10.0**

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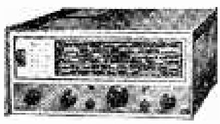
50W POWER AMPLIFIER. Model MA-50. Ideal for PA work etc. Kit **£19.18.0.** Assembled **£27.18.0.**



RG-1

COMMUNICATIONS TYPE RECEIVER Model RG-1. An excellent low cost receiver Freq. cov.: 600 kc/s-1.5 Mc/s. 1.7 Mc/s-32 Mc/s. A two speed tuning drive. R.F. "front end" supplied assembled, aligned and tested. Send for details. Kit **£39.16.0** Assembled **£53.0.0**

2½in. PORTABLE SERVICE OSCILLOSCOPE. Model OS-1. An ideal light, compact scope for servicing and general work. Printed circuit construction. Kit **£21.18.0.** Assembled **£29.8.0**

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VALVE VOLTMETER. Model V-7A. Measures up to 1,500 v. (D.C. and r.m.s.) and 4,000 pk-to-pk. Res. 0.1Ω to 1,000 MΩ. Kit **£13.18.6.** Assembled **£19.18.6**

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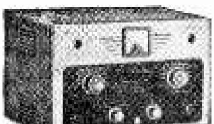
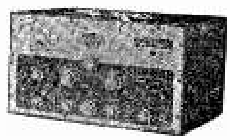


DX-40U

See Heathkit models at the RADIO SHOW, STAND No. 32, EARLS COURT, LONDON, August 26th—September 5th 1964.



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Practical Wireless

Vol. XL No. 690 AUGUST, 1964

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Contents

Finishing the job

AT this time of year many readers, we hope, are enjoying a well-earned holiday, or are contemplating one in the near future. Others — sad thought — have already had their annual break from the daily task.

The radio enthusiast, returning from holiday to take up the threads of his hobby will most likely be eager to get started again, like a lion refreshed. This is the time to consider whether enough thought and attention is given to the final appearance of equipment to be constructed.

Too many constructors spoil the ship for a ha'porth of tar. Too many pieces of equipment are electrically efficient but look like something from Steptoe's junk yard. Too many units are housed in unsuitable casings — or none at all — and too many panels are untidy in layout and finish.

There was once a popular saying that "it doesn't matter what it looks like so long as it works". This may have had an element of justification in bygone days but it does not ring true in 1964. Except for purely experimental projects, the average piece of equipment built by a constructor of average ability and experience, should work quite well at first switch-on. But there is no excuse, nowadays, to mar a nice piece of construction by slipshod appearances.

If one is not building from a kit, or from a published design, a little more thought on external appearance will often bring rewarding results. The placing of controls, etc., on a front panel do not have to be exactly symmetrical but they should have a semblance of tidiness.

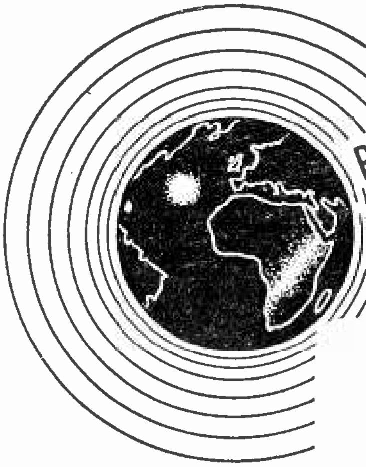
Knobs do not *have* to match, but it looks better if they do. Potentiometer spindles do not *have* to be the same length, but sawing them to a uniform projection looks neater. Controls do not *have* to be labelled, but the use of stencils or panel transfers will enhance the appearance. Wooden cabinets do not *have* to be painted or polished but they look better if they are. Crocodile clips (and worse) *can* be used for interconnections but proper plugs and sockets look better and are more positive — and safer.

Also, many enthusiasts do not have a separate radio room or even if they do, certain pieces of gear are used in rooms inhabited by parents or wives. A poorly finished item can be an eyesore to the non-enthusiast! These days neat, compact, units are easily possible but there is no reason for not trying to make them even more compact if circumstances dictate — and to make them as presentable as possible.

In radio clubs and at exhibitions equipment can often be seen which, though built by amateurs, has a crisp professional flavour. It should be the aim of all serious constructors to reach, within practical limits, this kind of standard. But, at least, the care and attention given to achieve electrical efficiency and neat wiring should be allied to a pride in the final appearance.

As for the inside of equipment — that is quite another story!

Our next issue dated September will be published on August 7th



ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

Radio Show Returns with a Difference

AFTER an absence of two years, the Television and Radio Show will be back at London's Earls Court in late August, but with a difference. Following on the success of 1963's "trade-only" shows staged by the different manufacturers, this year's Radio Show will lay restrictions on public viewing time, leaving periods when visiting radio dealers will be able to "take in" the displays at leisure in a relatively deserted Earls Court. This step has been taken to combat criticism from the trade that much of the benefit of the show is lost when dealers have to contend with a public crowd in order to see all the exhibits, as they have had to in the past. The first two days of this year's show then, will be strictly for the trade. The public will be admitted on August 26th but then only from 11 a.m. onwards, as on seven of the remaining ten days of the exhibition the hours of 9.30 a.m. to 11 a.m. will be reserved, once again, for the trade only.

What this means, in fact, is that the public is left with August 26th to September 5th (except Sunday) when they will be admitted from 11 a.m. (10 a.m. on Saturdays) to 9 p.m.

Festival QSL-Cards for Johannesburgs Contacts

DURING August, September and October this year, South Africa's capital city will be presenting "The Johannesburg Festival". Johannesburg's hams will be participating in the Festival and a special QSL-card will confirm all contacts with local amateur stations during the festive period. In addition, an award will be given to stations sending a certified list of contacts (no QSL-cards) made in accordance with specified rules, to the Awards Manager, P.O. Box 7227, Johannesburg, Republic of South Africa. The rules require that Dx stations, outside Zone 38, must contact five Johannesburg stations during the period of the Festival. 'Phone, s.s.b., a.m. or mixed contacts with a minimum report of RS 33 or RST 338 will be acceptable.

Short wave listeners can also qualify by sending a certified list of the required number of stations heard, as provided by the rules, to the same address.

The award, presented on the inside of a folded card, tells the story of the growth of Johannesburg in story and colour illustrations.

U.S. FIRM TO MANUFACTURE E.E.V. TUBES

AS a result of arrangements recently made with Compagnie Generale de Telegraphie Sans Fils (C.S.F.) in Paris, English Electric Valve Company products may now be manufactured in the U.S.A.

The two companies have exchanged manufacturing information, so that each now makes certain products of the other, and this facility is now available to Warnecke Electron Tubes Inc., in Chicago, U.S.A., which is a subsidiary of C.S.F.

Royal Albert Hall Gets Audio Boost

WHEN the BBC recently televised a "beat" music show from the Royal Albert Hall, screams from the teenage audience effectively drowned much of the output from the hall's audio installation. To prevent this problem arising on the second occasion that "big beat" performers and groups and hundreds of teenagers at the Albert Hall combined to provide BBC-2 with its Top Beat show, Standard Telephones and Cables Limited, who originally installed the Hall's amplification system, brought in extra loudspeakers and stepped up the power to boost voices and musical instruments above the screams.

STC engineers increased the regular installation, consisting of three 45W amplifiers, to over 300W for the performance.

COMMERCIAL RADIO FOR THE ISLE OF MAN

A COMMERCIAL radio station for the Isle of Man has been given the sanction of the Home Office.

This was established by a recent Press release in which it was stated that under an agreement with the Isle of Man Government (in which Pye of Cambridge have entered) a company will be set up to operate a radio broadcasting station on the Island.

Final details of the company and the concession granted to it remain to be finalised, but the principal conditions have been settled. Under the agreement, the company will provide a service on both the medium wave and v.h.f. bands and to broadcast news and items of interest.

Pye have been acting as technical advisers to the Isle of Man Government on the project, undertaking detailed radio surveys of the Island and providing technical recommendations concerning both the transmitters. These recommendations were passed to the British Post Office.

The specific frequency recommended in the medium wave band is entirely available for the purpose and will cause no interference with any existing broadcasting service in the United Kingdom. It is proposed to confine the hours of transmission in the medium wave band to daylight and under these conditions the station cannot interfere in any way with continental stations.

The allocation of a medium wavelength at the outset is essential as only a small minority of set owners would be able to tune into v.h.f. programmes.

The station will be broadcasting under the authority of the Postmaster General's Wireless and Telegraphy Act, and new legislation in the Isle of Man Legislature will ensure high standards of both public broadcasting and of the advertising material.

A complete broadcasting station with medium wave and v.h.f. transmitters and a studio was shipped from Cambridge to the Isle of Man during June.

Amateur Radio Exhibition Dates

THE Radio Society of Great Britain has announced the dates for its Exhibition this year, as October 28th to 31st.

Once again this year, the venue for the exhibition will be the Seymour Hall, Seymour Place, Marble Arch, London.

The 1964 International Radio Communications Exhibition will follow the style of previous shows, with manufacturers, retail firms, amateur organisations and technical publishers taking stand space in the hall. To accommodate extra exhibits, the balcony of Seymour Hall will be open, and occupying the stage at one end of the Hall will be a special presentation, illustrating the part played by radio in ships.

As before, amateur radio stations GB3RS and GB2VHF will be operating from the exhibition, making contacts on 70cm and 2 and 4m bands and other wavelengths, throughout the duration of the show. Amateur TV enthusiasts will be providing demonstrations and a c.c.TV installation will be in operation. The armed services will once again be providing interesting exhibits as will other government bodies.

Various presentations of awards will be made during the show, including a £130 communication receiver to the holder of a lucky ticket. The doors will open daily from 10 a.m. to 9 p.m. The price of admission will be 3s.

LORD FRASER GUEST OF VETERAN HAMS

LORD FRASER of Lonsdale was the principal guest at the Annual Reunion Dinner of the Radio Amateur Old Timers' Association which was held recently in London. In 1926 Lord Fraser, then Captain Ian Fraser, was President of the Radio Society of Great Britain, himself holding a transmitting licence.

At the dinner some eighty "hams", all of whom had had a transmitting licence more than twenty-five years ago, heard Lord Fraser speak of the milestones in the history of amateur radio and of his own experiences as a young wireless enthusiast. Recalling how, in 1927, British radio amateurs decided to demonstrate to a BBC reluctant to begin overseas transmissions, that music broadcasts to Australia could be reliable, Lord Fraser said:

"I well remember how, with the help of the transmitter of Mr. Gerald Marcuse, a leading amateur, we organised a transmission from Britain to Australia in the early hours of the morning. The High Commissioner for Australia and some leading Australian artists then in Britain put on an hour's programme from Marcuse's house in Caterham to Australia, and the Australian broadcasting stations gave it national coverage.

"So anxious was Marcuse to get his signals across that he overran his generators and the programme only lasted for a few minutes before they burnt out. Nevertheless we had spurred the BBC to action, and very soon they produced the Overseas Division which began world-wide broadcasting."

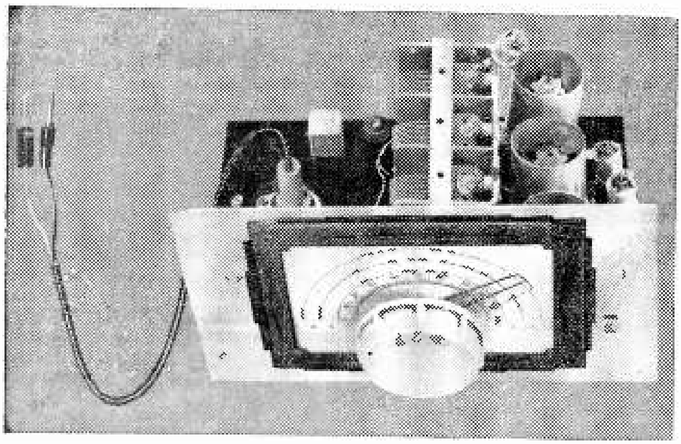
Commenting on the experimental work and services to the community performed by radio amateurs, Lord Fraser went on to say:

"I suppose that in every scientific field the amateur has made his contribution. Certainly in the wireless field much experimental work—hardly to be dignified by the name of fundamental research, but nevertheless of considerable intrinsic value and of great educational value—was done . . . When the General Strike occurred in 1926 I was a freshly elected M.P., and I remember helping to organise a skeleton service which offered to enlist hundreds of amateurs all over the United Kingdom who could communicate with each other if official services broke down. In fact there was no breakdown and we had no work to do, which greatly disappointed us."

Transistor Tuner/Converter

1, 2 or 5 Transistors Optional i.f. Strip Plug-in Coils

BY F. NEVILLE HART



This is how the tuner looks when complete except for the i.f. strip which will be described in our next issue.

THIS versatile unit can be built in a number of ways, depending upon the pocket and requirements of the constructor. In the first place it can be made as a one transistor tuner as described in the March 1963 issue of PRACTICAL WIRELESS, in which we had to wind on an extra coil for the base, on to the plug in coils designed by Denco for valve circuits.

This company has now produced a whole range of similar plug in coils for transistor use, still using B9A Noval valve holders, but with the new advantage of the coil former having nine pins, which hold the coil very firmly indeed.

Since some readers asked if the tuner could be made more selective, an r.f. stage is added in this version. In addition, the set has been designed to take a "plug in" 1·6Mc/s i.f. strip with volume control. This can either be used with the output taken to an audio amplifier through the crystal diode, or, as an extension of the first part, as a double superhet into the aerial circuit of any medium band radio.

Choice and construction of a cabinet is left to the reader, but one made of three ply, leaving room for the battery, and with a section of the top hinged to facilitate coil changing, is suggested.

The dial assembly is easily fitted but care should be taken to see that the shank and the spindle of the tuning gang are concentric, otherwise any undue pressure will make the faster of the two slow motion movements bind. This assembly has approximately 5 degrees either way of 36 to 1 movement, which makes selection very easy. Then the movement changes in either direction, to 6 to 1 for quick tuning.

Two Transistor Tuner

As with the Denco coils for valve sets, the bottom end of each oscillator coil is brought to a different pin on each range to connect with the correct padder capacitor. Although medium and long wave ranges are made, there is no advantage in providing for them in this design, and in any case, since Range 1 and Range 5 use the same padder pins, one would have to choose between the two, or incorporate a simple switch arrangement on the front panel, selecting the appropriate padder.

The coils are supplied in aluminium boxes which are used for screening cans, suitably cut and drilled. The lids of the cans have to be mounted at the same time as, and under, the B9A valve holders and care must be taken to see that they make contact with the metal rim of the holder. These should be cut as in Fig. 2.

First make two straight cuts across the centre, ⅜in. apart, the centre removed, and each end of the slot cut down to the knurled edge. Then with a round file, shape the hole to take snugly the ceramic or bakelite portion of the valve holder. One of the metal ends of the latter can now be inserted and the other end gently forced into place.

This being done before mounting on the paxolin chassis, it can be ensured that some portion makes contact so that when the screening can is screwed on it is properly earthed. It is easier to insert the fixing screws if they are round headed.

The requirements of the tuning capacitor are that it must have ceramic insulation and each portion 300pF, with a minimum capacity of 11pF. The Jackson "F" three gang 300pF fits these conditions admirably.

Solder on three wires to the stators before mounting, as these junctions are inaccessible afterwards. Mount the tag strip first, using countersunk screws to avoid fouling capacitor moving plates when fully open. It is also necessary for the same reason to "bush" up the capacitor with washers or fairly wide nuts on the fixing screws or the moving plates will not open to the fullest extent.

COMPONENTS LIST FOR TUNER SECTION

Resistors:

R1	2·7kΩ	R5	2·7kΩ
R2	10kΩ	R6	10kΩ
R3	1·2kΩ	R7	1·2kΩ
R4	1kΩ	R8	1·8kΩ

All $\frac{1}{4}$-watt carbon, $\pm 10\%$

Capacitors:

- C1 0·005μF disc ceramic C2 0·01μF mica
- C3 0·05μF mica
- C4 0·01μF mica
- C5 2μF 6V electrolytic
- C6 2000pF mica
- C7 0·01μF mica
- C8 0·003μF disc ceramic
- C9 0·01μF mica
- C10 50μF 25V electrolytic
- C11 250pF mica
- Cp1 340pF Cp2 960pF
- Cp3 2000pF

Variable Capacitors:

- VC1, VC2, VC3 3-gang, 300pF per section (Jackson Bros. Type F)
- TC1-TC7 3-30pF beehive type trimmers

Transistors:

Tr1 OC171 Tr2 OC171

Inductors:

- IFT1 Denco Maxi-Q 1·6Mc/s i.f. transformer, Type IFT16
- T1 Denco plug-in transistor coils. Aerial (Blue)
- T2 Denco plug-in transistor coils. R.F. (Yellow)
- T3 Denco plug-in transistor coils. Mixer (White)

(Note: ranges of T1, T2 and T3 to suit requirements. Range 3=1·67-5·3Mc/s. Range 4=5·0-15Mc/s. Range 5=10-15Mc/s

Other items:

Jackson Bros. 6/36 drive assembly, complete with dial. Number 4103. Four B9A valve holders. One blank Denco 9-pin coil former. Slider switch or similar small on-off switch. Paxolin (7 x $4\frac{3}{4}$in.); two angle brackets ($3\frac{5}{8}$in. long x $\frac{3}{8}$in.); two pieces aluminium sheeting ($1\frac{5}{8}$ x $4\frac{1}{2}$in.); 10-way tag strip $3\frac{1}{2}$in. long with end tags and tags 4 and 7 as earthing connections; 30 nuts and bolts, 11 with countersunk heads; 10 soldering tags; aerial socket; two miniature crocodile clips; sleeving; 6V battery; battery clips.

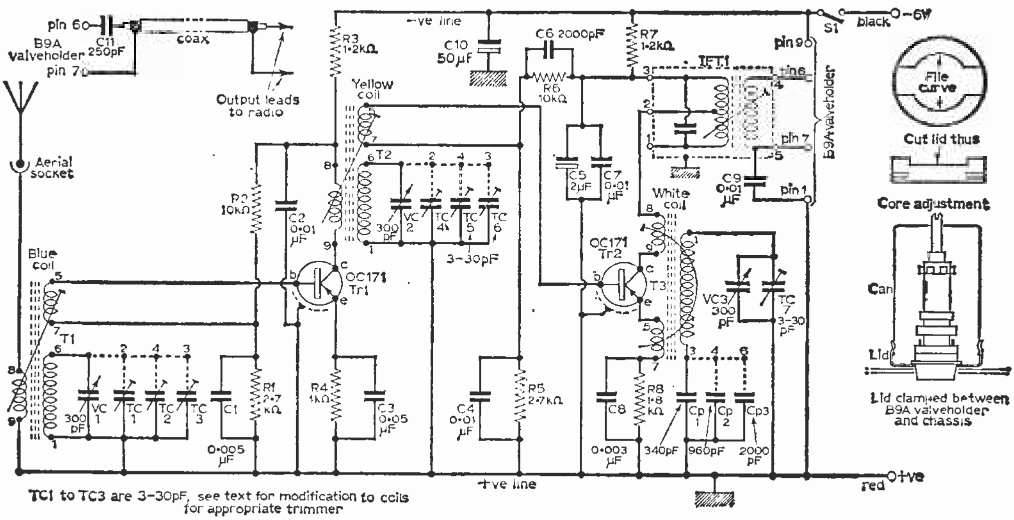


Fig. 1: The circuit of the tuner.

Fig. 2 (pictorial inset): Modifying the coil cans for accommodation on the chassis.

The oscillator trimmer TC7 can now be soldered onto the tuning gang, the "stalk" onto the body with a hot iron, after scraping and tinning the spot where it is to go. The "live" end must be soldered to the stator tag. When wiring up positive earth wires do not forget to connect a wire to each of the two contact springs in the middle of the gang capacitor, taking care to see that there is enough clearance for the moving plates.

Cut and drill the base panel, mount the angle brackets, the tag strip and i.f. coil (Denco IFT16). Also mount the valve holders (4), remembering to put soldering tags onto each of the fixing screws where indicated in the layout. This also applies to a screw on each angle bracket.

The dial assembly can be mounted after all the base wiring is finished but drilling holes should be marked to coincide with the angle brackets. The side pieces, of aluminium fixed onto the dial, serve the dual purpose of extending the screen and of supporting the dial, and to accommodate the sliding switch. If it is intended to use the i.f. strip, the left hand one will have to be drilled to take the volume control. Mount the switch ready to take the main minus wire when assembling.

Now solder in all the positive leads with bare

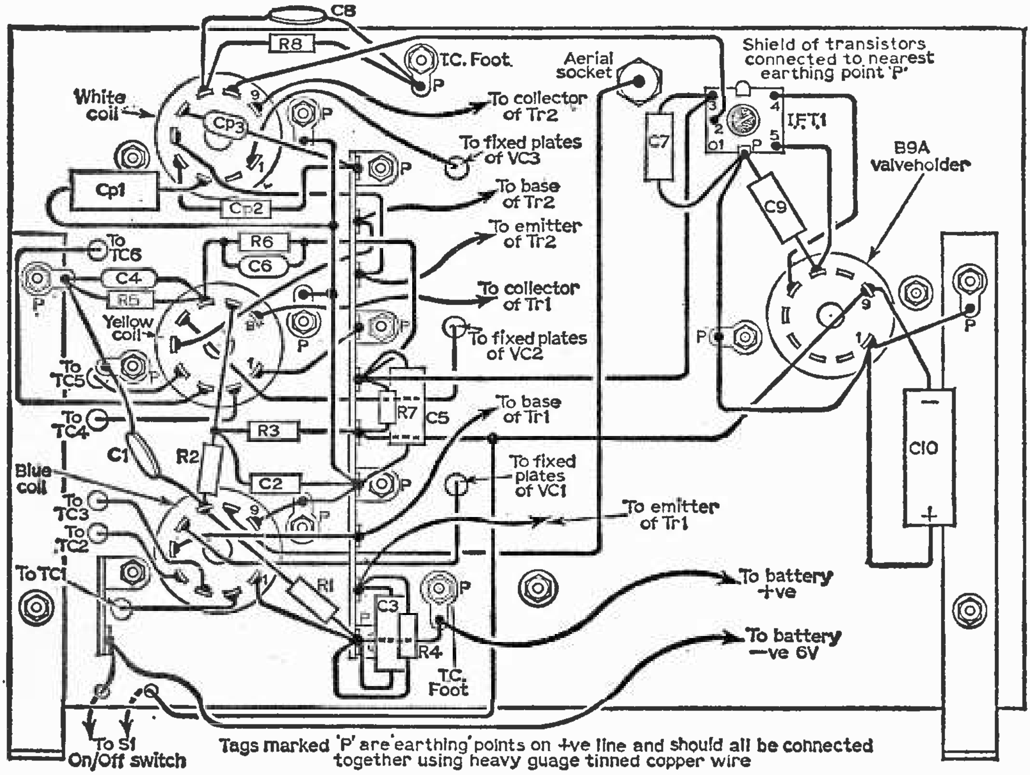


Fig. 3: The main wiring, as it appears on the underside of the paxolin chassis.

tinned 24swg wire, but use a heavier gauge wire for connections to tuning gang and across the four main soldering tags on the tag strip. These should be firmly joined at their bases to form a "bus-bar". It is an essential of short wave working that particular attention is paid to efficient earthing of all tuning components. Also earth the i.f. can.

It will usually be found that the metal around B9A valve holders is solderable, so solder on an earth wire to the three coil holders, slipping it under the slots on the screening can holders. Next wire on the tuning gang leads from the stators, having pushed these, suitably insulated with sleeving, under the tag strip, before attaching to the respective tags on the valve holders.

Proceed to wire on all negative leads except that to the switch. Wire on the resistors, then the fixed capacitors, taking care, as these are of a miniature kind, to make a quick joint. It is a good plan to treat these like transistors and use a heat sink, such as a long nosed pair of pliers with an elastic band around the handle. Transistors should be left until the very last.

When all the wiring of the chassis is done, mount the transistors. Their positions are not shown on the layout of the base panel, but they lie diagonally towards the rear of the underneath side, approximately under the tuning gang, their bases, emitters and shields soldered onto the tags indicated on the layout. It is as well to place sleeving on each wire and the writer uses a colour code as follows: Black for collectors, Blue for bases, Yellow for emitters and Red for shields. White can be used where needed for base bias circuits.

The output leads are of coaxial cable and terminate in a blank Denco coil former to fit into the B9A output valve holder. This is put there so that if it is decided to add the i.f. strip, it has merely to be plugged in. The 250pF series capacitor is contained in this former, two holes being drilled near the respective pins, through which one wire from the condenser is pushed, and the output earth wire through the other hole.

Seperate Aerial and R.F. Trimmers

One of the disadvantages of these plug in coils when they were designed for valve sets was that variations of trimmer capacitance of each individual range were not possible, for only four pins were fitted. But now the makers insert nine pins in the formers, and pins 2, 3 and 4 on the aerial and mixer coils are left blank. As this article covers only the three short wave ranges of these coils, what better than to utilise these blank pins for trimmers?

A small modification is needed on each aerial and mixer coil only, as it is found that the oscillator trimmer (TC7) needs no adjustment on the other bands after setting for band 5. Modify the coils as follows:—

Range 3. Solder a thin insulated wire from pin 6 to pin 3. Do this on both aerial and mixer coils.

Range 4. Solder same as above from pin 6 to pin 4, both coils.

Range 5. Again wire up both coils pin 6 to pin 2.

When doing this, first insert the coils into a loose B9A valve holder, in order to keep the pins from moving when they get hot, as the plastic former melts at rather a low temperature. Similar connections will be provided on the valve holders to the trimmers, i.e.:—

Range 3.	Aerial	coil holder	Pin 3 to TC3
	mixer	,, ,,	Pin 3 to TC6
Range 4.	Aerial	,, ,,	Pin 4 to TC2
	mixer	,, ,,	Pin 4 to TC5
Range 5.	Aerial	,, ,,	Pin 2 to TC1
	mixer	,, ,,	Pin 2 to TC4

Alignment

This is made very much easier with a signal generator, but the following hints will assist greatly those who do not possess this invaluable aid. Note that the Range 5 mixer coil uses second harmonic in the interests of stability. Alignment of this stage is carried out in the normal way, however. First start by placing Range 5 coils in the holders, with the tuning dial at about 80.

The output connection from the tuner to the existing radio will depend upon the type of set used. With a valve radio which does not use a ferrite rod aerial, take it to the "live" side of the tuning gang, or if this is inaccessible, to the aerial terminal, the wave change switch being, of course, switched to medium waves. With transistor sets, the output should have a miniature crocodile clip and be taken to the connection from the base of the mixer transistor to the ferrite rod aerial.

The ideal way is to fit a two-way slider switch on the front panel so that the mixer base is connected to the centre contact. One side goes to the ferrite rod for normal listening, and the other to a socket on the side, in which to plug the tuner. This socket is also wired up to a normal base bias circuit of 56kΩ resistor to battery negative and 10kΩ resistor to battery positive of the radio circuit. One could not use the existing base bias because it will be by-passed internally by a blocking capacitor.

Unfortunately, many transistor radios have not the room to mount this refinement, but it avoids the risk of medium wave band interference from the ferrite rod aerial. A certain amount of fine tuning can be achieved by varying slightly the radio's tuning dial.

Connect the earth wire of the tuner to earth terminal of the radio, or the chassis. It is not advisable to connect to the chassis of an a.c./d.c. radio, or use an earth connection to the tuner with *any* mains radio. Sufficient earthing will be made through the mains.

After having thoroughly checked tuner for any circuit errors, switch on both sets. Turn the slugs of all the coils until they are about half-way out, with the trimmers also half-way. Tune the dial of the tuner to about 80. The dial of the radio must be to its highest frequency, somewhat higher than Radio Luxemburg (208m). This should be as near as possible to 1.6Mc/s but more probably about 1.4Mc/s. In that case, the i.f. coil slug will have to be tuned to this frequency. When any loud signal is received on the tuner, it should be adjusted until maximum volume is obtained.

If using a signal generator, refer to the alignment chart which follows. If not, a fairly strong signal should appear in the 25m band at about 80 to 90 on the dial. Adjust the coil slugs and the i.f. slugs for maximum output. Shift this gradually by moving the oscillator slug, followed by the mixer and aerial slugs until the top of this band is about 89 on the dial.

The trimmers TC1, TC4 and TC7, should be about half-way in, although finally they may have to be in further when aligning 13m and 10m bands. Next try for the 19m band, which should come in with the top of the band at approx. 61 on the dial. Then look for the 13m band which should come in between 30 and 35 on the dial. Here, the trimmers will have to be adjusted. It is probable that the aerial trimmer will have to be furthest in, the mixer and oscillator about three-quarter way in.

Some patience will be needed to bring in the 10m band, which should fall between 15 and 20 on the dial. Instability around this end of the dial may be due to a poor earthing connection, or the 0.003μF bypass capacitor across the mixer resistor will have to be reduced to 0.002μF.

It may also be found that below 10 on the dial there is some break-through of stations on the fundamental frequency of the mixer coil. This is not important as there is little of interest here anyway! Repeat the whole process until satisfied. The 15m amateurs should be strong about 35 on the dial, and the 20m at about 67.

Align Range 4 coils next. The slugs should be one-third way out. Start at the low frequency end with the 49m band between 75 and 80 on the dial, 41m band 60 to 64, 31m band 37 to 40, 25m band 24 to 25, and 19m band 7 to 10 on the dial. The makers of the coils state that the Range 4 coils coverage is 20 to 60 metres, but they seem to take in the 19m band quite efficiently with 20m amateurs at about 12 on the dial. This is an advantage for it saves coil changing at times. Do not move oscillator trimmer TC7 after setting for the Range 5 coils. For Range 4 coils, the TC2 will probably be half-way and TC5 three-quarter way in respectively.

Next align Range 3 coils which take in the 160m and 80m amateur bands. The slugs will be: oscillator half-way, mixer half-way, and aerial one-third way in. Trimmers. TC6 mixer one-quarter way in, aerial fully out (TC3).

The 160m band can often be found by a broad tuned bubbling noise, presumably caused by some powerful direction beam. This should fall about 80 to 84 on the dial. As the i.f. is 1.6Mc/s, the set will probably burst into oscillation near this, at the l.f. end of the dial, giving one some indication in alignment. The 80m amateur band should be between 25 and 30 on the dial, the trimmers being operative here.

To those possessing a signal generator, the

—continued on page 369

Transistor Superhet Faults

SOME HINTS ON LOCATING FAULTS WITHOUT INSTRUMENTS

by R. F. Graham

FAULTS which may occur in the usual type of transistor superhet can generally be located quite rapidly if the task is undertaken in the correct way. The first step is to determine whether the mixer, i.f. amplifier, or audio amplifier is responsible. The stage where the fault arises is then located. Finally the faulty component or other defect is isolated.

Many faults produce particular and characteristic symptoms, and can be located without instruments. In the testing methods described some tests require instruments, and these are included because a meter, set of headphones, or other test equipment will often be available, and can be used to simplify checking suspected stages.

The circuits are representative of popular pocket and full-size transistor superhets, and most points apply to all such receivers, even when circuit details vary. Stages are dealt with in their logical order, but the first step should be to refer to the type of defect described.

Mixer

This uses the first transistor, Tr1 in Fig. 1, and includes the ferrite rod aerial with its windings, oscillator coil, and variable tuning capacitor, with associated trimmers, etc. Typical mixer stage faults include reception on one band only, inability to tune correct wavebands, poor sensitivity, parasitic oscillation, and flat or ineffective tuning.

In Fig. 1, with the wavechange switch at A, the long wave aerial winding L.W., trimmer T3, capacitor C2, and trimmer T4 are not in use. So if m.w. reception is good, but l.w. reception faulty, investigation can be confined to these items, and wiring to them, including the switch. Faults to check include open-circuited or wrongly connected l.w. winding, a short in T3 or T4, or C2 defective, or of wrong value.

If proper m.w. reception is not obtained, T3, T4, C2 and the long wave winding L.W. can be ignored, and even temporarily disconnected, in a home built receiver. Check that point 1 on the m.w. coil goes to positive line for m.w. reception.

If m.w. reception is poor, and attempts to align aerial and osc. coil fail, a simple test is to disconnect the m.w. winding at 2, and temporarily take this to a 300pF or similar variable capacitor wired from m.w. winding to positive line. If individual adjustment of this new capacitor, and the usual tuning capacitor, provides many stations at good volume, there is probably no fault except wrong alignment.

To secure alignment, aerial and osc. coils must tune simultaneously, with a frequency difference equal to the receiver intermediate frequency (often 470kc/s). This will only be so if all capacitor values are correct. When the temporary tuning capacitor described gives good results, check VC1 for shorts due to long fixing bolts, and see T1 opens fully. T2 may be checked, and fully opened, and point 2 reconnected. If ganged tuning is still impossible, C4 should be replaced.

If the temporary tuning described gives no results, check m.w. winding for continuity (meter, or phones and dry cell). Also check the coupling winding, and connections. Osc. coil windings can also be checked. Wrongly wired pins may prevent results. The circuit can be tested from collector (3) to negative line. No circuit indicates defective windings in IFT1, or osc. coil, or wrong wiring to these.

If the stage still does not operate, R1, R2, R3 and C1 and C3 should be checked. Resistors or capacitors are sometimes defective, and may have a loose end wire, or may have been overheated. Colour coding should be checked.

If all the previous points are in order, Tr1 is suspect. When m.w. results are good, checks can be confined to l.w. winding, T3 and T4, C2 and switch, as mentioned, if l.w. results are poor.

Incorrect coverage with VC1 nearly open is generally due to T1 or T2 being screwed down too far. Coverage with VC1 nearly closed depends on the position of the m.w. winding on the rod, and on the osc. coil core position, in addition to C4.

Oscillation with VC1 nearly closed probably indicates this is reaching the intermediate frequency, due to the i.f. being too high, or the m.w. winding being too far on the rod.

Oscillation with VC1 nearly open may often be cured by adding a 100-500Ω resistor at 4.

I.F. Amplifier

This has two transistors, Tr2 and Tr3, and provides amplification at a fixed frequency (often 470kc/s). When tuning and band coverage are correct, but sensitivity is low, the i.f. amplifier may be responsible.

With a local station tuned in, the cores of IFT1, IFT2 and IFT3 should all have a definite peak giving best results. If so, these transformers are probably in order. If any transformer cannot be tuned in this way, check wiring to it. If wiring is correct, and each winding is continuous, the internal capacitors C12, C13 and C14 may be defective or disconnected from lengthy soldering.

When each i.f.t. can be tuned to a definite point giving best results, leave them untouched. A short aerial may be temporarily connected to point 2, if no signal to work with is heard.

If oscillation begins when the i.f.t. cores are peaked, check that leads to Tr2 and Tr3 are short. If so, check values of R11 and R12, and C10

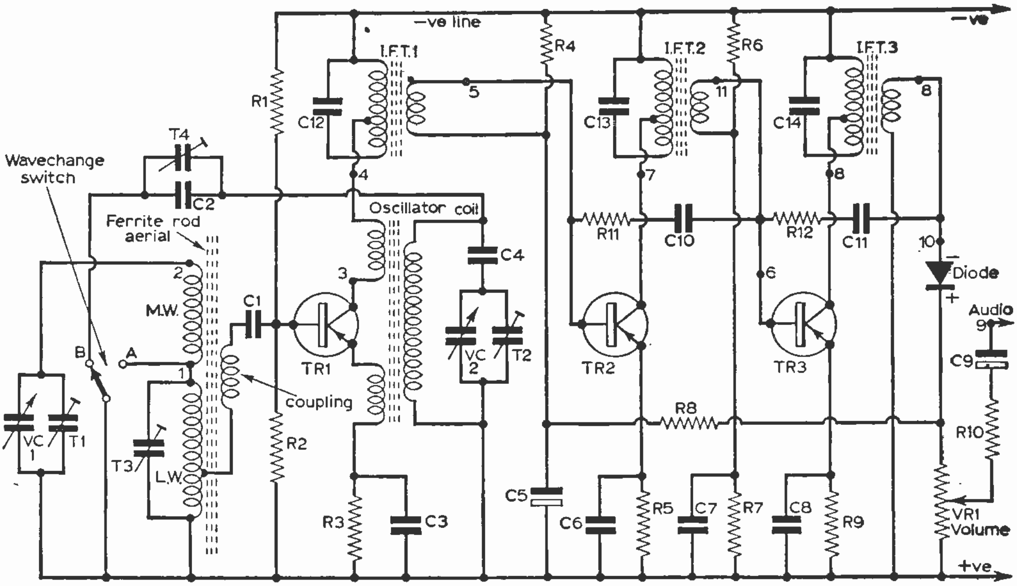


Fig 1: Mixer and i.f. stages of a typical receiver

and C11. In some receivers, i.f.t.'s have to be *very slightly staggered* (off tune) to maintain stability. If oscillation persists, any fairly large capacitor can be temporarily connected across by-pass capacitors C5, C6, C7, C8 and C15 (Fig. 2) to check them.

If gain is still low with i.f.t.'s peaked, resistors R4, R8, VR1, R5, R6 and R7 should be checked. If these are in order, Tr2 and Tr3 are suspected.

Tr2 and all associated items can be checked by temporarily taking lead 5 to Tr3 base, point 6. If results are then quite good, investigation is confined to Tr2, IFT2, R5, C6, R6, R7 and C7. Tr3 and items in that stage can be checked by temporarily taking collector 7 to IFT3 at point 8. This isolates IFT2, Tr3, etc.

If necessary, R11, R12, C10 and C11 can be checked by removing them. The receiver should work quite well, and be stable if the i.f.t.'s are staggered. If phones wired from point 9 to positive line give good results, the whole circuit in Fig. 1 is in order.

A stage-by-stage check can be made by disconnecting the diode at 10 and temporarily taking it to point 5. With a short aerial added at 2, a local station should give reasonable phone results. If not, the mixer stage is not working.

With the mixer working, taking the diode to point 11 brings in Tr2 and IFT2. If results are then good, this stage is working. If results cease, investigate the Tr2 stage as described.

If results are good with the diode connected to 11, but not when normally connected, check the Tr3 stage as described. If results are good with the diode connected to 11, but not when normally connected, check the Tr3 stage as described.

If loud, clear reception is obtained with phones from point 9 to positive line, but the receiver does not operate, investigation can be confined to the audio amplifier, Fig. 2.

First A.F. Stage

Wrong operating voltages here often cause audio distortion. Phones across the driver transformer primary P should give much amplified signals, compared with those heard from the diode. If so, the amplifier Tr4 is in order. If amplified signals are not heard from Tr4, check connections to it, and resistors R13, R14, R15 and capacitor C16.

A similar additional a.f. stage may be present, with a resistor instead of the primary P. If so check this with the phones first.

Output Stage

This has two transistors, Tr5 and Tr6. Faults in this stage cause distortion, heavy battery drain, or overheating of Tr5 or Tr6. When good signals are heard from Tr4, but speaker results are distorted, the values of R17 and R18 are first suspected. These are usually important, and should be within 5% of the specified values for the particular transistors at Tr5 and Tr6.

If a meter at point 12 shows a heavy current, R17 is probably too low in value, or R18 too high in value. If so, reduce R18 slightly, until the average type of output stage takes about 2mA to 4mA or so, with no signal, peaking up to 15mA to 25mA or so, with good speaker volume. R18 may be shunted with other resistors, to achieve this. On no account switch on with no resistor in the R18 position.

If the meter at point 12 shows almost no current, reduce R17 (or increase R18) until current is as just described. R19 is often 3·3Ω to 5·6Ω or so, and bad results sometimes arise from using 33 to 56Ω in error.

If good signals are heard at primary P of the driver transformer, but no speaker reception is obtained, check driver transformer connections and windings. With phones from 13 to 14, or from 13 to 15, results should sound much the same as with them across the primary P. If not, that half secondary is suspect.

Collector currents may be checked by placing the meter at 16 and 17. No-signal and average signal currents should be fairly equal. If not, Tr5 and Tr6 are not matched, and proper results will not be possible until they are replaced.

If the output transformer is in order and correctly wired, there will be continuity from 12 to 16, and from 12 to 17.

Speaker

This should click loudly if momentarily connected to a small dry cell. If not, the speech coil or

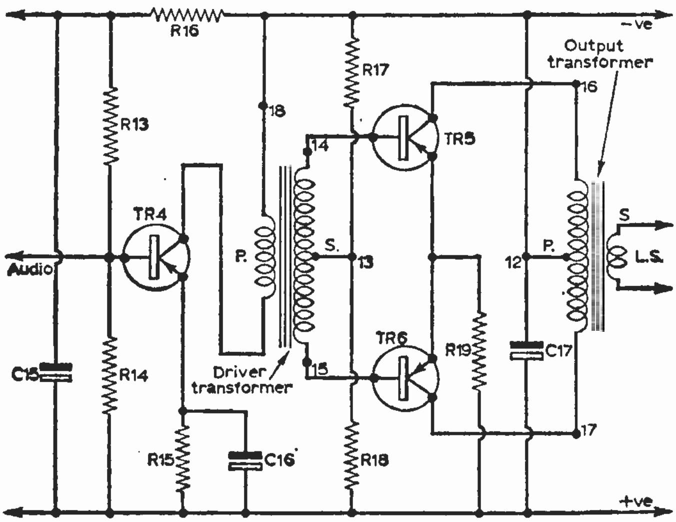


Fig 2: Driver and push-pull output stages of a typical receiver

pigtail leads are suspected. If results are distorted or scratchy, the cone can be moved in and out about $\frac{1}{16}$in. with *careful* finger pressure. If the speech coil is heard to rub the magnet assembly, it requires re-centering. This is usually done by freeing bolts or nuts which hold either the magnet, or the cone spider. If the cone moves with no audible scratching, leave it unchanged.

Distortion may arise from wrong impedance matching. This is generally due to a wrong output transformer, or trying to use a speaker with the wrong impedance. Most transformers are for 3Ω or similar speakers. A 15Ω or other speaker requires a different transformer.

Noisy Reception

If the noise is unchanged, with VR1 in any position, it arises in the audio amplifier, Fig. 2. Loose connections or bad (dry) joints may be found by moving leads, etc., with an insulated tool, with the set working.

A continuous hiss may be caused by Tr4, which may be defective. Or R13 may be too low in value, or R14 too high in value, so that Tr4 collector current is high. Current, measured with a meter at 18, should usually be 1mA to 2mA.

If the noise increases in volume as VR1 is turned towards maximum, it arises in the part of the circuit in Fig. 1. Bad joints, etc., can be located as before.

A.F. Instability

This is by howling not influenced by tuning. C15 and C17 should first be suspected. If the set has negative feedback, and howls when first tested, connections to the output transformer may need reversing.

Instability

If this remains virtually unchanged, at any position of VR1, except for the normal volume control effect of VR1, it is arising in the mixer or i.f. amplifier, and may be located as already described.

If the instability begins only with VR1 near maximum, feedback from output circuits to aerial may be responsible. The aerial, wires to it, and connections in parts of the circuit in Fig. 1, should be reasonably clear of the output transformer, speaker leads and parts and connections in Fig. 2.

In miniature receivers, a fixed capacitor (0·01μF to 0·04μF) may be wired across driver primary P, or from collectors 16 and 17 to positive line, to cure this type of feedback.

Equipment

To locate any of the faults described, in the manner explained, 500-4,000Ω phones, and a dry cell, may be used. A simple d.c. multi-range meter, or 0—10mA or 0—25mA meter, will allow output stage and other current checks to be made. Continuity tests can be made with a 1½V dry battery and 1kΩ resistor in series with the meter, which should read 1·5mA. Test voltages must not be applied to transistors.

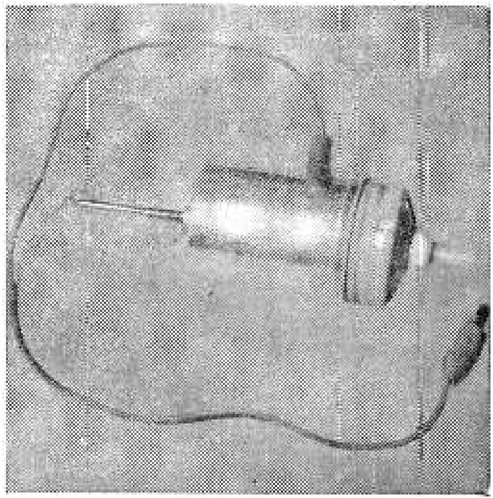
Some tests described can most easily be made if phone leads have small clips. To test suspected r.f. by-pass capacitors, a 0·1μF or similar capacitor, with clips, is useful. Electrolytic capacitors can be shunted with a 25μF to 100μF capacitor, with clips.

If a meter to measure resistance values is not available, suspected resistors can be checked with reasonable accuracy with a dry battery and the meter. If the battery voltage is divided by the current reading in mA, this gives the resistor value in k-Ohms. That is:

$$\frac{V}{mA} = \text{Resistance (k-Ohms)}.$$

Aerial, osc. coil and IFT windings will usually be only a few ohms, while driver transformer windings will often be only 10-20Ω or so. The output transformer primary is usually only a few ohms, and the secondary S is of almost zero d.c. resistance. ■

A "HANDY" SIGNAL INJECTOR



BY RAYMOND CRUISE

SEVERAL excellent designs for signal injectors have been described in the past but the one about to be described will bear favourable comparison, mainly as regards cost, ease of construction and ready availability of components.

A printed circuit construction is used which, together with switch and U16 battery, can all be contained quite easily in a 35mm film casette tin. The total cost inclusive of chemicals, printed board, paint and components is under £1 and, of course, there will be sufficient chemicals and paint left to do quite a lot more printed circuits.

Circuit Description

The circuit, as will be seen by Fig. 1, is the well-known "Multivibrator" or "Astable circuit". This circuit in its valve form was described as long ago as 1918 and was originally conceived as a square-wave generator. Since a square-wave is very rich in harmonics the name "Multivibrator" was coined. The circuit operates as follows:

When the unit is switched on, both transistors conduct a relatively high level of current, approximately 6mA, and this causes a sharp drop in collector voltage and a positive-going pulse is sent to the other transistor which counteracts the effect of the base bias resistor and switches the transistor off. This causes a negative-going pulse which switches the first transistor on again.

Slight unbalance in the components or random variations in the current will always, on switching on, cause the transistors to go into one of the unstable states rather than the other: the circuit is, therefore, self-starting. The circuit subsequently oscillates between the two unstable states and so is quite free running.

The output produced is of square-wave form at a fundamental frequency of approximately 2kc/s and, as previously mentioned, is rich in harmonics, enabling it to provide a continuous note when injected into any receiver. It may be used for r.f., i.f. or a.f. equipment and is one of the most useful instruments one can have for testing and tracing faults in radios and amplifiers and, as a high voltage is not produced, the unit cannot harm transistorised equipment.

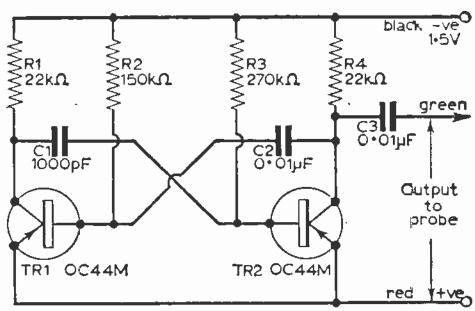


Fig. 1: The two-transistor circuit for this handy instrument.

Whilst not really necessary, due to the fact that the probe and wander lead socket, if assembled as per instructions, are insulated from the can, in the interests of safety when testing equipment of the a.c./d.c. variety the can could be easily and quickly wrapped with insulating tape.

Construction

Obtain first two 35mm film casette tins, one Ilford and one Kodak. The Ilford can is used with the Kodak screw top. The Ilford can is slightly larger and the Kodak screw top is preferred as this has a raised centre, whereas the

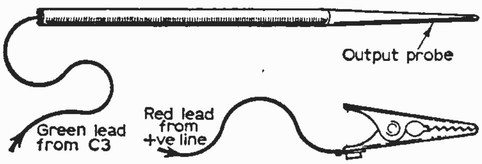


Fig. 2: Details of the probe used with the injector.

Ilford is flat. These can be obtained from any photographer's and if you have to buy them they will cost no more than 6d. for the two.

Construction can commence with drilling casette tin. Centre bottom of can should be drilled $\frac{3}{16}$in., a $\frac{3}{16}$in. hole should also be drilled in side of can $1\frac{1}{4}$in. from bottom, and the centre of the screw cap should be drilled $\frac{3}{8}$in.

A 2in. length of 4BA screwed brass rod should next be obtained. Place this in a drill chuck, leaving approximately $1\frac{1}{2}$in. projecting. Leave $\frac{3}{4}$in. of original thread (next to chuck) and shape the remaining length as shown (Fig. 2); this can be done quite easily in a power drill with a file or an ordinary breast drill secured in a vice.

When this operation is complete remove from chuck and saw off the $\frac{1}{2}$in. that has been in the chuck as these threads will be distorted due to the pressure of the chuck. This completes the probe.

The next job is to make the printed circuit; the materials needed are:

One piece of $\frac{1}{16}$in. thick copper clad board $1\frac{5}{8} \times \frac{7}{8}$in.
Ferric Chloride, Acetate — these are available from any industrial chemist at approx. 1/9 per pint
"Britfix" Nitrate Cellulose Dope (any Hobbies Shop, 1/6 tin)
Fine tipped paint brush

The Printed Circuit

The procedure is as follows: First rub the copper over lightly with steel wool, then the outline shown on Fig. 3 must be transferred on to the copper side of the board. This can best be done either by tracing the outline with tracing paper and then transferring this on to the copper, using carbon paper and a hard, fine-pointed pencil or alternatively copying Fig. 3 directly on to the copper, using carbon paper.

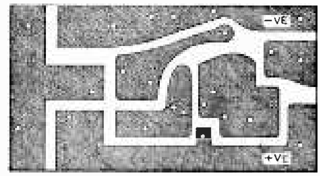


Fig. 3: An actual-size representation of the printed circuit board ($1\frac{5}{8}$in. x $\frac{7}{8}$in.).

Next the areas thus shown shaded must be painted with the dope to resist the etch (the reason I use nitrate dope is that it is cheap. A 1s. 6d. tin will do literally hundreds of circuits, it is very quick drying—approximately 20 minutes—and is very easily removed by the acetate).

When painting these areas, if you have used carbon paper you may find that two adjacent areas will run into each other. Don't worry about this but wait until the dope has dried, then you can go over the board with a fine-pointed scriber or penknife and separate the conductors.

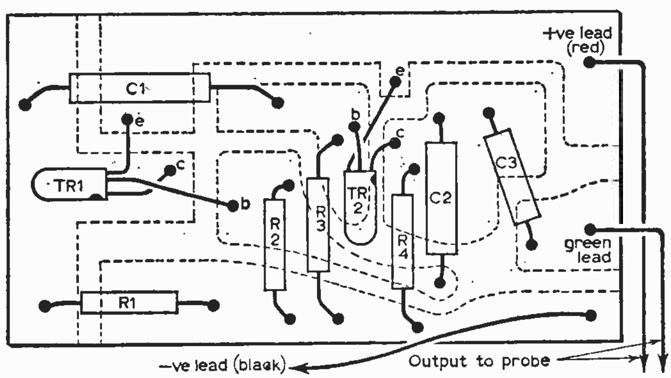


Fig. 4: The complete component layout and wiring diagram.

When this is completed satisfactorily, place the board in a small dish (I use a $2\frac{1}{4}$in. x $3\frac{1}{4}$in. plastic print developing dish) and cover with ferric chloride, which will remove the unpainted areas of copper and leave the painted conductors.

The process takes 45 minutes to an hour but can be speeded up considerably by placing the dish containing board and chemical into a larger dish containing hot water. The board should be agitated during the process, using plastic print forceps (this is to displace removed copper as it tends to cling to the board).

When all traces of uncovered copper have been removed wash the board thoroughly under running cold water and dry with an old cloth. After examining the board again to see that there are no traces of uncovered copper left take an old piece of rag, moisten with the acetate and rub over the dope, which will be completely removed in three or four seconds. After rinsing and drying again the board is ready for drilling.

Take care with the ferric chloride not to get it on hands or clothes; it is a poison. When it has been used empty it away on a vacant piece of your garden and *not* down the sink.

All holes should be drilled with No. 60 drill. This can best be done from the copper side after first lightly centre-punching positions for lead-out wires of components, which should be cut to approximately $\frac{1}{4}$in., scraped bright with a penknife, then bent at right-angles to body and

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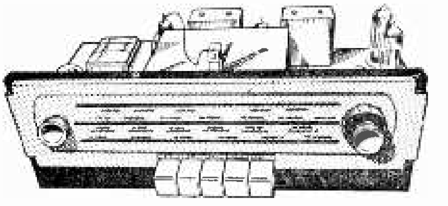

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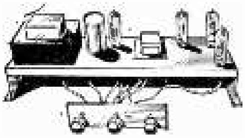

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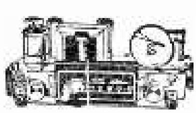

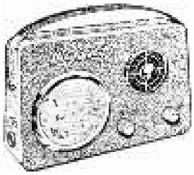

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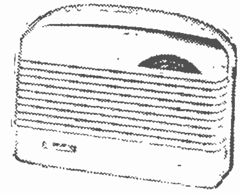

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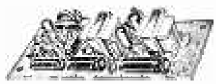

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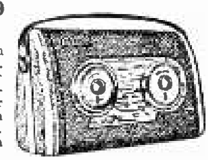

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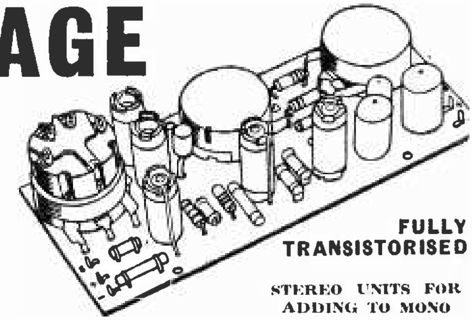

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inserted in correct position on board.

The protruding ends should then be cut to leave about $\frac{1}{32}$in., which should be bent over to be flush with the copper and soldered quickly, using a hot iron and cored solder (preferably 22s.w.g.) and observing the usual precautions with these miniature components and transistors (i.e. heat shunt). The black line down the side of the OC44M indicates collector.

The components when in position and soldered should be as shown in Fig. 4. At the points marked solder 3in. lengths of thin flexible insulated wire, inserting these through from component side of board.

Testing

At this stage the injector can be tested. After first ensuring that no short circuits exist on copper side of board a $1\frac{1}{2}$V battery can be connected, observing correct polarity. If the green lead is now placed on the slider of the volume control of a transistor radio the injected signal should be heard very loud; if not, check the circuit again, paying particular attention to soldered joints and ensuring that no adjacent soldered joints are shorting.

If all is well solder a 4BA solder tag to the end of the green lead. Next run a 4BA brass nut on to the probe about $\frac{1}{2}$in. from threaded end. Cut a piece of insulated sleeving about $\frac{1}{8}$in. in length and which fits fairly tightly round the threaded rod, push this on from the threaded end and right up to the nut. Next push an insulated washer over this sleeving and right up to the nut, then insert probe, screwed end into can, drop another insulated washer over rod from inside, followed by another 4BA nut and tighten quite tightly. This will effectively insulate the probe from the can (it should be checked with meter to see if this is so).

The miniature socket can now be fitted, screwing the nut on tightly from inside the can and bending the socket tag up slightly. There should now be about $\frac{3}{8}$in. of screwed rod left above nut inside can.

Solder a 3in. length of thin black flex to the negative end of U16 battery and cover the end with insulating tape. Take a $2\frac{1}{2}$in. length of red flex and solder to + end of U16 battery. Cover this with tape.

The entire printed circuit board can now be wrapped completely with insulating material. In my case this was a piece of plastic, such as is used for toothbrush containers, secured and wrapped tightly round with Sellotape. If this is not available the whole board can be wrapped completely in insulating tape.

Now drop the solder tag connected to green lead over screwed rod inside can and secure tightly with a 4B.A. nut (with leads left at approximately 3in. lengths—this can be done with the component board out of the can). Now the red lead from board and red lead from battery + can be soldered to socket tag inside can, the board and battery can now be inserted into can, pushing board one side and battery down opposite side. Whilst there is not a lot to spare there is quite sufficient room to do this; tuck all the wires in neatly.

All that remains now is to remove the screwed collar off the switch and fix in the two black leads, one from the board and one from battery negative, place switch midway between top of board and battery, drop can lid over switch, allowing push-button and screwed neck to come through a $\frac{3}{8}$in. hole, whilst holding push-button screw can lid on to tin, drop screwed collar over push-button and again whilst holding switch stationary by grasping push-button screw collar home, thus securing switch to lid. Connect a wander clip with lead to the miniature plug and the injector is complete.

COMPONENTS LIST

R1	22kΩ	Miniature $\frac{1}{4}$ watt high stab (Henry's Radio)
R2	150kΩ	
R3	270kΩ	
R4	22kΩ	
C1	1,000pF min tubular (Suflex)	
C2	0·01μF	min tubular paper, 150 volt working
C3	0·01μF	
TR1—TR2	OC44M	
S.P.	Press on, press off (Woolworths, 9d)	

Radiospares min. plug and socket
Eveready U16 $1\frac{1}{2}$V battery

Using Injector

In practice the injector is used as follows. The wander lead is clipped to + battery line of transistorised equipment or chassis (negative line of valve equipment), then in the case of, say, a radio, the probe tip is applied to the volume control slider with this control turned to full volume and, of course, with the set switched on.

If a note is heard then the fault lies in the r.f. or detector stages (from aerial tuning circuit up to volume control). If no note is heard the fault lies between loudspeaker and volume control.

Assuming the latter fault to exist the probe tip should be applied to output transformer secondary and primary windings, bases of output transistors, secondary and primary windings of driver transformer, base of driver transistor and so on, working back from loudspeaker to potentiometer. This injection should proceed until a point is reached where the signal is not heard when the probe is applied: the fault then obviously lies between this point and the one previously checked when a signal was heard.

Similarly if a note is heard when probe is applied to slider of potentiometer, the fault lies between this component and aerial and the same procedure should again be applied, working back from behind diode to collector, then bases of i.f. transistors and mixer oscillator transistor till a point is reached where there is a signal going in but none coming out. The fault can therefore be localised to a few components which can be checked quickly with a meter which should then reveal the malfunctioning component.

As has been pointed out before in previous articles on this method of fault finding, the injector would probably be of no use if the fault is a transistor which for some reason has lost its

—continued on page 335

audio oscillator DESIGN

Transistor oscillator circuits described and explained.

By D. K. Greig

THE shortage of design circuits for transistors is at last now being overcome. The designers, however, cater mainly for the experienced constructor. Many designs for audio-oscillators have appeared in these pages, but none have been worth converting to a generator.

A recent development in another magazine introduced a multi-transistor audio generator incorporating a frequency meter. Although the design was admirable, the expense made it virtually impossible for the amateur constructor. With this thought in mind the following circuits were used.

The final professional design can be built for about 50/- and is compact and accurate. The introductory sections leading to the description of this Wien-bridge oscillator are included for the benefit of the home experimenter, who would like to try his own hand. The theory has been kept to a minimum and much of the mathematics omitted so that beginners and experienced constructors alike can follow it.

In the final design it must be emphasised that the OC140 is an n-p-n transistor and is therefore shown connected the right way round.

WIEN BRIDGE OSCILLATORS AND LADDER NETWORK OSCILLATORS

The design of resistance-capacitance oscillators is similar for transistors and thermionic valves, but three factors must be borne in mind. The r.c. phase-shifting network is required to feed into the input of the transistor, which is of low impedance.

The internal phase-shift of the transistor will be added to, or subtracted from, that of the network. When ladder networks are used, the current amplification factor of the transistor must be appreciably greater than the attenuation of the network.

Ladder Networks

The basis of the stable oscillator is the generator network; the ladder network, being basically simple, is in common use. Ladder networks may be built up by cascading a number of similar r.c. phase-shifting sections, using any one of the sections shown in Fig. 1 as a basic element.

The ladder sections (a) and (b) give a phase-shift between the input and output currents, so that the input of the transistor, which is connected across the pair of terminals on the right-hand side, is fed with a current, I_{out}. The input impedance of the transistor should preferably be much less than the impedance of the network—which is R in (a) or the reactance of C in (b)—in order that the transistor impedance will not disturb the operation of the circuit. This requirement is fairly easy to meet. However, a current gain, at low frequency, of at least 60 is needed for satisfactory operation, and since the input impedance of the transistor in grounded-emitter connection may be as high as 2·5kΩ or more at emitter current (I_e)=1mA, the resulting circuits are of high impedance, and a collector supply voltage of 12V or more is needed.

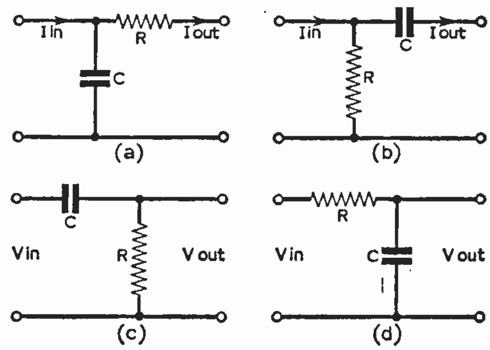


Fig. 1: Four variations on the basic element of ladder networks.

Sections (c) and (d) in Fig. 1 are voltage-transfer networks, and are normally employed with thermionic valves. For transistors, the input impedance, which is connected across the right-hand side, needs to be large compared with the impedance of the network.

The voltage V_{in} across the left-hand terminals of (d) could be generated by allowing the output-current generator of the transistor to work into R. No such simple method can be found for (c) and this circuit may be dismissed as unsuitable.

This way of generating V_{in} sets a lower limit to the value of R which may be employed while obtaining sufficient voltage for oscillation. The condition is $R > A r_e$ where A is the attenuation factor of the network, and is equal to 29 for a network of three equal sections. At I_e=1mA, re is equal to $25/I_e$=25Ω and R needs to be greater than 29 × 25=725Ω (say 1·2kΩ).

To have an input impedance which is sufficiently high for satisfactory operation, the transistor needs to have an α'_0 (current amplification factor, at low frequency) greater than 100.

These networks therefore are better suited to thermionic valves than to transistors; although if transistors of sufficiently high α' are available, the circuit can be made to work from lower supply voltages than when using sections (a) or (b).

Number of Sections

The most suitable RC phase-shift networks may be built up, therefore, from sections of the (a) or (b) type.

Neglecting the internal phase-shift of the transistor for the moment, at least three sections are necessary, and the networks could be of the form of (a) or (b) in Fig. 2.

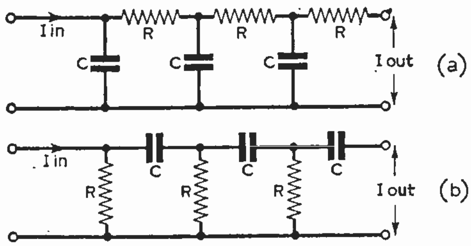


Fig. 2. Suitable ladder networks for transistors.

If the circuit (b) is used, the first R can be the load resistance of the transistor, and the circuit design is considerably simplified.

The current attenuation of these networks, at the frequency where the phase-shift between the input and output currents is 180°, is 29. To allow for losses in the input and output impedances of the transistors, the α'_0 should be greater than about 60.

The OC75 is therefore suitable, though transistors at the top end of the OC71 production spread should also work in this type of circuit.

The current attenuation of 29 applies to a network having three equal resistances and three equal capacitances. These are the simplest to design and the most commonly used. Also, since the grounded-emitter transistor has an input impedance which is only an order or so different from its output impedance, tapered networks are of little use.

Operating Frequency

Single-transistor phase-shift oscillators are best restricted to low-frequency operation, where the internal phase shift of the transistor need not be considered at higher frequencies, both the phase-shift and the reduction in α'_0 cause design difficulties.

For instance, with the network shown at (b) in Fig. 2, the phase shifts in the network and in the transistor vary in opposite senses, so that at high frequencies more phase-shift has to be provided by the network. The phase shift in each section has to be increased, or a fourth section added. There is consequently more attenuation.

With network (a), the transistor and network phase-shifts vary in the same sense, and a two-section oscillator can be constructed though the operating frequency will be somewhat dependent upon the particular transistor. Also since any shunt resistance across the input capacity of this network reduces the phase shift, a higher collector-load resistance, and possibly a higher transistor output impedance will be demanded.

The phase-shift in V and hence in the output-current generator will be $f'\alpha$, where $f'\alpha$ is the grounded emitter cut-off frequency, and $f'\alpha = f_1/\alpha'$ where $f_1 = f\alpha/1{\cdot}22$ for alloy-junction transistors.

800c/s Oscillator

From the fact that single transistor phase-shift oscillators are best restricted to low frequency operation, the following circuit was designed, using the (b) network and a transistor type OC75, and shown in Fig. 3.

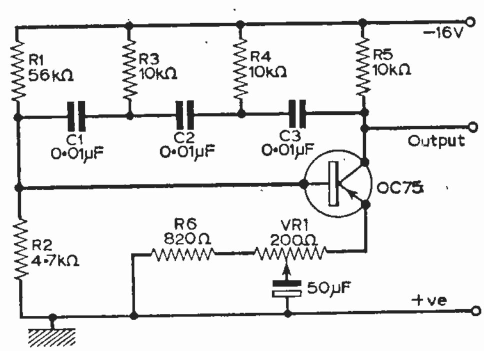


Fig. 3: The circuit of an 800c/s oscillator using a 3-section ladder network.

The circuit operates at a frequency given by

$$f = \frac{1}{2\pi CR\sqrt{6}}$$

which for the circuit shown gives 650c/s. The transistor input and output impedances, however, modify this to 800c/s.

The value of the phase-shift resistors (10kΩ) is chosen to be a mean between that which will be appreciably affected by the transistor output impedance, which is high, and that which will be appreciably affected by the transistor input impedance, which is low.

With these networks, it is not easy to control the amplitude of oscillation without somewhat affecting the frequency of operation, and the amplitude control may change the frequency by approximately 10% or so.

The gain is controlled by changing the distribution of the feedback current between the base-bias resistors and the transistor input, the unbypassed resistance in the emitter increasing the transistor input impedance. The control should be adjusted so that oscillation amplitude is smaller than that giving objectionable oscillation.

The Wien-Network oscillator circuit follows on naturally from the ladder network system. The advantage of the Wien-Network is that the attenuation factor is only 3 at the frequency

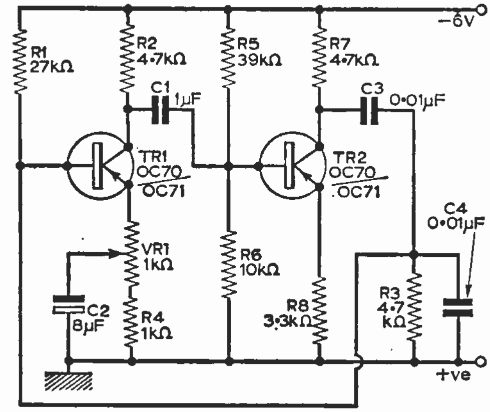


Fig. 4: A two-transistor Wien-network oscillator.

which gives zero phase shift although, since the output is in phase with the input, at least two amplifier stages are necessary.

Two Transistor Circuit

A simple two-stage oscillator of this type is given in Fig. 4, in which the Wien-Network is R7, C3, C4 and R3.

Both stages are d.c. stabilised and the lower base-bias resistance of Tr1 also being part of the bridge network (R3). The 3·3kΩ emitter resistor (R8) of Tr2 is left unbypassed so that this stage has considerable a.c. negative feedback.

VR1 in the emitter of Tr1 provides a convenient means of adjusting the waveform for amplitude and distortion, and for temperature compensation from one day to the next. The wave-form is good, and the short-term temperature stability is fairly good.

Supply voltage may range from −3V to −6V, the lower voltage being necessary to obtain sufficient oscillation, with VR1 suitably adjusted. The output may be taken from the emitter or collector of Tr2 i.e. (R7 or R8).

This circuit operates at very nearly the theoretical frequency of $f = \frac{1}{2\pi\sqrt{(C_3C_4R_7R_3)}} = \frac{1}{2\pi C_3R_7}$ since in fact $C_3=C_4$ and $R_7=R_3$. With the capacitances shown the circuit oscillates at a frequency of about 3·4kc/s.

For operation at other frequencies the capacitances should all be increased or decreased by the appropriate figure. (The resistors cannot be changed without altering the d.c. conditions). The values of C_3 and C_4 should be chosen according to the frequency accuracy required, but for C_1 and C_2 the nearest standard values may be taken.

This circuit is sufficiently uncritical of gain to accept the OC70 or the OC71, but if operation is required at higher frequencies, it would be better to use two OC45's.

Three Transistor Circuit

A more professional Wien-Bridge oscillator is shown in Fig. 5, although the design has been kept as simple as possible. This circuit incorporates a thermistor R5 as an amplitude-control device, and the output is essentially independent of small changes in supply voltage or ambient temperature. (A suitable component for R5 is the S.T.C. thermistor type R53).

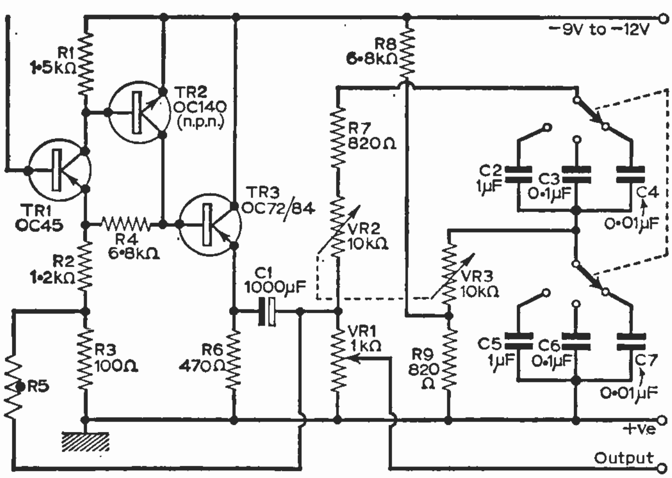


Fig. 5: The final, improved design for a Wien-bridge oscillator.

Apart from the frequency determining capacitors, only one capacitor is required. Consequently the unit can be built compactly, and no difficulties arise from phase shift in the coupling capacitance.

The output voltage is 1V r.m.s., and the circuit operates with supply voltages between 7V and 12V and consumes approximately 10mA. In Fig. 5, a lower limit of 9V has been set to the supply voltage to ensure low distortion.

The frequency coverage is from 15c/s to 20kc/s in 3 ranges (15—200c/s, 150—2,000c/s, 1·5—20kc/s) the lower frequencies being associated with the larger capacitors. The ganged variable resistors VR2 and VR3 allow the frequency to be adjusted within any given range. In the experimental model the ampltitude over the whole range was constant to within better than 2%.

If it is desired to extend appreciably the upper frequency limit of the oscillator, Tr3 should be changed to an OC41. This modification allows the oscillator to work satisfactorily up to

—*continued on page 335*

Making Panel ESCUTCHEONS

A PHOTO—PRINTING METHOD DESCRIBED BY A. GREGORY

AN important feature of the radio constructor's art which seldom gets more than scant mention, is the making of escutcheons or indicator dials.

The reason, no doubt, is that most workers regard as unobtainable the superior, glossy, indelible appearance of the factory printed article, so settle for a rough pencilled attempt, which somewhat mars the final appearance of their "masterpiece", to say the least.

However a very easy and cheap method of printing escutcheons, one off, or more as required, is ready to hand in the form of "contact photo printing", as is used for making snapshot prints.

Essentially this process consists of: laying photo printing paper in contact with a negative—exposing to electric light—and developing and fixing.

The negative, in the present case, is a paper tracing, made in ink, of the escutcheon design; the latter having first been drafted upon a drawing board in the normal manner.

The tracing is transferred from the drawing to a photo printing frame or sheet of glass serving the purpose, and held thereto with adhesive tape.

A sheet of contact printing paper (hard/white/glossy) is clipped in position, whilst being protected from exposure to bright light in a dark room, and then the assembly is turned towards an electric light source which is switched on about twenty seconds. This figure should be doubled or halved for subsequent prints if adjustment of exposure time is required.

The print is next detached from the printing frame and immersed in a dish of developer solution for about two minutes whereupon it will be seen to have turned a full black with the detail picked out in white.

This reversal process so described, i.e., white on black, is simpler to obtain and more distinctive in appearance than the original black on white. The print is finally fixed in hypo, washed and glazed, in the usual way.

The process of contact printing is so simple and widely practised that full instructions are included with each packet of papers bought and so the subject does not warrant detailing in the present article. One point of importance regarding the negative is that it should be oiled, to obtain maximum transparency and conducive to print sharpness.

The best adhesive for sticking the escutcheon to the non-responsive shiny surface of the normal plastic panel material is "Bostik C". ■

AUDIO OSCILLATOR DESIGN

—continued from page 334

and above 100kc/s. For other transistors, R8, the 6·8kΩ bias resistor feeding the bridge, may need to be adjusted to ensure optimum working points for the transistors.

The OC140 (Tr2) is an n-p-n transistor and its connections should therefore be made as in the circuit diagram, with the emitter connected to the negative supply line.

To avoid excessive distortion the external load connected to the oscillator when the output is at its maximum should be not less than 1kΩ. With the addition of the load the change in the maximum output voltage is less than 1%.

Stability

With a change of 3V in the collector-emitter supply voltage (from 9V to 12V) the change in frequency at 10kc/s and the change in the output voltage are less than 1%.

Power Supply

The power supply can be constructed from parts which may be ready at hand, but choke smoothing should be employed and the value of the reservoir capacitance should be high (500—1,000μF).

This generator, although simpler than many of its counterparts, fulfils a need on the bench of the hi-fi enthusiast for compactness and accuracy. ■

HANDY SIGNAL INJECTOR

—continued from page 331

gain but is not in any way open-circuit. If this occurred the signal would still pass through the faulty transistor due to the fact that such a faulty device is still a good electrical connection between two stages.

However, this is a very rare fault which is seldom encountered. This could not occur with a thermionic valve which had lost its emission completely, the non-conducting vacuum existing between anode and cathode in this event would effectively isolate two stages.

Incidentally, one of the most revealing tests on a transistor receiver is the measurement of the d.c. voltage across the emitter resistor of each transistor. The voltage measured should be within ± 20% of the nominal values shown on service sheet or manual and should a voltage of a stage be outside this limit there is a fault in the stage. Voltage measurements, however, will not show up a.c. faults such as faulty coupling capacitors, etc. The fault-finding procedure with the injector on thermionic valve equipment is similar to that with transistors. Starting at slider of potentiometer to determine whether the fault lies in r.f. or a.f. section, if a.f. inject signal into grid of output stage, then back to first a.f. stage; if r.f. commence at potentiometer and work back to demodulator, then i.f. amplifier and so on until a stage is reached where there is a signal going in but none coming out. This last stage must then be the faulty one. ■

Versatile Gramophone Amplifier

A BETTER-THAN-AVERAGE DESIGN, USING DIRECT COUPLING, FOR THOSE PREPARED TO ACCEPT SOMETHING LESS THAN HI-FI, BUT WITH FULL BASS AND TREBLE TONE CONTROL.

By J. G. Ransome

MANY small amplifiers have been described from time to time in this journal but, in general, the tone control networks in these circuits have been little more sophisticated than "top-cut" controls.

This situation can be quite frustrating on occasions—especially when an "awkward" record is to be played which needs special compensation, and so in order to overcome this problem, this circuit has been provided with more elaborate tone controls than is usually found in such simple circuits. Now, it could be argued that since the distortion in the final output stage is about 10%, the provision of elaborate tone controls is pointless. Against this it must be said that while distortion may affect the output *quality* the tone controls affect the actual *content* of the output signal and it is felt that it is still useful to have a good control over the signal even if this signal is a little distorted.

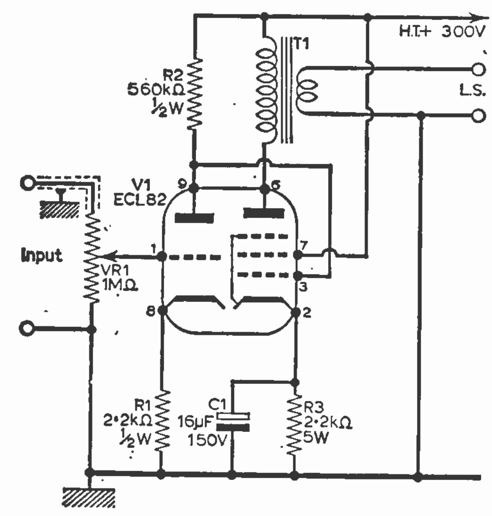
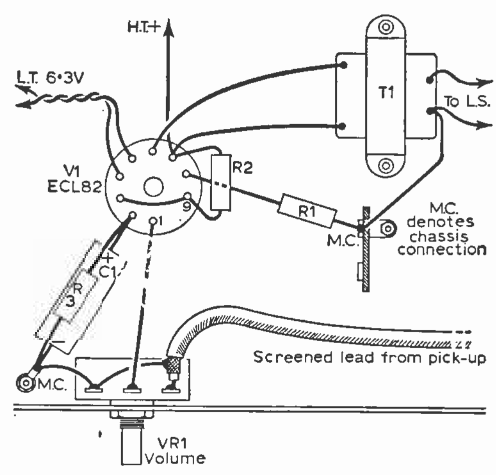


Fig. 1: The basic design.

It must be agreed, however, that the facilities offered by this circuit and its tone controls will be wasted if the amplifier is to be used in conjunction with something like a crude 4in. loudspeaker mounted on a thin wooden baffle!

The basic circuit is shown in Fig. 1 and it is difficult to think of a simpler circuit than that depicted. This circuit (Fig. 1) will work quite satisfactorily as it stands, and if the tone controls are not required, then the wiring diagram of Fig. 2 may be used.

Fig. 2: A wiring diagram for the circuit given in Fig. 1.



As will be apparent from the circuit diagram direct coupling is employed and the basic operation is as follows:

Consider the pentode section of the valve V2. V2 draws current from the h.t. line and as it does so there is a current flow through R3 and this means that the cathode voltage rises. In the present case we require that the cathode should be between 90 and 100V so that the anode of the

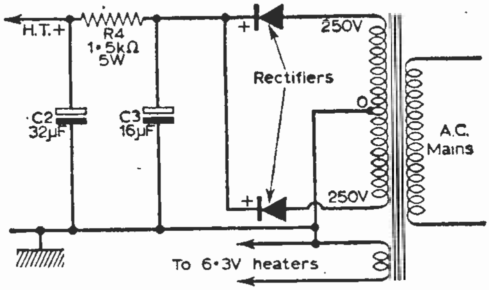
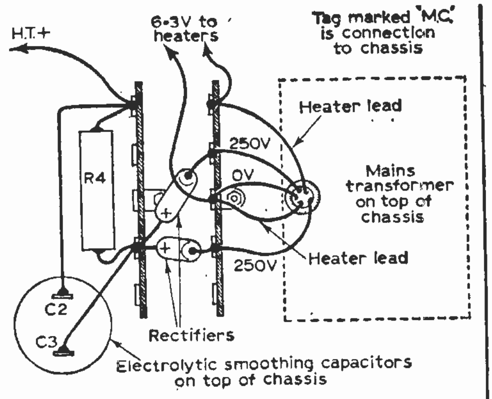


Fig. 3 (above): A power supply circuit suitable for either amplifier. The two rectifiers are 250V r.m.s. 50mA silicon types.

Fig. 4 (right): Wiring for the power supply.



triode has sufficient applied potential, and since the h.t. line is at 300V the voltage drop across the pentode will be some 200V.

Reference to the manufacturers data reveals that the anode current at this voltage is 35mA and the screen current is 7mA. This means that the total current drawn by the valve—and thus through R3, is 42mA. Using Ohm's Law we can see that the value of R3 should be:

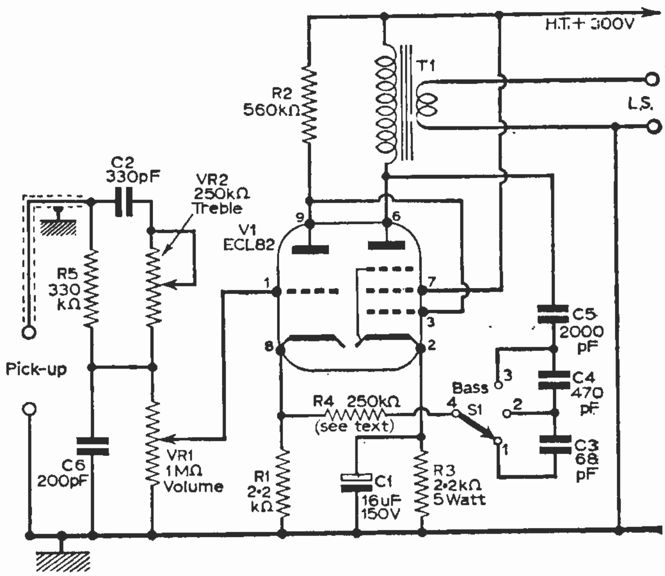
using $R = \frac{E}{I}$

where R = resistance—ohms
E = potential—volts
I = current—amps
substituting

$$R3 = \frac{90 \times 1{,}000}{42} \simeq 2{\cdot}2\text{k}\Omega$$

The grid of the pentode should be about 16V negative with respect to the cathode and so the triode anode must be arranged to be at 74V and this is achieved by the value assigned to R2 in the diagram. The output pentode acts as a load for the triode and thus receives all the output developed at the triode anode. The resistor R1 provides a little bias for the grid (about 0·5V).

Fig. 5 (below): The final circuit which includes the bass and treble tone controls.



Construction

The wiring diagram of Fig. 2 shows the simplicity of layout and the only special features are that the grid connection to pin 1 of the valveholder should be made as short as possible and that C1 must not be too close to the resistor R1 or there may be a risk of impairing the function of C1 by subjecting the capacitor to a too high ambient temperature.

The power unit is shown in Fig. 3 and the wiring diagram for this unit is shown in Fig. 4.

The test voltages as measured on the original, using a 20,000Ω/Vmeter, were as follows:

Pin	1	2	3	4	5	6	7	8	9
Voltage	H	92	77	0	6·3*	290	300	0·5	77

* = a.c.

The Full Circuit

The full circuit is shown in Fig. 5 and it will be noted that several additions have been made to the basic circuit.

Let us consider first the input circuit. The voltage developed by the pick-up crystal is applied across the comb'nation of R5 and C6 and this network provides some compensation for a crystal pick-up by providing a litle top cut. R6 is shunted by C2 and VR2 and, since C2 offers a comparatively low impedance to high frequencies but has a high impedance to low frequencies, the high frequency components of the input signal can by-pass R6.

VR2 controls the degree of this by-pass and is, therefore, a treble control. This control provides "treble lift". The compensated signal is applied to the top of VR1 and the slider of this potentiometer is taken to the triode grid—VR1 is the volume control.

The next network to consider is that comprising the resistor R4 and the capacitors C3, C4, C5. This circuit feeds back part of the output signal appearing at the anode of the pentode to the cathode of the triode, and this has the effect of reducing the overall gain of the amplifier.

This effect can be simply illustrated if we consider the case when a positive signal is applied to the triode grid. In this case a negative going, amplified signal appears at the anode of the triode and this signal is applied to the pentode. The resultant amplified signal at the pentode anode is positive going and is fed back to the cathode of the triode. The triode cathode is now driven positive causing the grid to be made more negative with respect to the cathode, and this means that the gain of the triode is reduced.

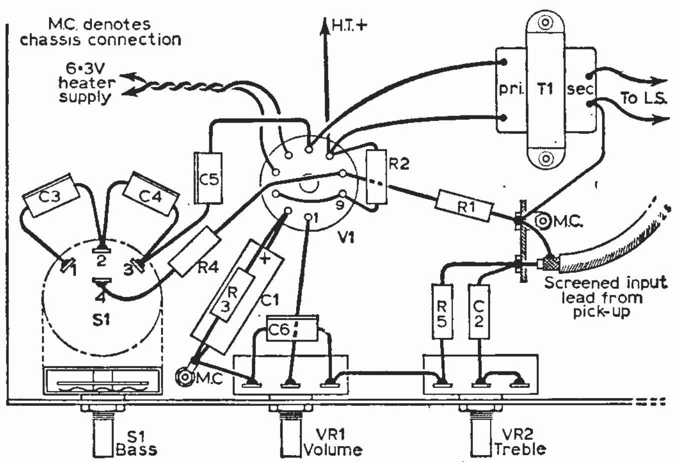


Fig. 6: The wiring for the second circuit.

Now, if the feedback circuit is made frequency selective we can make the amplifier have a high gain to one set of frequencies whilst at the same time having a low gain to another band of frequencies. The frequency selective network is that R4, C3, C4 and C5.

This network to a greater or lesser degree feeds back the high frequency component of the input signal and in this manner the high frequency gain is reduced providing what is, in effect, a "bass boost" in the amplifier.

With the switch S1 in position 1 the capacitors are all wired in series and therefore there is minimum capacitance in circuit which means that the degree of treble feedback is low and so position 1 is the position of minimum "bass boost".

In position 2 C3 is removed from the circuit and the combined capacitance of C4 and C5 is 400pF and in this condition a greater degree of high frequency feedback and so more "bass boost" is effectively given.

When the switch is in position 3 only C5 (the 2,000pF capacitor) is in circuit and this results in all the high and middle frequency signals being fed-back, and this results in a high degree of "bass boost".

The resistor R4 has an effect on the degree of bass boost and it may be found that the range of control offered with the value given for R4 may be inadequate and a suitable value will have to be found by trial and error. In general, however, the value of R4 should not exceed 1mΩ nor be less than 47kΩ.

The optimum load for the pentode is 5kΩ and this means that for a 3Ω loudspeaker the transformer ratio should be: $\frac{5{,}000}{3} = 40:1$.

Similarly for an 8Ω speaker the ratio will be 25:1 and for a 15Ω speaker 17:1 (nearest preferred value).

Construction

The initial stages of the construction follow that outlined for the basic circuit and Fig. 2 should be followed at this stage. When the circuit has been constructed to the basis of the basic amplifier it should be tested as such using the voltage test table outlined previously. Fig. 6 shows the wiring diagram for the complete unit.

The first addition is that of VR1, VR2, R5, C2 and C6. The input to this network should be brought in using screened cable but providing that all the wiring is kept as short as possible this is the only screened wire that will be required. The whole sub-unit is easy to construct and no further comment will be required here.

The bass-selection switch wiring is carried out by mounting the components on the switch tags thus keeping the wiring direct. The switch and its associated circuitry should be mounted as far away as possible from the input to prevent instability due to positive feed-back, and a useful precaution in this respect would be to screen the switch with a small metal plate.

In conclusion, therefore the author would like to say that despite the simplicity of construction the amplifier is capable of some quite excellent results which may prove a surprise to those used to the results of more conventional circuitry. ■

END FED AERIALS

THEORY AND PRACTICE

by F. G. Rayer
G3OGR

AS the author has several acres available for aerials, it is natural that many end fed wires have been tried. This type of aerial is simple and can work effectively on several bands. It is hoped the details following will be of use especially to those who are awaiting their transmitting licences, and wondering what kind of aerial to erect.

Advantages of the end fed aerial may be summarised briefly—the same aerial may be used on all bands, the length is not critical, it is inexpensive and often easily erected, and may provide some gain over a dipole, on the h.f. bands.

Its main disadvantages are an increase in receiver static when conditions are poor, and its tendency to cause TV interference, especially when incorrectly coupled to the transmitter. With correct coupling, TVI should not be exceptionally troublesome.

Materials

Hard drawn 14 gauge copper wire is generally used, and may be obtained in any suitable length. Enamelled wire is preferable, to reduce the surface losses eventually likely from oxidization of bare wire. Stranded 7/26 wire, with weatherproof covering is available in coils up to 100ft. The 7/26 wire is cheaper and lighter than 14G. and no reduction in aerial efficiency was apparent when it was used. Necessary joints were made by twisting the wire together for about 2in., soldering, and painting with bitumen.

One 3in. ribbed glass insulator can be used at each support point, or a pair, if available. The polythene line sold for aerial erection is ideal between insulators and supports, though any thin strong cord, for outdoor use, would be suitable.

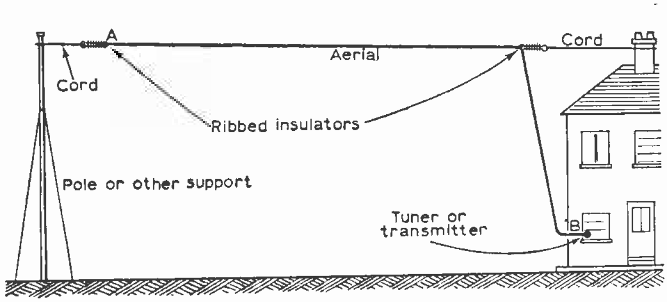


Fig. 1: Typical end-fed aerial system.

With an end fed aerial, the transmitter end is usually supported at the house. The line should be taken to the highest possible point, and is of such a length that the down-lead is at least 2ft. from the walls for most of its descent, as in Fig. 1. In many cases the whole aerial can be a single, uncut wire. Its length is made up by the horizontal top, down-lead, and connection to the transmitter or tuner. That is, from A to B in Fig. 1.

Only one other support is required, again as high as can be arranged. It may be possible to take a line to another building, or to a tree, or to a pole fitted vertically in a tree, or attached to a building. Or a 6ft. 4in. x 4in. or similar post may be set in the ground, and the pole may be bolted to this.

If the line is run through a spare insulator attached to the top of the pole, it will be easy to raise or lower the aerial, or adjust its tension.

Harmonic Working

The lowest frequency at which the aerial is a ½-wave long is its fundamental frequency, and multiples of this frequency are harmonics. In Fig. 2, the aerial is a ½-wave long for 40 metres. Current is nearly zero at each end, and reaches a maximum in the centre. Voltage is at a maximum at each end, and low in the centre.

If the aerial were used for 20m. it would accommodate two ½-waves, as at B. If used on 10m, the length would be four ½-waves, as at C. The length of wire for a ½-wave aerial may be found from the following, the result being in feet:

$$\frac{468}{\text{Frequency in Mc/s.}}$$

The lengths thus found are 0·95 of a ½-wave in free space, to allow for end effects. A length near the centre of an amateur band is sufficiently accurate for the whole band. Suitable ½-wave lengths are:

1·8Mc/s band	246ft.
3·5Mc/s „	128ft.
7Mc/s „	66½ft.
14Mc/s „	33ft.
21Mc/s „	22ft.
10Mc/s „	16¼ft.

When the aerial is operated upon harmonics, end effects only apply to one ½-wave. As a result, the aerial length is more nearly that of the number of ½-waves in free space. For harmonic working, the length is easily calculated as follows:

$$\frac{492 \times (\text{No. of } \tfrac{1}{2}\text{-waves} - 0{\cdot}05)}{\text{Frequency in Mc/s}}$$

As example, suppose an aerial is four ½-waves at 21·2Mc/s. The length is:

$$\frac{492\ (4 - 0{\cdot}05)}{21{\cdot}2} = 91.7\text{ft.}$$

Feed Impedance

If the aerial is a ½-wave long, or any multiple of ½-waves, as in A, B or C, Fig. 2, high voltage but low current will be present at the end connected to the transmitter or tuner. The feed point (end) will thus be at high impedance. The actual impedance can easily be 1,000Ω, or higher.

Should the aerial be only long enough to be a ¼-wave, as at A in Fig. 3, low voltages but high currents will be present at the transmitter end, which will thus be low impedance. In these circumstances, the feed point impedance may be 50Ω or even less.

When the aerial is some intermediate length, such as at B in Fig. 3, its feed point impedance will also be some intermediate figure. The feed impedance will also be of some intermediate value when the aerial does not accommodate an exact number of ½-waves, at some harmonic frequency, as at C in Fig. 3.

It is thus apparent that provision must be made at the transmitter to operate into a wide range of impedances. This can be done by using a pi-output tank circuit, or an aerial tuner. The latter is often preferable, because it allows the whole aerial system to be tuned to resonance, and helps suppress TVI.

Aerial Lengths

Methods of calculating the length for fundamental and harmonic use have been given. The length of the aerial will also help influence the gain (if any) which the end fed aerial will have over an ordinary ½-wave dipole.

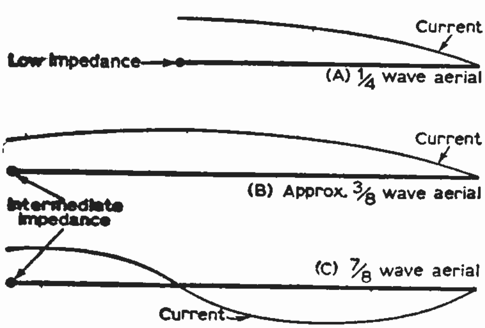


Fig. 3: Current in odd-length aerials

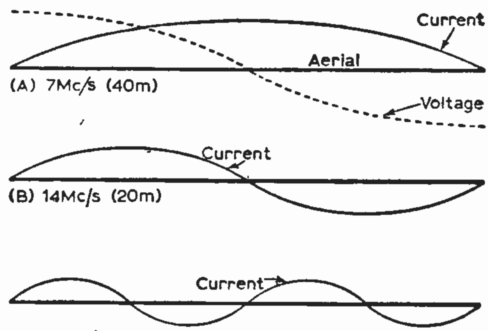


Fig. 2: Fundamental and harmonic operation, showing distribution of current and voltage.

When the aerial is sufficiently long to accommodate a number of ½-waves, the strength of the signal radiated is increased in some directions. The power gain, for aerials of several ½-wave lengths long, is approximately as follows:

No. of ½-waves	*Gain in dB*
4	1·5
6	2·3
8	3·2
10	4·2
12	5

As example, suppose the aerial is 138ft. long. This could be used as a ¼-wave on 160, and a ½-wave on 80m. It would be two ½-waves on 40. On 20m. it would be four ½-waves, with 1·5dB gain over a dipole. On 15m. it would be six ½-waves, with about 2·3dB gain, and on the 10m. band it would be eight ½-waves, with a gain of just over 3dB.

When the aerial is fairly long, useful gain is obtained. It is generally found that the aerial is also a good radiator in other directions. For general purposes, lengths between about 90ft. and 246ft. have all been found effective. The directivity and increased gain are most likely wanted on the 14 and 21Mc/s bands, and suitable lengths for these are as follows:

14Mc/s Two ½-waves, 68ft. Three ½-waves, 103ft. Four ½-waves, 138ft. Six ½-waves, 207ft.
21Mc/s Two ½-waves, 45¼ft. Three ½-waves, 68ft. Four ½-waves, 91¾ft. Six ½-waves, 137ft.

Some lengths will be a multiple of ½-waves on several or all bands. For example, 138ft. is suitable for 3·5, 7, 14, 21 and 28Mc/s. In experiments between G3OGR and Capetown, reliable contact was maintained with an aerial six ½-waves long, when attempts to cover this distance with a dipole had failed. When space is limited, 68ft. is useful for 7, 14, 21 and 28Mc/s bands.

Intermediate, odd lengths can be worked successfully provided the method of feeding the aerial is adjusted to suit. This is best done by using an aerial tuner. It is then not even necessary that the length is known, though this information can be useful.

Directivity

When the aerial is about $\frac{1}{2}$-wave long at the working frequency, there is little directivity, though radiation is best at right angles to the wire. When the wire is two $\frac{1}{2}$-waves long, strongest radiation is at about 54 degrees to the aerial. For three $\frac{1}{2}$-waves, the best radiation is at about 44 degrees to the wire, and for four $\frac{1}{2}$-waves the angle is about 36 degrees. The angle is about 28 degrees for six $\frac{1}{2}$-waves, and 17 to 18 degrees for eight $\frac{1}{2}$-waves.

It will be seen that radiation is more and more nearly in line with the wire, as the number of $\frac{1}{2}$-waves is increased. For example, the 138ft. aerial would have lobes at 54 degrees on 7Mc/s, 36 degrees on 14Mc/s and 28 degrees on 21Mc/s.

This increased radiation may be pictured as a cone extending away from the ends of the wire, and the angles given are for radiation at approximately horizontal levels. At angles above and below the horizontal, the radiation is more nearly in line with the wire, when plotted on a map.

The aerial can thus give good coverage in directions other than those favoured by the angles of the four lobes in a horizontal plane. In addition, much of the low angle radiation obtained is extremely useful for long distance working. If it is wished to know bearings, these must be taken from a globe or great circle map.

Fig. 4 shows a wire four $\frac{1}{2}$-waves long, with main and secondary radiation lobes. If the same wire were used on one-half the frequency, it would then be two $\frac{1}{2}$-waves, and the lobes for this are also shown.

Aerial Feeding

The down-lead is brought into the house by means of an insulator or tube, insulation being as good as possible. A detachable earthing clip, or earthing switch, may be fitted here.

In some cases the aerial can be fed directly from the transmitter. If the transmitter has a pi-output circuit, such as that in Fig. 5, the aerial is taken to the tank coil at C2, as shown. C2 (usually a 2-gang or 3-gang 500pF capacitor) is fully closed, and the tank is tuned to resonance by C1.

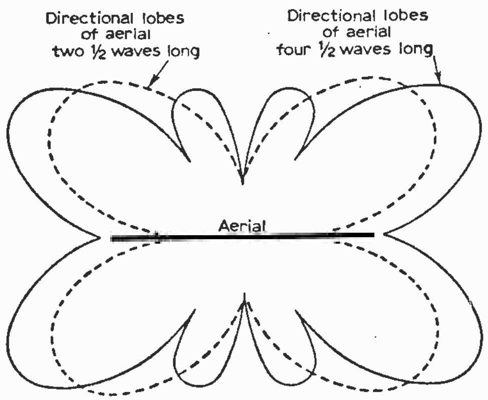


Fig. 4: Directional lobes at 2-waves and four $\frac{1}{2}$-waves.

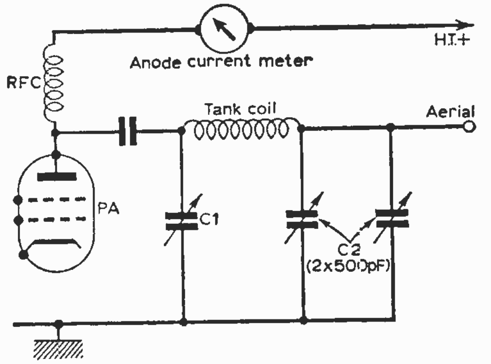
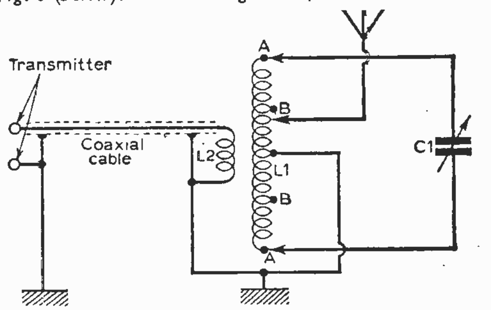


Fig. 5 (above): Typical pi-output circuit.

Fig. 6 (below): Tuner arrangement for end-fed aerials.



Resonance is indicated by a dip in anode current, as read on the meter. If the anode current is too low, C2 is opened slightly, and C1 re-tuned, this being repeated until the valve is drawing its expected anode current.

If the aerial impedance is very high, C2 will have to be opened very much, and the voltages developed will be high. In these conditions, C2 may spark over. If so, an aerial tuner is needed. In other cases, the setting of C2 for correct loading may make it impossible to tune the tank to resonance with C1. An aerial tuner will also avoid this.

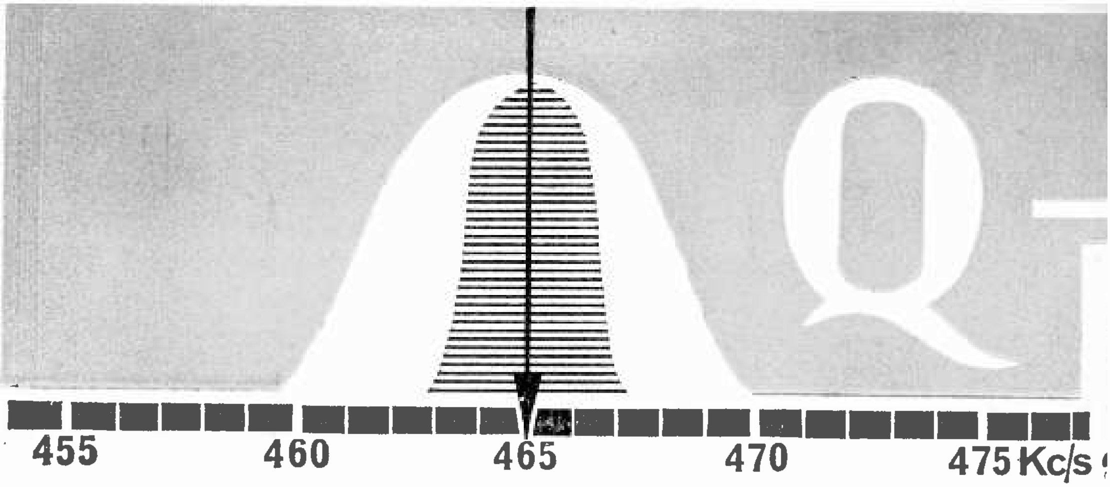
When C2 is at a relatively low value, as it must be with a high impedance aerial, harmonics are more likely to reach the aerial itself, thus causing TVI. An aerial tuner will then also be of benefit.

If TVI does not arise, and if the transmitter can be loaded properly by the aerial then the latter is directly connected, then Fig. 5 may be used. But if there is insufficient loading, sparking over, or other troubles, some kind of aerial tuner is required.

Tuner

Any ordinary aerial tuner will be suitable. A circuit is shown in Fig. 6, and may be easily constructed in a separate case. The coil L1 is tuned to the operating frequency. For 3·5—28Mc/s, 26 turns of 18s.w.g. wire, on a former 2½in. in diameter and 5in. long (e.g., Eddystone 1090) will be

—continued on page 378



IN recent years the Q-Multiplier circuit has been widely used as a cheaper and more flexible method of varying selectivity than the crystal filter.

Most Q-Multipliers are in the form of an "add-on" unit employing a single or double triode and have the advantage of requiring no modification to the circuit of the receiver with which they are used. On the other hand, they have the disadvantage that either room for them has to be found within the receiver cabinet or an entirely new unit has to be constructed.

This article describes two extremely cheap Q-Multiplier units which can be formed by simple modification to an existing stage of any superhet receiver and which require an absolute minimum of additional components. Before discussing the new circuits, a word about "Q", which is a measure of the efficiency of a circuit or component.

Circuit Inefficiencies

If the capacitor C, in the simple oscillatory circuit (Fig. 1) is charged, it will discharge through the coil L. In doing so, it will produce an e.m.f. which tends to charge the capacitor up again. This having occurred, the capacitor will discharge again and the whole cycle is repeated.

In theory this oscillation would go on *ad infinitum*. In practice, of course, it soon dies away due to inefficiencies in the coil and the capacitor and, more particularly, due to the resistance of the circuit. (This is analogous to the decay of a pendulum swing due to air resistance and friction in the bearings.)

If the losses in the oscillatory circuit can be made good, the circuit can in fact be made to oscillate continuously. Thus a simple oscillator can be made up as in Fig. 2. A coupling coil from the anode of the valve being used to feed energy back into the oscillatory circuit.

Similarly, if a tuned circuit is used in an amplifier it is also subject to losses affecting its performance. In theory, the circuit responds only to one frequency determined by the formula $f = \frac{1}{2\pi\sqrt{LC}}$. In practice, due to inefficiencies, it allows frequencies either side of the theoretical one to pass through it, although to a lesser degree. The circuit has *bandwidth* (i.e. a band of frequencies which will pass through it) and its response may be shown graphically as in Fig. 3.

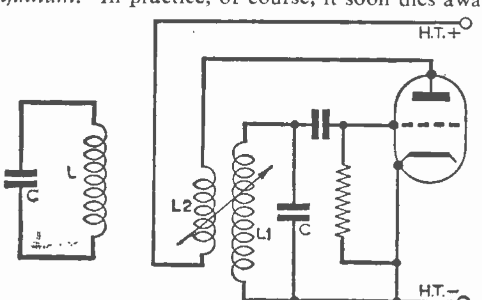


Fig. 1 (left): A simple oscillatory circuit.
Fig. 2 (right): A simple oscillator. Energy for the anode circuit is fed back from the coupling coil L2 into the basic oscillatory circuit (L1 and C) thereby maintaining continuous oscillation.

Bandwidth

Some degree of bandwidth in a receiver is, of course, essential since, owing to its information content, the received signal occupies a certain width of the r.f. spectrum. For reception of musical programmes a total bandwidth of 10kc/s might be regarded as essential. For speech only this could be much reduced and for c.w. 200c/s could well be adequate (or, indeed, essential if the desired signal was adjacent to unwanted powerful signals).

Thus, assuming that most receivers have a fairly wide bandwidth suitable for reception of music, we see that this bandwidth can be reduced if necessary by increasing the efficiency of the tuned circuits of the receiver (Fig. 3). And we have also noted that the efficiency of a tuned circuit can be improved by feeding energy back into it, thereby increasing (or multiplying) its "Q" value.

The simplest possible Q-multiplier can be formed, therefore, by connecting a small capacitor between anode and grid of one of the i.f. amplifier valves of a superhet receiver. Such a modified stage is shown in Fig. 4. Additional components are shown dotted.

MULTIPLIERS

by P.R.LEWIS

• Improving selectivity without a crystal filter •

The capacitor Cx provides feedback to the grid circuit and in practice can be formed by a short length of stiff wire soldered to the anode pin and bent over towards the grid pin of the valveholder. If not already present the gain control VR1 must be added to provide control over the stage gain and therefore over the Q multiplication.

In this particular application the stage cannot be allowed to go into oscillation. (If this happens it is because the feedback is cancelling out all losses, the Q is infinite, the bandwidth nil and the circuit is useless as an amplifier.)

Improving Stability

In practice, therefore, it is desirable to adjust the feedback so that the circuit only just goes into oscillation when VR1 is at the top of its track. It will be found necessary to keep the gain control turned well down until the required station has been accurately tuned. The gain control is then turned up to a point just below oscillation when the effective Q is as high as can be obtained with this simple circuit.

As gain is increased, music or speech will sound "boxy", indicating a narrowing bandwidth and adjacent interference will be much reduced. The margin between high Q and oscillation with this basic circuit is very fine, however, and its uses are therefore limited.

A more stable configuration is shown in Fig. 5, just a few extra components being necessary to improve the performance enormously. The main change is that by substituting two series capacitors for the original capacitor in the second i.f.t. anode coil, and earthing their centre point, it is possible

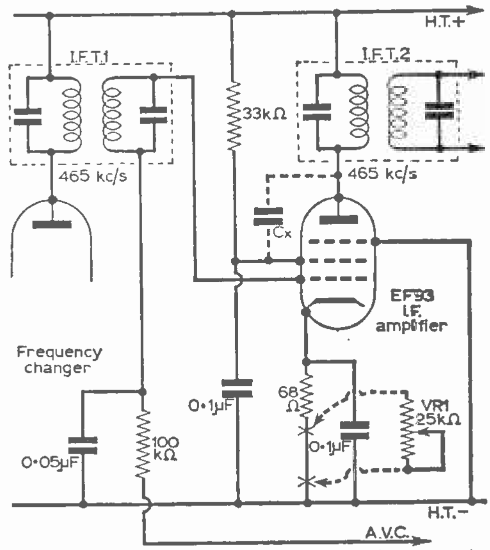


Fig. 4: A simple Q-muliplier circuit, using capacitor feedback between output and input tuned circuits, and incorporated in a typical i.f. stage using an EF93 or similar variable-μ pentode. Additional components are shown dotted. For value of Cx, see text.

to feed back to the grid circuit only a proportion of the signal developed across the anode circuit.

This, together with the introduction of a radio frequency choke, makes for much better control. The feedback capacitor Cx is nominally 5pF but should be adjusted as before until the circuit just goes into oscillation at the top end of VR1.

Note that it is desirable to disconnect the a.g.c. line and use a straight r.f. valve (EF95) instead of the original variable μ valve, although this latter is not absolutely necessary.

Fine Tuning Control

An interesting innovation is the tuning capacitor VC1, which may be fitted if there is room on the chassis. This enables the frequency of the tuned circuit to be varied by ±5kc/s from the nominal 465kc/s, thereby permitting investigation of the passband of the receiver without altering the main tuning control.

This method is considered to be a more effective method of *fine* tuning than the more normal band-speed control. The receiver may be tuned over an amateur band with VR1 turned down and the

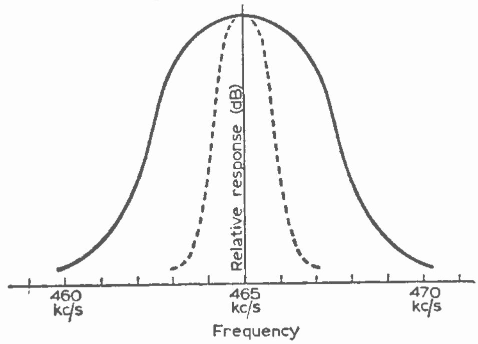


Fig. 3: Theoretical response of a circuit tuned to 465 kc/s only. The dotted lines show the improvement which might result if the Q of the circuit is increased.

position of and interference between various stations noted. VR1 can then be turned up to isolate one transmission and, by tuning back over the band with VC1, previously heard transmissions may be picked out in isolation. If VC1 is fitted the lead from it to the anode pin should be screened.

When this type of modification is made to the i.f.t. the core will need to be accurately realigned. A weak but steady transmission should be tuned in with VR1 turned well down. The core should be adjusted for maximum signal and then VR1 gradually turned up, adjusting the core all the time. The most important thing to check whilst doing this is that the original transmission is retained since, with the increasing Q multiplication, it is very easy to move on to another transmission.

Finally, Fig. 6 illustrates another type of feedback arrangement in which alterations are made to the input circuit of the stage. Once again a.g.c. is disconnected from the stage and a straight r.f. valve used.

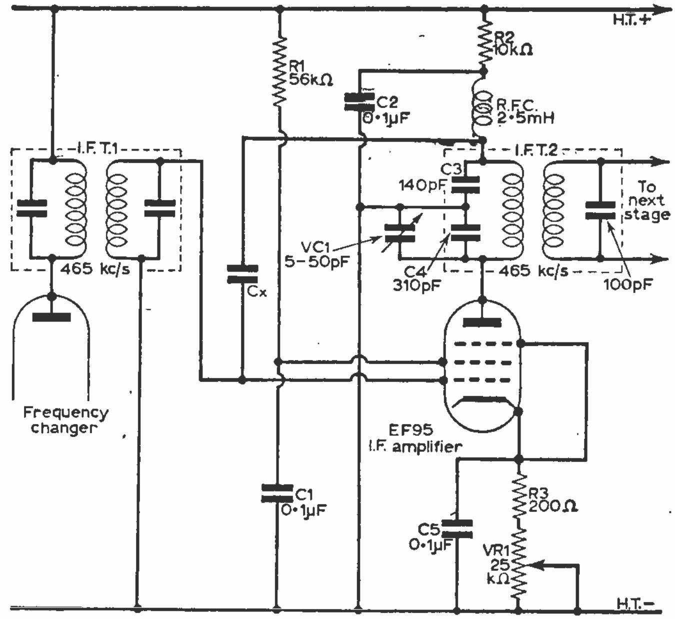


Fig. 6: An i.f. stage modified to form a high stability low gain Q-multiplier unit. The stage is operated as a cathode follower and a portion of the output is fed back via VR1 to the input tuned circuit.

This type of amplifier provides a very stable system (i.e. the margin between high Q and oscillation is not so critical as in the other circuits. Once VR1 has been set to its highest possible position the circuit is not likely to go into oscillation spontaneously).

"Q" multiplications of over 150 are obtainable (i.e. the Q of the stage may be 15,000), the only disadvantage being that the stage gain is less than unity. The circuit is thus best incorporated into a multi-stage receiver, in which case the modified stage should be the earliest possible one after the front end.

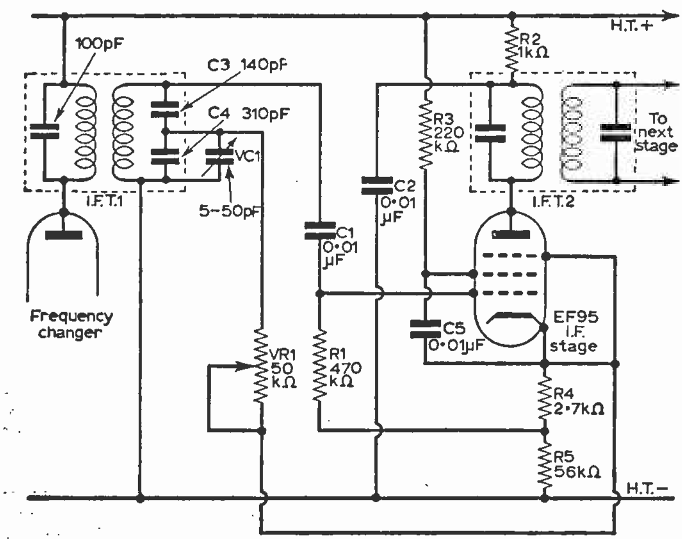


Fig. 5: An i.f. stage modified to form a Q-multiplier unit, feedback being by capacitor Cx from output to input tuned circuits. Values of VC1, C3 and C4 are calculated on the assumption that the original i.f.t. capacitor was 100pF. If VC1 is not fitted, C3 and C4 should both be 200pF.

Mechanical Construction

It should be borne in mind that in both the circuits of Figs. 5 and 6 the object is to achieve a carefully controlled feedback of energy. Therefore precautions must be taken to prevent unwanted feedback.

The two series capacitors replacing the original i.f.t. capacitor must be situated in the can. The tuning capacitor should be screened if possible and, as mentioned in Fig. 5, the lead from VC1 to anode should be shielded.

In Fig. 6 the leads from the centre point of the capacitors C3 and C4 to VC1, from VC1 to VR1 and from VR1 to the valve cathode pin should all be screened, as should the input lead to the grid. VR1 itself should be shielded or, if in metal case, the case back should be earthed. ■

Electronic VIBRATO

PRODUCING THE TRUE MUSICAL EFFECT FOR ELECTRICAL INSTRUMENTS

BY J. HOLDEN

MANY of us who enjoy the fascinating pastime of electronic music have many times wished for a simple device that would produce a true vibrato and not, as is so often found in published circuits, amplitude modulated tremolo which is to say the least disappointing.

It is well known that the most successful vibrato to date is the Hammond Line Vibrato, which, of course, is used on the Hammond organs, and is accepted by most organists to be the most outstanding feature of these instruments. In fact, records made on the old organs which had amplitude modulated tremulants sound "thin" and artificial.

The Line Vibrato consists of a complicated electronic circuit comprising many chokes and a large number of capacitors, also a high-precision scanner which would be practically impossible to duplicate without special tools.

The following circuit effectively does the same job as the above, but only requires the ordinary parts that are found in most junk boxes. It consists of an inter-valve transformer with centre-tapped secondary, ratio approximately 1:3 primary to secondary—Fig. 1(a).

The centre tap of the secondary in conjunction with a 50kΩ resistor is the output to main amplifier, and should be followed with not less than a potentiometer of 1mΩ. One side of the secondary is connected to earth through a 500kΩ resistor.

The other side of the secondary is connected to earth through a variable capacitor of approx. 0·001μF; this is made up of two sections of a tuning gang of 500pF per section, the two sections being connected in parallel.

This variable capacitor is driven by a small electric motor at approximately 5-7 revs. per second; this causes the signal to be effective across firstly one half of secondary, and then as the gang attains its maximum capacitance the signal is effective across the section connected to this capacitor.

Now it will be seen from the above, without going into the matter too technically, that we have obtained a phase change which at its maximum is nearly 180°. A change in phase is heard by the listener as a change in frequency so long as the phase is constantly changing.

The idea of phase change vibrato is not new and various devices have been published, but all have used valve methods of changing the phase which always results in a "thumping" sound being added to the original signal: all the above devices are fitted with filters to remove this "thump", but in doing so the signal has to be very much attenuated at the lower end with the result that the final sound is poor.

The system we are discussing requires no filters whatsoever and the frequency range is entirely dependent on the quality of the transformer. It must be stated at this point that the same effect of phase change can be obtained by replacing the fixed 500kΩ resistor with one of the new light sensitive variable resistances, such as ORP60 cadmium sulphide cell. In this case the variable capacitor is replaced by a fixed capacitor of 0·001μF—Fig. 1(b).

The change of resistance is brought about by cutting off and on the light from a small dial bulb placed in front of the sensitive portion of the ORP60. This can be done by a piece of suitably shaped card rotated by a small motor.

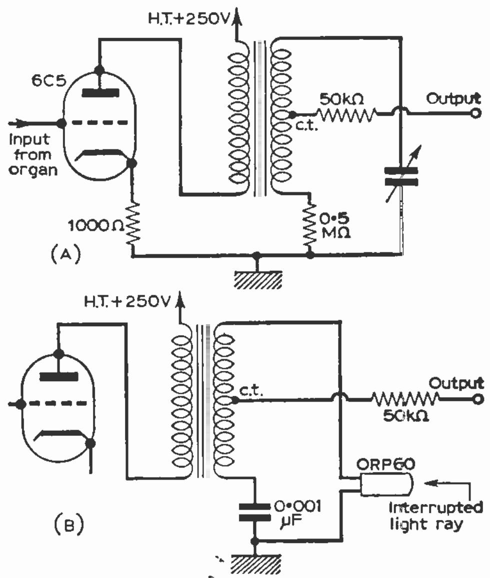


Fig. 1 (a) and (b): The two versions of the circuit required for producing a true vibrato effect.

Both methods have been tried out for long periods with complete success and no fault has been found whatsoever, both on the writer's own home-made organ and a commercial model, viz., Polychord.

The variable capacitor used is the type fitted to most all-dry portables, but must be of construction that will allow the vanes to complete the full circle: the small piece of paxolin which is fitted to the ends of the vanes has to be carefully removed. Do try not to distort either the moving or fixed vanes. ■

Cabinet Care

by M. A. QUALES

finishing • renovating • repairing

wood • plastics

EVERY home constructor must have suffered the frustration of seeing his laboriously built equipment disparaged because—in the words of the critic—it has "an amateur finish". Useless to argue that you are getting umpteen distortion-less decibels if the distaff side has sniffed: "All those wires and things!" The only answer would seem to be a course on basic carpentry, followed by a study of polishing techniques.

There is no need to be discouraged; nor is it necessary to take such drastic steps. The amount of carpentry that the radio enthusiast needs to undertake will be quite small. This is not the place to discuss it at any great length. For any reader who wishes to follow the subject further, a regular subscription to *Practical Householder* is to be recommended. We are more concerned, at this point, with the art of the "finishing touch".

Whether one is merely repairing the damage from a careless cigarette or polishing and finishing a complete set of equipment enclosures, there are some basic factors to consider. First, the method of work is determined by the material.

WOOD CABINETS

Most cabinet work is carried out in wood—which is rather like saying that every day is a weekday except Sunday! But there are many types of timber, and each type has its peculiarities. Moreover, the very many veneer and artificial finishes available at present give a bewildering choice to the constructor. Much depends on the required appearance of the piece of furniture we are building to house our electronic dreamchild.

Colour

The simple and obvious answer would seem to be a wood finish left in its natural colour—a trend that has had a recent renewal of life in furniture. But even this has its drawbacks. No timber remains indefinitely the same colour as when it is first cut. There is a gradual darkening with exposure to light, and as this is a chemical change, the type of finish that protects the wood will not prevent this natural tendency.

Any finish will tend to darken the wood slightly; a point that must be remembered when matching pieces. Whilst it is possible to bleach, it is by no means simple, either to carry out, or control. Far better to begin with a blonde wood, such as birch, in the first instance.

If it is intended to paint or enamel a piece of timber, to obtain the necessary match or to provide a certain decorative effect, the softwoods are best choices. Fir plywood or knotty pine is a common choice.

Preparation

Whatever the material, the first essential is its preparation. Too often, a neglect of this important phase of the work can spoil a finished job, and there's no way of overcoming the fault except to strip down and start all over.

Smoothing

The first thing is to plane and rub down the surface until it is smooth. Remember that the small groove or excrescence becomes alarmingly visible after the decorative finish is applied. This can be very noticeable if a high-gloss finish is used, and is the reason that some people advocate the use of solid core plywood instead of the cheaper veneer-cored types, which may have more of a tendency for face veneers to transfer surface ripples from the core veneers.

If a plane is used for preliminary work, a very sharp iron and a smooth setting are required, so that by sighting along the bottom of the plane, only the merest whisker of iron protrudes. Finishing edges with a plane, especially the edges of some plywoods, can be difficult.

A right-angle block sander can be made, as shown in Fig. 1, which takes away some of the anxiety. Two blocks of wood are fastened at right-angles by shelf brackets, so that a space sufficient to take a medium grade sandpaper is left between the upper edge of the vertical block and the lower face of the horizontal block. The latter is fixed to the bracket so that it overlaps an inch or so.

The glass-paper is fastened as shown, and the device allows good edges to be rubbed down without the chipping and scarring that often results from inexpert use of a plane.

When sandpapering, use a coarse grade, followed by a finer grade, clearing dust with a fine brush between sanding operations. (Grades of sandpaper vary according to coarseness of abrasive surface—

the lower the number, the finer the particles. Normal grade for this work would be No. 2 medium for preliminary work, finishing with 0 or 00). The softer the wood, the finer the paper.

Rubbing down of plane surfaces should be done with the grain—usually along the length of a piece of timber. The easiest method of rubbing by hand is to wrap the glasspaper around a wooden block. Cork is an excellent base material for this work, having just that amount of "give" that helps toward a satiny finish.

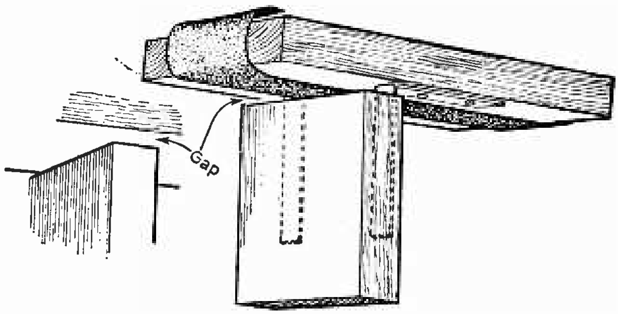


Fig. 1: Rubbing block for sand-papering edges of timber. Note gap between blocks to permit easy replacement of glass-paper.

Power Tools

Nowadays the handyman has a battery of powered tools at his disposal, and sandpapering can be less of a chore. But it should be stressed that some machines are quite unsuitable for delicate finishing.

A rotary sander, for example, must operate for part of its travel *across* the grain of the wood, and this is not advisable for the kind of work we are considering. Where there are ridges, mouldings, etc., it is always better to fashion a block to fit the shape of the moulding and rub down patiently by hand.

The importance of this rubbing down—and the next point to be mentioned—cannot be too strongly emphasised. A good finish will not be obtained unless the basic material is quite smooth.

Small Flaws

If there are small flaws, cracks or crevices, these should be filled. Large holes can be stopped with a putty filler, or one of the water-mix powders on sale for plaster-filling, or with plastic wood.

A point to note is that putty has a linseed oil base. The oil will soak into the wood as the putty dries out and the stopping shrinks. Similarly, the powder mixtures dry and shrink, and being softer than the basic material will tend to drag from the stopping when re-sanded, leaving a noticeable blemish.

Best method of preparation is to impress the stopping firmly, leaving it proud of the main surface, allowing it to dry (the plaster-of-paris mixtures and the newer polymer preparations dry out very quickly—too quickly, as one finds when too much is mixed at one time!) After this, the protruding surface of the stopping is cut down to the level of the wood, and the whole surface sand-papered until no difference can be felt to the level.

If the hole to be stopped is fairly big, or a crack deep, it may be necessary to make two or three stoppings, or the outer skin of the material used for the stopping hardens, preventing the softer inner core from drying out.

This is similar to the filling carried out to even the roughness of hardwood finishes, preparatory to staining and polishing. Depending on the type of timber, and the direction of cut that gives it the characteristic grain, the amount of rubbing down that can be done will vary. Before taking this operation too far, it is necessary to decide on colouring and type of finish.

Basic Methods

There are three principal methods of finishing a hardwood surface: oil polishing, french polishing and wax polishing. Unless it is required to keep the natural colour of the wood, perhaps protecting it with a clear varnish or a french polish alone, a stain will first be worked into the wood.

It is often necessary to mach this colouring very carefully, and the choice of stain depends upon the wood, as well as the effect that is being striven after. Although there are three types of stain available (alcohol, water and oil-based) it is usually the last two which find most popular employment by the amateur.

In general, oil stains do not penetrate the wood as readily as water stains. On a hard, or close-grained wood, water stain may be quicker and easier to use, whereas on soft woods, such as pine or fir, oil stains may be easier to control for colour matching.

Water stains are usually supplied as crystals, mixed as you require, but oil-based or naptha-based stains are more often ready mixed. A cheap water stain can be made by dissolving crystals of potassium permanganate in water.

Using a water stain requires patience. A little is applied at a time until the shade you require has been achieved. Application tends to raise the grain of the wood, and it is often necessary to rub down again after it has been used.

Oil stain is laid on fairly quickly with a well loaded brush, to cover the whole work, then surplus stain wiped off until the right shade is obtained. If the wood is porous, it will be necessary to wipe off fairly quickly to keep the tone even, especially on a surface of any appreciable area.

Care must be taken when staining the end grain of a workpiece, as this is more porous, and will soak up the stain more quickly, resulting in a darker finish.

Grain Filling

The next stage, after staining, is the filling of the grain, A patent filler can be used, and is perhaps a better method for small surfaces, but if a larger amount is required, a powder plaster filler can be mixed as required. The dampening agent for light-coloured surfaces could be linseed oil, or a stain of the same colour as the prepared surface.

After staining, and before filling, the surface should be rubbed down with a fine glass-paper. The object of filling is to level off the ridge-like irregularities of the grain, and thus the filler should be applied with a pad of rough cloth *across the grain.*

The usual method is to begin lightly, over a small area, working until the powder of the filler is used up, recharging the pad until the surface is covered, then going back over the surface in small sections with a circular movement.

As the filler commences to dry, change to a dry pad and wipe all surplus powder from across the grain and at edges and in crevices. After the filler is completely hard—usually an overnight process, even for the quick-drying preparations—the surface can be wiped over with a pad moistened in linseed oil.

This should be done lightly, so as to just form a seal on the surface, combining with the powder filler. Again, leave the work to dry, then rub down with a fine glass-paper, or a worn piece of O-grade, finally dusting to remove all loose particles of filler.

Oil Polishing

Oil polishing is simple to carry out, but it does take time. It is absolutely vital that the work be left undisturbed between rubbings.

The oil used is raw linseed oil, and it is worked well into the wood by a soft cloth with a firm surface, varying the direction of movement of the pad as the surface is covered. Between polishings, the surface may be rubbed down with a soft brush to burnish it slightly. Heating the oil a little improves the penetration.

The finish is attractively "deep", without the high surface shine of a hard polish, and re-oiling every six months or so is all that is needed to maintain the work.

French Polishing

French polishing is a different proposition, and the beginner would be well advised to practice on spare pieces of timber before committing himself to the precious cabinet he has constructed. The work is prepared in the same way as before, with the filling done after staining and the surface rubbed down with a fine-grade glass-paper.

There are four kinds of French polish in general use, and different qualities of these polishes. The types are determined by the shellac used as a base, dissolved in methylated spirit. The preparations ready bottled are in the right proportions, but the professional prefers to mix his own. The following notes are intended only as a guide for the constructor who wishes to experiment.

Finishes

Garnet polish has a rich, greenish-brown colour. It is normally used on dark woods, but may be employed to darken the colour of a piece—although this needs some experience to achieve both a quality finish and a colour match. Six ounces of garnet shellac dissolved in a pint of methylated spirit gives the correct proportion.

Button polish is not quite so dark, having a golden-brown finish, suitable for meduim colour woods. It has a slightly cloudy appearance and is rather harder than the other types. Six ounces to one pint.

Orange polish may be used on lightly stained or unstained woods, the latter method giving a pale yellow finish. Again, six ounces to a pint of spirit.

White polish is almost colourless, and can be used on unstained woods, or where it is necessary to preserve the lightness of tone. Eight ounces of bleached shellac are dissolved in a pint of spirit.

The four kinds may be mixed to give intermediate tones. The shellac should be put in a bottle containing the required amount of spirit, tightly corked, and left for several days to dissolve, with an occasional vigorous shaking to help things along. Because of its highly volatile nature, the usual precautions against fire must be taken and the bottle should always be tightly corked.

It is a good idea to groove a cork as in Fig. 2, and substitute this for the stopper when working. This allows a better control of the amount being poured, and limits evaporation. A further precaution is to keep the work well away from any dust.

If possible, work in a warm dry room, where there is likely to be no disturbance; and if it is possible to place the work in front of a window, the bringing-up of the surface can best be gauged.

Fadding

First step is "fadding" with a pear-shaped pad of wadding—unbleached—prepared by first soaking the wadding in the polish, allowing it to dry, then making it into the pad shape, pouring just enough polish on the pad to wet it, without setting up a drip, tapping off any surplus polish on a sheet of paper, then applying directly to the wood.

Fadding seals the timber, giving a good foundation, and the pad should be worked evenly and quickly over the whole surface, with the grain at first, taking care to overlap the edges so as to prevent the building up of light-catching ridges at later stages of polishing. When the first rubbing has dried and hardened, it should be sanded-down with a grade-O glass-paper, then well dusted.

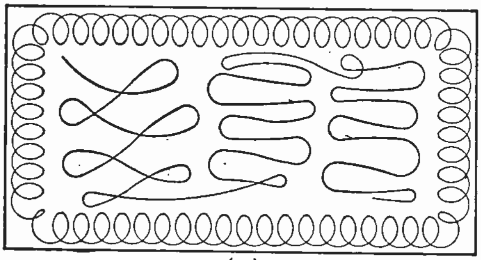
This operation should be repeated several times,

building up the base of protective polish. The spirit dries out in a few minutes.

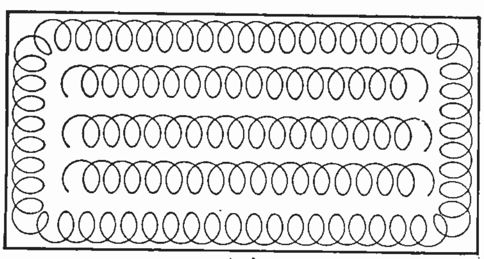
Next step is to oil the pad with either a white mineral oil for light pieces or boiled linseed oil for darker wood. Only a small amount of oil is applied to the work surface to act as a lubricant, while the polish is used to dampen the pad as before.

As the pad becomes dry, recharge with oil, working always with small amounts, and covering the whole surface with a sweeping figure-of-eight movement, and the edges with small, regular circles or loops, so that the whole work is covered evenly. Fig. 2 a and b.

When this operation is concluded, view the surface toward the light to make sure that no irregularities remain. Then leave to harden and rub



(a)



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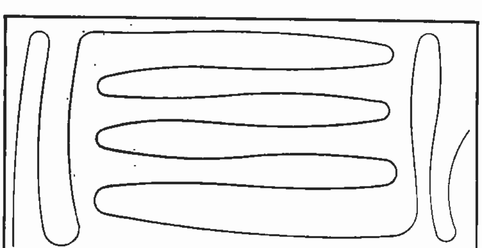

(c)

Fig. 2: Rubbing movements for polishing: (a) fadding; (b) loop pattern to cover whole surface, used in latter stages of fadding and first stages of rubbing—the small outer loops carry the polish right to the edge; (c) broad, light sweeps in last stages of rubbing, gradually straightening as the polish becomes harder.

down with OO grade glass-paper, carefully removing all dust with a soft brush.

Bodying

After oiling, "bodying" is carried out; this is a build-up of several layers of polish, and again, oil is used to lubricate the rubber, which is made of a piece of white linen over a pad of unbleached cotton wool.

First stage of the bodying is a straight backwards and forwards movement of the rubber, lifting it cleanly at the ends so as not to scrape the edges, and using a very light touch. As the surface begins to gleam, recharge the rubber and change the directional movements, using long sweeping loops. Fig. 2c.

Do this several times, after each operation leaving the work to harden for 24 hours between rubbings.

Spiriting-off

The final process is "spiriting-off" with a rubber half-charged with methylated spirit and half with polish. This rubber is taken over the surface in a series of oval movements which graduate to straight strokes as in Fig. 2c.

Reduce the polish content with each application, until the last rub is made with a rubber completely charged with methylated spirit only (but take note: very lightly charged).

This burnishes the surface, which can be rubbed over afterwards with a soft cloth, dusted with Vienna chalk.

Wax Polishing

Wax polishing is comparatively simple. A polish can be bought ready-made, or prepared from a mixture of beeswax and turpentine. Dissolve 4oz. beeswax in $\frac{1}{2}$ pint turpentine, cutting the wax into thin slivers and allowing the mixture to stand until the beeswax dissolves.

The process is accelerated by heat, but care must be taken not to ignite the polish. Colouring is adjusted by adding dry powder colour to the turpentine before the wax is shredded into it, then decanting the turps into another container through a fine mesh cloth strainer.

The polish can be applied quite vigorously, and as many times as required, until a gleaming surface is obtained.

RENOVATING WOOD CABINETS

This is all very fine for the new piece—that virgin cabinet with the flawless surface—but more often we are concerned with "touching-up" operations, and here there may be several short-cuts.

Various scratch removers, stains and retouching polishes are available, and sticks of shellac are readily obtainable. A rubbing compound is a useful finishing aid. Minor scratches, which result in a "tired" look, can be quickly polished out with a rubbing compound used on a gloss finish. For the satin finish, or dull sheen look, a pumice and oil is more suitable, or even fine steel wool.

Deep Scratches

Deeper scratches require individual treatment. If the chipping or scratching lies deeper than the polish, burning in or French polishing will be needed. First, the damaged area must be cleaned up, any loose chips or splinters removed, and the rough edges stained for a colour match.

Then, the application of a shellac stick, with a little heat applied from an alcohol lamp or heated palette knife is employed to fill the depression, finally smoothing out the protruding shellac, rubbing down and polishing as described before.

Shallow Scratches

If the mark is wide but shallow, it may be preferable to French polish with white shellac, rubbing the shellac and spirit mixture with a fairly well damped pad into the depression, gradually building up the level until it matches the surrounding surface, then spreading the polishing area to obtain an even finish.

This requires a little practice, but can give excellent results. Even bad-looking burns can be camouflaged by this method—but it should be remembered that burnt or charred wood must be scraped away before the polishing begins, or it will leave an eventual discoloration.

Stains

Water or beverage stains—those annoying rings that remain after the party has broken up—are often quite shallow, and will succumb to judicious rubbing with steel wool or pumice. If stubborn, the stain may be treated with a pad lightly damped with ammonia, brushed lightly over the affected area. Lacquer finishes require a touch of lacquer thinners, but great care must be taken not to remove the actual polish, or the end result will be a complete polishing job.

It is extremely difficult to "patch" this kind of work, and a careless rub may mean completely removing the finish and starting again—if you will pardon the pun—from scratch!

PLASTIC CABINETS

Plastic cabinets require a different treatment. Scratches are often quite easy to deal with. The colour of the material is the same all through, so that removing scratches is usually a matter of polishing them out with a flatting paste and metal polish.

To minimise the effect of the slight depression that is noticeable on a flat surface where a small

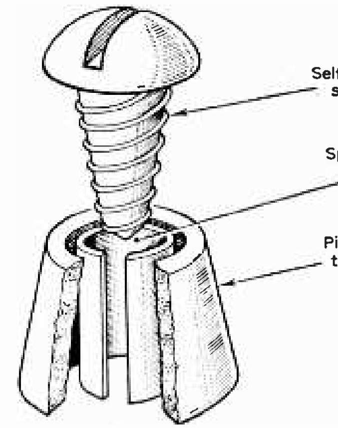

Fig. 3: Method of overcoming worn threads in plastic cabinets and mountings.

area has been polished, simply extend the polished area. Quite deep scratches can be dealt with this way, needing only the application of metal polish, elbow grease and a modicum of patience.

Methylated spirit is a useful cleaning medium for soiled plastic cabinets. The dull smear that it leaves as it evaporates is easily polished away with a dry cloth. But care must be taken, when using methylated spirit, or even warm water and household detergent, which can be effective, if messy; the danger is that painted or leaf-painted lettering will rub off.

It may be necessary to mask the area of lettering, cleaning the main body of the work, then treating the small spaces around the lettering individually with a rag around an orange-stick, or even a fine paint-brush.

Dust

A film of dust rapidly builds up on plastic surfaces left unattended. Much is due to electrostatic attraction. A good cure is a rub over with an anti-static preparation, or a wipe with a record-cleaning cloth—several of which can be obtained on the open market.

Never use a dirty cloth for polishing wood or plastic, and always keep the cloth in a paper or plastic bag when not in use.

Deep Scratches

Particular problems are deeper scratches, broken knobs, and dirt in ridges and milled edges. The latter problem is again a matter of patient cleaning —this time with soapy water and a soft nail-brush, scrubbed across the ribs of a speaker louvre or the milled edge of a knob, toward the open end.

Take care that the fabric behind a speaker louvre does not get discoloured or stretched—it is often

—*continued on page 378*

on the Short Waves

A MONTHLY COMMENTARY BY J. GUTTRIDGE

IF properly kept a log is invaluable to the DX-er. From it he can gather together the information required when making reports, make notes of station schedules and compare conditions on different bands so that he can quickly choose the best frequency when he wants to tune in again to a station. Here then are some notes on the system I use, but they can be modified or simplified to suit individual requirements.

I use 17 columns to set down details of a listening contact that I require. This is a lot of columns to rule up but the amateur radio station log book issued by Webb's Radio, 14 Soho Street, Oxford Street, London, W.1, can be modified easily to fill the bill.

The first column is for the date. The second contains time that listening started and the third the time that it finished. To avoid confusion always use Greenwich Mean Time and the 24-hour clock. The next column gives the frequency of the station under observation. This wants to be accurate to 5kc/s.

After this comes the name of the station, followed (where applicable) by its call sign. I then use a column for the power of the transmitter. This requires reference to a handbook and is not strictly necessary but can be interesting when comparing signals from two transmitters in the same neighbourhood.

The next five columns give details of the signal being received. I use the SINPO code, which is favoured for reports by most stations (Signal strength, Interference, Noise, Propagation disturbance, Overall merit). Each of these is given a mark out of five. More about how to use the code next month.

I then have another column for details of any interference (e.g. jammer, c.w., telephone, S.s.b., broadcast), the frequency and, where possible, location.

Because of the format of the log sheet I use the next two columns contain the date any report was sent and the date a QSL was received. Logically these would be the last two columns on a drawn-up log sheet. After this comes a column indicating the transmitter beam, if any.

In the final column I record details of the programme being monitored. To save this column getting too unwieldy you will probably have to boil down the information, using your own form of shorthand.

LANGUAGE TUITION

If you're thinking of learning German or just want to pick up a smattering of the language for a holiday try the German lessons for English listeners broadcast by Osterreichischer Rundfunk, Wien IV, Argentinierstrasse, Austria, at 1830 GMT on Tuesdays and Saturdays on 6,155kc/s. This station is on the air to Europe from 0500—2200 on 6,155kc/s, 0600—2000 on 7,245kc/s, 0900—1700 on 9,770kc/s and 0900—1300 on 11,785kc/s. This station QSL's and will also supply special report sheets.

A letter to "Dutch by Radio", c/o Radio Nederland, PO Box 222, Hilversum, Holland, will bring you free of charge full details and printed texts for their second series of "Dutch by Radio" programmes, due to start in November. The 19m band with a standby outlet in the 16m band have now been added to the 25, 31 and 49m bands for this station's 2000 English transmission. This is another station that QSL's.

PROGRAMME CHANGES

All-India Radio has made some changes in the frequencies for its English transmissions from 1945—2045. This is now beamed to the U.K. on 6,130/7,235/9,915kc/s and to West Africa on 7,125/9,690/11,835kc/s. Best reception is on 7,235 and 9,915kc/s. A special three-minute transmission in connection with the International Year of the Quiet Sun gives a chance to hear this station in the 75m band on 3,925kc/s. Other frequencies used include 4,760/7,270/9,615kc/s. Full programme schedules are available from the Director of External Services, All-India Radio, Post Box 500, New Delhi, India.

Slight changes have been made by Radio Prague, Czechoslovakia. Its broadcasts to the U.K. are now from 1200—1230 in the 49 and 25m bands and 1900—1930 in the 49 and 31m bands.

Very good reception of the Spanish programme of Radio Warsaw, Poland, from 2030—2057 is given on the new frequency for this transmission of 9,540kc/s.

Radio Sweden, Box 955, Stockholm 1, Sweden, has now moved from 1,5420kc/s to 15,445kc/s for its 1445—1600 transmissions to South Asia. Unfortunately this frequency is the same as that used to Europe at this time by Radio New York Worldwide. Sometimes New York and sometimes Sweden come out on top!

The full schedule (valid until September) of Radio New York Worldwide is: To the British Isles, 1200—1624 on 11,825kc/s, 1630—1815 on 11,900kc/s, 1830—2145 on 15,290kc/s; to Continental Europe, 1200—1554 on 15,445kc/s, 1600—2154 on 15,440kc/s; to Africa, 1200—1815 on 15,260kc/s, 1830—2145 on 15,290kc/s; and finally, to the Caribbean from 1200—0000 on 11,940kc/s.

An African station now giving good reception in the 60m band is the home service of Radio Ghana. After 1900 it can be heard through the c.w. on 4,915kc/s.

Transistor Pre-amp

WITH TREBLE AND BASS CONTROLS

by P.K. Cripps

ANY small transistor pre-amplifiers do not provide for any form of tone control, and this deficiency has often limited their usefulness. The unit to be described offers separate control of treble, bass and volume, in addition to the pre-selection of one of three alternative input sources.

The Circuits

After selection by S1, a three-way single pole switch, the signal passes to the base of the OC71 transistor via the volume control, VR1, and the bass control, VR2. Base bias for the transistor is supplied by the potential divider R1/R2.

The amplified signal appears at the collector of the transistor and is fed across a treble cut control circuit VR3/C3 to the coupling capacitor C4 and from there to the main amplifier.

Components

The three variable resistors should be in good condition without worn tracks which could cause crackling when their spindles are rotated.

In the interests of a quiet background, it is recommended that resistors of half or even one watt rating are used. Quarter watt resistors, of the type normally used in transistor sets, tend to induce rather a large amount of noise, which is undesirable in a pre-amplifier of any sort.

A good quality a.f. transistor is also recommended: r.f. types, although more expensive are generally much noisier than a.f. types.

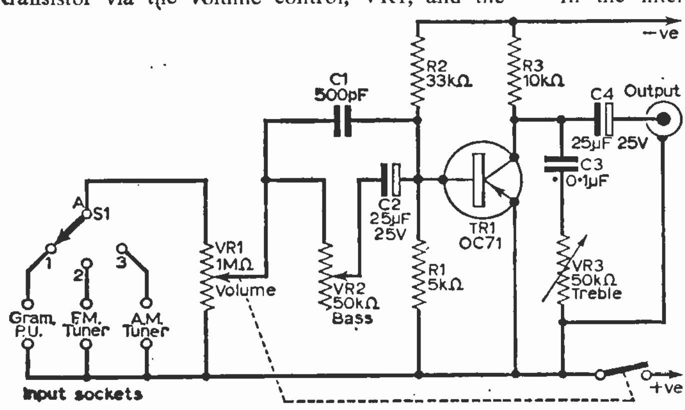

Fig. 1: Circuit diagram of the transistor audio pre-amplifier.

COMPONENTS LIST

VR1	1MΩ variable, with on/off switch
VR2	50kΩ variable
VR3	50kΩ variable
R1	5kΩ ½W 10% or 20%
R2	33kΩ ½W 10% or 20%
R3	10kΩ ½W 10% or 20%
C1	0·0005μF silver mica
C2	25μF 25V electrolytic
C3	0·1μF paper
C4	25μF 25V electrolytic
Tr1	Mullard OC71, or equivalent
S1	3 way, 1 or 3 pole. See text.

Miscellaneous:
6 input sockets with plugs, 2ft of co-axial cable, Ever Ready 1289 torch battery, etc.

Construction

The unit is constructed round the front panel, which can be made of either metal or wood, measuring 9in. x 3in. The four holes should be drilled in this panel, and the four controls mounted securely. Wiring-up may now be commenced, starting with the selector switch and finishing with the coaxial output lead. Most of the wiring is self supporting. A guide to component positioning and positions of holes is given in Fig. 2.

All joints must be soldered, *including those to the transistor*. There is no danger of damage so long as the transistor leads are not shortened and the soldering process is carried out quickly.

The tags of the three variable resistors may be used to hold the components soldered to them and the other components soldered to them will be supported by these.

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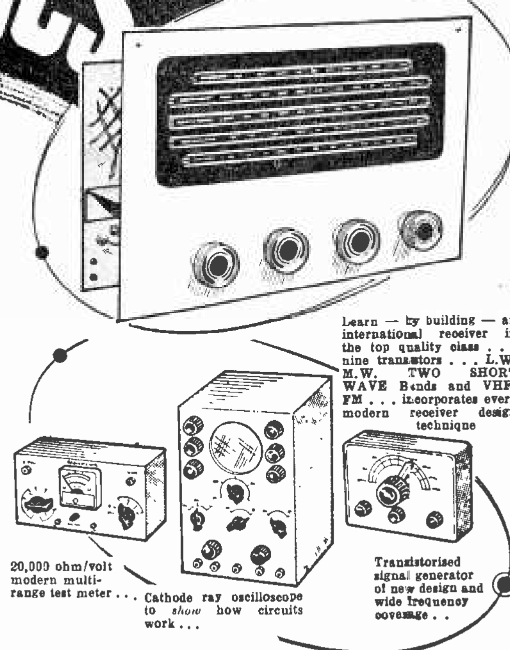

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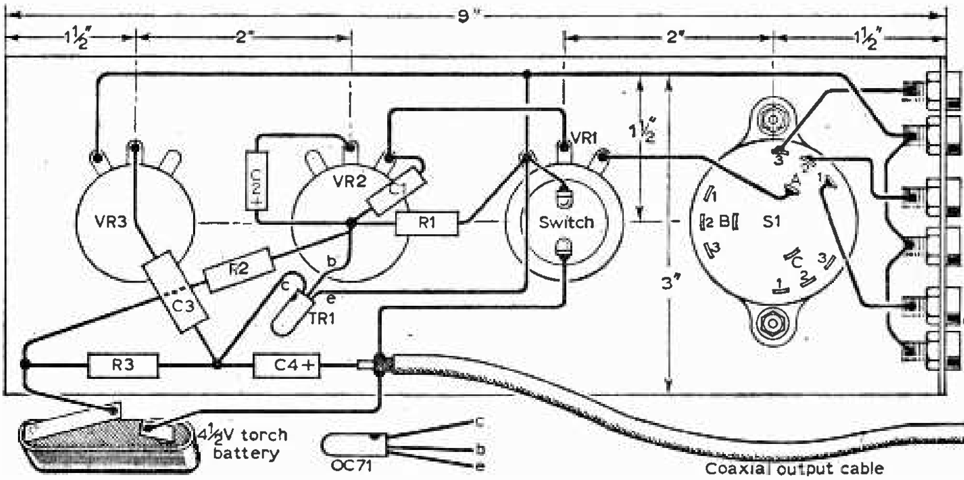


Fig. 2: Layout of components for the pre-amplifier, with dimensions for the four panel-control holes.

The battery specified will have a very long life and therefore is a convenient source of power to use. If the pre-amp is to be used with a valve amplifier, the h.t. supply can provide power to run the unit. A suitable circuit is shown in Fig. 3. The $10\mu F$ 25V capacitor is for additional smoothing.

Testing

When all wiring is complete, the unit may be tested. Connect the output lead to a suitable amplifier, either valve or transistor, and feed in via one of the input sockets a suitable signal. The action of the Volume, Treble and Bass controls may be tested.

Both Treble and Bass have a wide range of cut-off and this obviates the need for a "middle" control. Indeed, with the controls set at minimum treble and minimum bass, the gain of the pre-amplifier is reduced to less than unity.

In practice, of course, this state of affairs will never come about; the treble control may be set below maximum to reduce needle scratch on old 78 r.p.m. recordings and the bass control similarly set to reduce motor rumble from a cheap turntable.

As has already been mentioned, three inputs are provided. Various signal sources will load the pre-amp: a.m. tuner, f.m. tuner, gramophone pick-up, crystal or high resistance dynamic microphone, tape head (with a suitable bias oscillator) or even a simple crystal set will give very high quality results when coupled to a good amplifier.

The P.W. *Mini-Amp* is very suitable. If the *Mini-Amp* is used, its volume control and the 330kΩ resistor (R1) should be disconnected and the pre-amp output fed directly to the base of Tr1 (V6/R2).

It is a good idea to obtain a three-pole three-way switch, as the spare poles can be used to apply power to the various other pieces of equipment which feed the input when the respective input source is selected. This arrangement is shown in diagramatic form in Fig 4.

Fig. 3 (right): Circuit of alternative power supply unit, as discussed in the text.

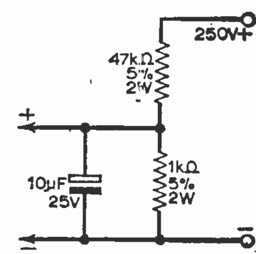
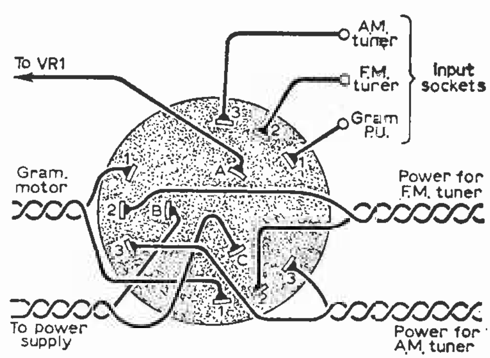


Fig. 4 (below): Wiring for a 3-pole 3-way switch to cater for a.m./f.m./gram switching.



The control panel may be given an attractive finish by cutting a sheet of cardboard to the exact size of the front panel and carefully writing the functions of the various controls on it and then slipping the card over the four spindles. A sheet of transparent plastic may also be placed over this for protection, if desired.

All the spindles should be sawn down to the same length of about ⅜in., so that the knobs are almost flush with the panel.

If a little care is taken in finishing, the appearance of the completed unit will match its excellent performance. ■

CLUB NEWS

ACTON, BRENTFORD AND CHISWICK RADIO CLUB
Hon. Sec.: W. G. Dyer, G3GEH, 188 Gunnersbury Avenue, Acton, London, W.4.

When the Club next meets on 21st July "Test Equipment for Transistors" will be the title of the talk given and all local enthusiasts are invited to attend.

BURSLEM AMATEUR RADIO SOCIETY
Hon. Sec.: J. R. Sherratt, G3SAJ, 23 Ash Way, Ash Bank, Bucknall, Stoke-on-Trent, Staffordshire.

Members who attended the meeting for 4th June, took the opportunity of discussing the organisation of the Society and forthcoming programmes of lectures, prior to their move to new headquarters at Moorland Junior High School, Burslem, which is scheduled to take place during September.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: P. J. Holland, 19 Kingsley Road, Great Boughton, Chester, Cheshire.

On 9th June the Society met to discuss its participation in this year's N.F.D. Later in the month, on the 16th and 23rd respectively, members heard an R.S.G.B. recorded lecture and a talk by Mr. P. White on "Receiver Alignment".

Activities for June ended on the 30th with a sale of surplus equipment.

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

After the N.F.D. activities of the weekend, members who attended the Wednesday meeting on 10th June enjoyed a two-hour film show. This was followed on the 17th by the third d/f practice event.

At the open evening of the 24th, junior members held a discussion and on 28th June, G3ESB and G3IFA handled the local R.S.G.B. d/f qualifying event.

July began with a surplus sale on the 1st. Then on 4th and 5th July, members of the Society took part in the second 144Mc/s portable contest.

DURHAM CITY AMATEUR RADIO SOCIETY
Hon. Sec.: E. D. Watson, G3SHE, 5 Park House Road, Neville's Cross, Durham.

This newly formed Society is proving very popular and any enthusiasts in the area who are interested in joining are invited to attend any of the meetings which are held on alternate Thursdays at the Bridge Hotel, North Road, Durham. Meetings start at 7.30 p.m. Activities include lectures, sales and various contest and an R.A.E course is being run for beginners.

On 18th June the Society's first Annual General Meeting was held. This was arranged so that members could elect a full committe to replace the inaugural one which had held office for an agreed six months.

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

Apart from manning an N.F.D. station on 6th June, this Society also provided a demonstration station at the Halifax Charity Gala, using the callsign G30MM/A. The same callsign was used at the Forest Cottage Gala in Halifax, where members of the Society set up another demonstration station on the 27th.

Activities for the rest of the month were all visits. The first of these, on 10th June, was to the Manchester Radio Society where several members met some old friends. A week later a party of members went on the first of three visits to the Moorside Edge transmitting station of the BBC. This was followed by an inspection of the Bradford factory of Wharfedale Speakers.

Another visit had been arranged for the meeting of 1st July and this was to the Bradford Fire Station.

PLYMOUTH RADIO CLUB
Hon. Sec.: R. Hooper, G3SCW, 2 Chestnut Road, Peverell, Plymouth, Devon.

In anticipation of numbers of mobile amateurs visiting the West Country during the summer months, members of this Club are attempting to contact as many as possible to extend an invitation to them to visit the City of Plymouth where they will find a welcome at any of the Club meetings which are held on Tuesday evenings.

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

The June meeting was held on the 27th when the subject of the evening's lecture was "Receiver Alignment". The speaker was G. Preston, G3OLA.

ROYAL NAVAL AMATEUR RADIO SOCIETY

At this year's Navy Days (1st–3rd August) the Royal Naval Amateur Radio Society will operate a special exhibition station from H.M. Dockyard, Portsmouth. The station will be located just inside the main gate and will be on the air as GB3RN on all amateur bands from 1.8Mc/s to 145Mc/s inclusive.

Visitors to the Dockyard and the Fleet will be welcomed at the station.

SOUTH SHIELDS AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. I. Forster, G3KZZ, 41 Marlborough Street, South Shields, Co. Durham.

On 21st June members enjoyed a mobile picnic held at Finchale Abbey, Co. Durham.

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

The final meeting for the 1963/64 club-year was held on 11th June. The following meeting on 25th June saw the election of the committee of officers for 1964/65 at the Society's Annual General Meeting.

WEST KENT AMATEUR RADIO SOCIETY
Hon. Sec.: H. F. Richards, 17 Reynolds Lane, Tunbridge Wells, Kent.

After two years' absence, this Society returned to participation in National Field Day. On 12th June the annual construction competition was judged. Two awards—the John Wheeler Trophy and the VS9AW Trophy—were presented to the prize-winners of this competition.

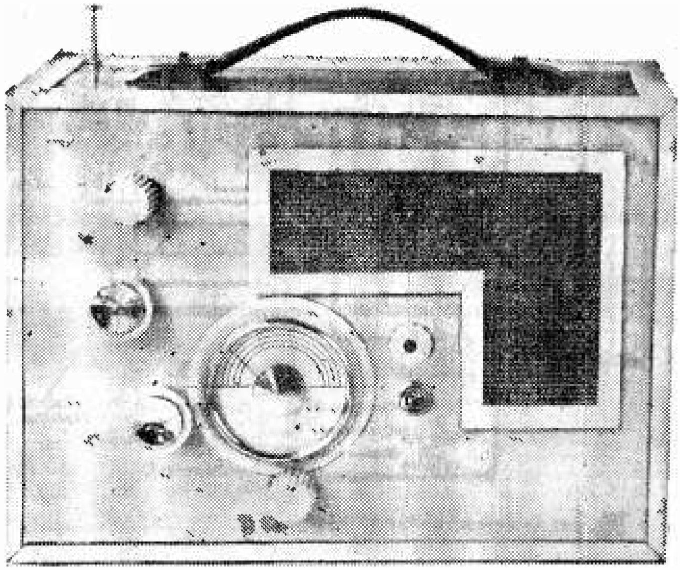
The last club event for June was on the 26th when members heard an R.S.G.B. tape-recorded lecture on "Aerials".

July began with an outside visit by a group of members to a local Decca Navigator transmitting station.

COMPONENTS FOR THE "TRANSISTOR RADIO MAINS UNIT"

Some readers have had trouble in obtaining certain components for the "Transistor Radio Mains Unit" as featured in the June 1964 issue. The two diodes specified are now discontinued and replacement ones have been suggested by AEI. They are: silicon junction rectifier type SJ103-F, costing 4s. post paid, and silicon voltage reference diode type VR9-F at 9s. 9d. post paid.

All the components for this unit, including the replacement diodes are available from *Electronic Constructors, Sutton Montis, Yeovil, Somerset,* who will be pleased to submit a price list to any reader without delay.



A 4-VALVE, 4-BAND, ALL-DRY SUPERHET PORTABLE

By L. R. Repage

The CHELMER 4

CONTINUED FROM PAGE 247 OF THE JULY ISSUE

THIS month we continue with the main assembly. Owing to the closeness of the components, particularly between coil-unit and the gang capacitor, it will be impossible to make the few final connections necessary unless the following procedure is strictly adhered to.

Presuming that the below chassis wiring has been completed, this including the I.f. section in its screened compartment, the above components can be assembled. However, firstly connect two short lengths of bare flex to osc. grid and control grid tags respectively. These should be about ¼in. long, and should be twisted around and nipped tight with pliers, then soldered to the tags.

FITTING THE COIL UNIT

The coil unit can then be fitted in the elongated hole, but the nut not fully tightened. The osc. grid and control grid leads below should then be soldered to these short leads just mentioned, as close to their tags as possible. Take care to identify these leads correctly—it is so easy to get reversed connections and then, of course, the coils do not function correctly. The third loose lead osc. anode should then be soldered to the appropriate tag. Finally, the h.t. tag must go to the h.t. line, and if R2 resistance has been included with its miniature decoupling condenser C3 on the unit, a direct connection only is necessary.

Next fit the ganged capacitor by its three set screws, and solder on the two short wires from the coil unit to the aerial section and oscillator section respectively. The short wires may have to be bent slightly to rest exactly on the tuning capacitor tags before soldering. The other tags on the tuning capacitor can conveniently be utilised for making the parallel connections to the vernier gang; but these connections will have to be made first, by short, but thickish flex leads near the I.f. screen. These leads should not rest on the screen of course, or the vernier effect of the capacitor will be shorted.

This twin vernier may vary in dimensions so take care that sufficient clearance is given between the twin vernier and the main gang moving vanes. This point should be checked before drilling the holes for this vernier in the chassis, of course.

The padder capacitor bank can next be fitted by soldering its "earthed" side to the E main wire, and the four trimmer free tags soldered to the adjacent tag board of the coil unit by short lengths

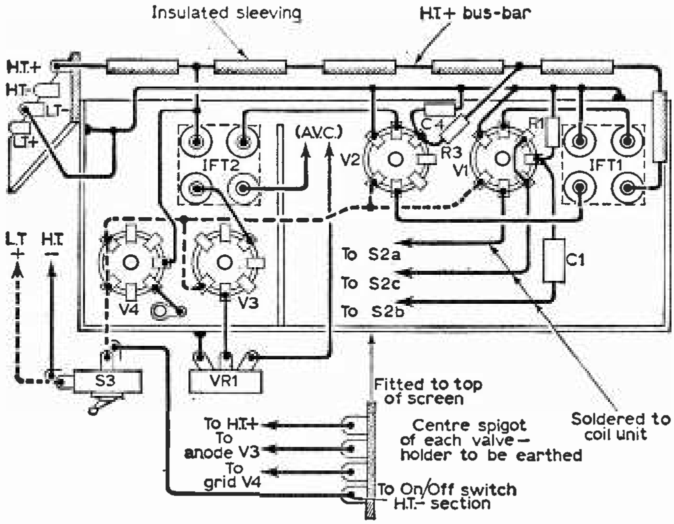


Fig. 5a: An underside view of the chassis showing the wiring in part.

of flex. (Construction of the padder capacitor bank is described below.)

THE A.V.C. PANEL

Finally the a.v.c. panel can be similarly fitted by soldering the "earthed" connecting tag to "E" main wire. The leads to this panel will, of course, have to be brought out from the chassis wiring, and it is a good plan to stick a paper label on each so that the correct tag is used. Colour-spots on tags and leads might be a useful procedure here.

The a.v.c. panel is shown in Fig. 5b. Again this was an experimental arrangement and allowed for easy change of valves of components. Four connections are taken from it to various points in the set, but more will be said of this later. The miniature button-type potentiometer VR1 and the two pole on/off switches S3 are on stand-off panel No. 2 and wires from the inside of the set are passed through holes to them. The button potentiometer stands off the panel by suitable set screws and washers and has a clearance hole cut in the outer cabinet. Another pattern could, of course, be used with the more normal spindle, but may necessitate altering the on/off switch.

The fuse is a flashlamp-type bulb of 1·5V, ·0A rating and is a worthwhile fitment.

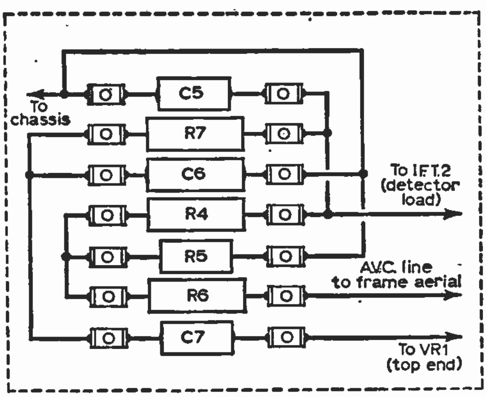


Fig. 5b: The component layout of the a.v.c. panel.

PADDER CAPACITOR BANK

The padder capacitor "bank" is made up by soldering the four trimmer capacitors to the brass strip by one of their tags, each component being pushed close up against its neighbour.

The tags at the opposite ends go to the small panel on the coil unit.

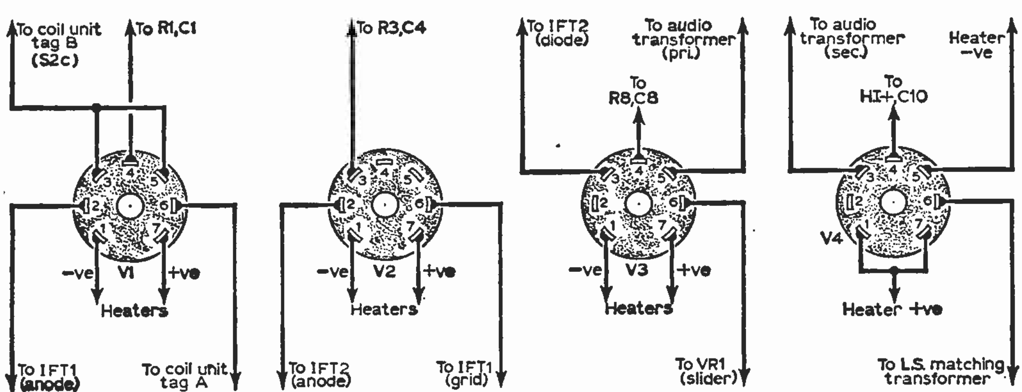


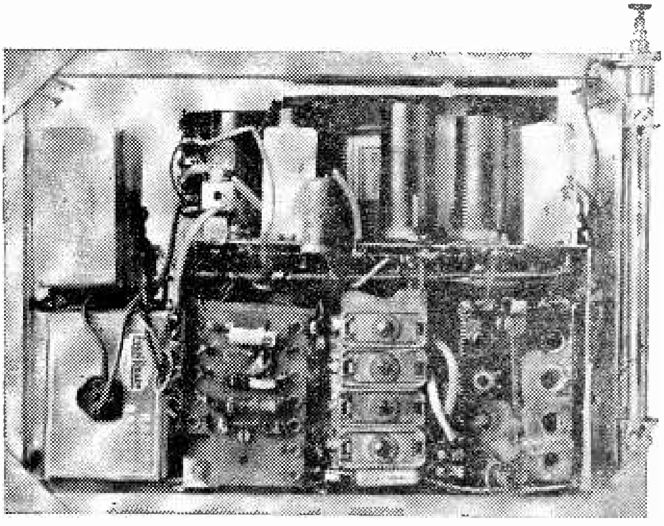
Fig. 5c: Connections to the valve bases. Valveholders shown as seen from underside.

To give added support to the "bank" a stout tinned wire should be soldered to the outside of the shank of the adjusting set screw of each at the back, taking care not to allow the solder to run into the threaded portion of the shanks. This stout wire and the brass strip, are soldered to the lower chassis bar and give adequate support for this unit.

The author fitted all 500pF padders though other values can be substituted according to the coil makers' instructions.

A maximum value of 150pF is given by Messrs. Osmor for their QO9 long waveband oscillator coil, though the author has not found the 500pF one fitted gives too coarse an adjustment.

Once adjusted for correct alignment, these oscillator padders are left alone, of course, as are also the slug trimmers in the oscillator coils themselves.



Looking into the back of the completed receiver

ALTERNATIVE VALVE TYPES

There are several "alternatives" for the valves which have been specified. See Table 1.

The centre spigot on each valve should be earthed, since this makes connection with the screening can.

Note that V4 has pins 1 and 7 joined to l.t.+. This is essential for 1·5V working, in this type of output valve. However some valves can be obtained with the normal filament connections for 1·5V operation, as per V1, V2 and V3, their filament connections being to pins 1 and 7 as shown.

BATTERIES

The batteries used with this set are the Ever-Ready A.D.35, 1½V for filament, and the compact 90V battery B.126 for h.t.

The author has not tested the length of life of this h.t. battery for continuous use, and prefers to use it only when taking out as a portable. For indoor operation the author uses an Ever-Ready B.107. This larger battery cannot be accommodated actually in the set of course.

The h.t. current consumption was found to be 12mA.

Table 1

	Mullard	Osram	American	Mazda
V1 ...	DK92	X17	1R5	1C1
V2 ...	DF91	W17	1T4	1F3
V3 ...	DAF91	ZD17	1S5	1FD9
V4 ...	DL94	N17	3S4	1P10

Next month details of the frame aerial and cabinet will be given.

TRANSISTOR TUNER/CONVERTER

—continued from page 323

following table gives spot frequencies:—

	L.F. Band end	L.F. Tracking point	H.F. Tracking point	H.F. Band end
Range 3—	1·67Mc/s	1·83Mc/s	4·5Mc/s	5·3Mc/s
Range 4—	5·0Mc/s	5·5Mc/s	13·5Mc/s	15·0Mc/s
Range 5—	10·5Mc/s	11·5Mc/s	28·5Mc/s	31·5Mc/s

The h.f. tracking point should be approx. 15° from minimum and the l.f. point 20° from maximum. Note what has been said about the 19m band earlier and if it is desired to include this on Range 4, trim the h.f. end accordingly to minimum, about 16Mc/s.

Oscillator Pulling. When adjusting the signal circuits, some slight detuning of the oscillator can occur (pulling) and in order to prevent this effect giving a false peak, the tuning capacitor should be slightly rocked to and fro while aligning either mixer coil or trimmer.

Second channel. Owing to the fact that an r.f. stage is used, second channel images will not be obvious. It is, however, essential that one uses the higher frequency of the two always present in a mixer, so if two settings are found during adjustment of trimmer or core of oscillator coils, the one with the trimmer or core furthest out is the right one, thus putting the oscillator above the incoming signal.

Check on this by moving the core both ways on lower frequencies, and if two similar signals appear, the correct one is the furthest out. The same applies to trimmer TC7 on the high frequency end of each range.

A SIMPLE CARBON MICROPHONE

BY P. H. P. HARRIS

THE unit to be described was made for home entertainment purposes, and has given much pleasure, although it is certainly not in the hi-fi class.

The carbon was obtained by crushing the rods from old dry batteries, and is sandwiched between two Meccano plates, each 2½in. square, although they can easily be made up from sheet metal. Also required are two pieces of plywood, each 2½in. square, and some ¼in. x ¼in. balsa strip. In the prototype, 3-ply only $\frac{1}{16}$in. thick was used, so that the finished microphone was both light and slim. The balsa wood can be obtained from any do-it-yourself shop.

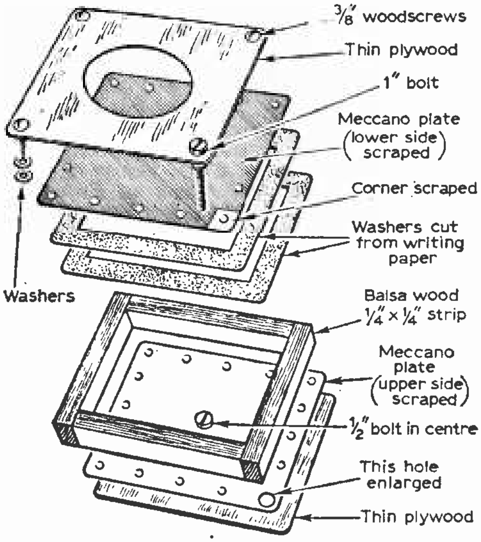


Fig. 1: Illustrating the simple construction of the microphone.

Construction

Construction is shown in Fig. 1. The lower plate, with its upper surface scraped clean of paint, and one corner hole enlarged, is glued over one piece of plywood. (Evo-stik is a suitable adhesive agent.) A hole is drilled in the centre of the plate to take a small bolt, and a nut and a terminal are fitted to the bolt. The balsa sides are then glued in place.

The tray can now be filled with the crushed carbon. The particles must be as small as possible, and they must fill the space completely, or the microphone will make rattling noises as it is moved.

The two large paper washers and the upper plate are laid on top. This plate acts as the diaphragm; its lower surface and one upper corner is scraped clean. (This corner must be over the enlarged hole in the lower plate.)

The upper piece of plywood is used to cover the diaphragm, and present a neat appearance. A 1½in. diameter hole is cut in its centre with a fretsaw (or a pattern of holes may be drilled), together with small holes in the corners for screws. Through one of these, a bolt 1in. long is passed, and a nut screwed up tight.

A hole is drilled through the scraped diaphragm corner to the back. Washers are placed on the screws in the other corners to the same thickness as the nut, and the diaphragm cover is screwed down. The bolt from the top plate must not touch the lower plate. A further nut and terminal are placed on this bolt.

The corners can now be rounded off, and the microphone painted, if so desired.

The Circuit

The circuit is shown in Fig. 2. When the diaphragm vibrates, the resistance between the terminals varies. When a voltage is applied, the varying current induces a varying e.m.f. on the secondary of the transformer, which is amplified in the usual way.

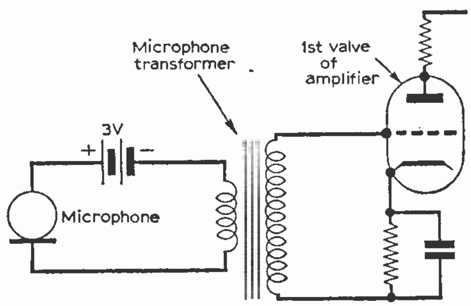


Fig. 2: The input circuit used with the microphone.

A microphone transformer with a ratio of 50:1 will be suitable. The author used a small bell transformer, connecting the microphone to the 5V output, and the amplifier to the 230V input. ■

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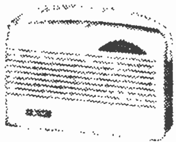

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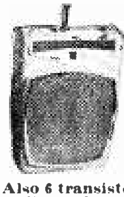

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Trade News

This new capacitor tester is made by KLB Electric Limited.

Two in Tune

FEATURES of the two latest transistor portables from Baird, are their light weight and neat design.

Model 290 weighs $1\frac{3}{4}$lbs. with PP6 battery, covers medium and long waves and employs seven transistors. It has a 3in. speaker, aerial and earth sockets and tape recorder/earphone socket. The brown fibre case is covered with foam-filled leathercloth and measures $7\frac{1}{16}$in. x 2in. x 5in. Price is 11 guineas inc. P.T.

Model 292 weighs 2lbs. with PP6 battery, has seven transistors and covers medium and long waves. Like the model 290 it has a 3in. speaker and tape recorder/earphone sockets. Provision is also made for the attachment of an external aerial and earth.

Housed in a deep grey leather grain plastic case, model 292 measures $8\frac{1}{2}$in. x $1\frac{3}{4}$in. x 5in. Price is $10\frac{1}{2}$ guineas inc. P.T. *Baird TV Distributors Ltd., 414 Chiswick High Road, W.4.*

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THE PACO C.25 "In Circuit" capacitor tester is described as one of the most valuable pieces of fault-finding equipment that any service engineer could have on his workbench. It reveals immediately any open or short-circuited capacitors without removing them from the circuit. The PACO C.25 also locates dried-out electrolytics in one quick test. Price is £15 19s. 6d. complete, or may be purchased in kit form for £14 12s. 6d. *KLB Electric Limited, 335 Whitehorse Road, Croydon, Surrey.*

The model 292 transistor receiver new from Baird.

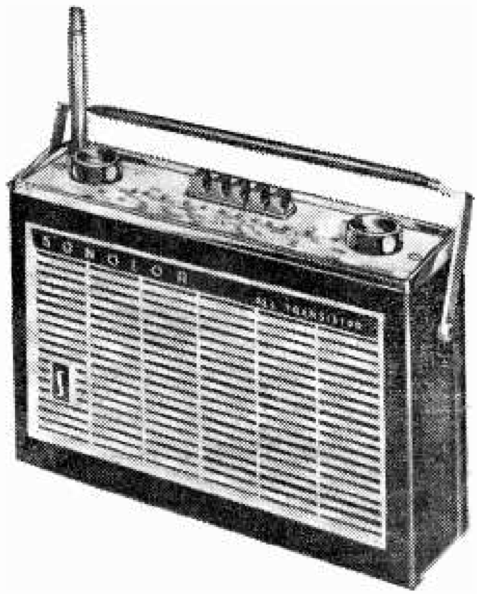
The Danetone model SRT 620 record player.

Danish Record Player

FROM Denmark comes this new Danetone SRT 620 Hi-Fi mains record player. Typical of Scandinavian design, this record player is styled for use as a portable unit, and its black base and teak coloured wooden top make it a very attractive accessory in the home.

Features include autostop mechanism, 4 speeds, stereo cartridge, tone control and 2½W virtually undistorted output into an 8in. speaker housed in an acoustic wooden cabinet.

The Danetone SRT 620 costs 21 guineas inc. £3 1s. purchase tax. An additional matching loudspeaker for stereo is available in a cabinet with extension lead supplied, at an extra cost of 7 guineas. *Denham and Morley Ltd., Denmore House, 173/175 Cleveland Street, London, W.1.*



This new French receiver has recently become available in this country.

Portable Car Radio

NEW from Sonolor, of France, comes the "Flash 64" portable transistor receiver. It is said to work equally well in a car and in the home. The Flash 64 covers long, medium and short waves (16—50m) with push-button wavechange and variable tone control. The circuit includes seven transistors and a 6½in. speaker. Also fitted are telescopic aerial, slow motion tuning, earphone socket and car aerial socket with ferrite rod isolating switch.

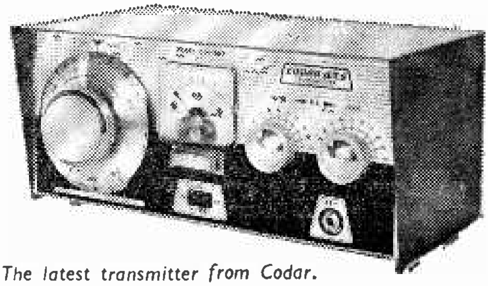
The Flash 64 measures 9½in. x 8in. x 3in. and costs 22½ guineas, including £3 5s. 4d. purchase tax. *Denham and Morley Ltd., Denmore House, 173/175 Cleveland Street, London, W.1.*

New Codar Transmitter

CODAR RADIO COMPANY announce a new transmitter, the A.T.5. The dial is calibrated 1·8—2·0Mc/s and 3·5—3·8Mc/s, covering the 160 and 80m amateur bands. At the rear of the 8¼in. x 5in. x 4in. cabinet, are Mic. co-ax socket, preset mic. gain control, power supply socket, phone/c.w. switch and output co-ax socket

The valve line-up is: EF80/EF80/6BW6/12AX7/6BW6, and the power requirements are 250V. 100mA; 6·3V. 1·8A (or 12V, 0·9A) 150V stabilised for VFO supply. There is a matching power pack for 200-250V a.c.

Also included is standby/net/transmit switching, together with aerial changeover, transferring the aerial to the receiver in the "standby" position. Neon indicator monitors "standby" and "transmit". Price of the transmitter complete £16 10s., and the power unit, £8. *Codar Radio Company, Bank House, Southwick Square, Southwick, Sussex.*



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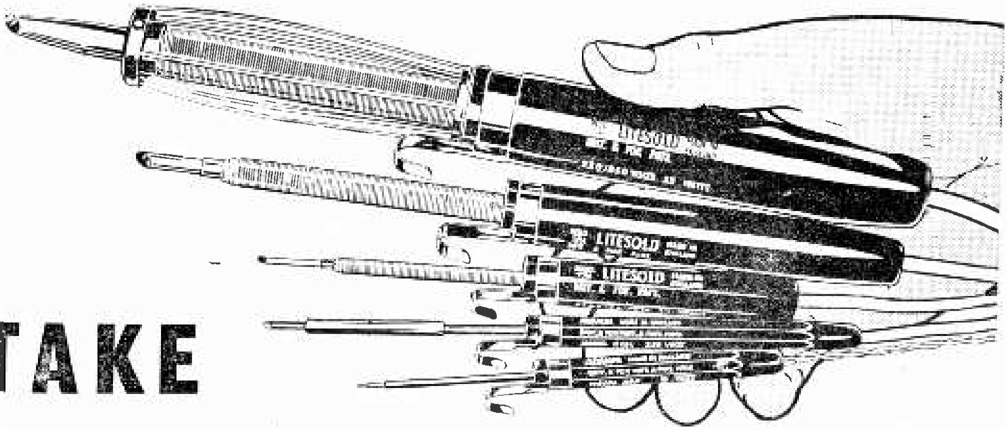
WARNING: LIVE CHASSIS

With reference to the article a "Voice-operated Baby Alarm" published on page 253 of the July PRACTICAL WIRELESS, we bring to reader's attention that the chassis in this design is connected directly to one side of the mains supply. It is therefore possible for the chassis and the microphone to be "live," presenting a danger of shock to the user.

Certain modifications should thus be carried out to render the equipment safe. The fitting of 0·02μS 1,000V d.c. capacitors in each of the leads to the television receiver, and also in the microphone leads before they leave the chassis is recommended to readers intending to construct this piece of equipment.

Contact with the chassis should be avoided, and no attempt should be made to "earth" the equipment. It is further recommended that the equipment is contained in either a wood or bakelite type cabinet to reduce the risk of shock to others. Any fixing screws that appear on the outside of the cabinet should be carefully "hidden" or covered. If a slight "shock" is experienced when contact is made with the microphone, either the mains lead to the wall plug should be reversed, or the plug itself.



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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

PRE-WAR FIELD DAYS

SIR,—Before the last war I used to belong to the "Thornton Heath S.W. Society", now defunct. Some of our members were G2RD, G2DP, G4AA and G4FW, but I had only reached the 2FXT artificial aerial licence stage.

In June, 1938, we had a 5m field day and I partnered G4AA. We found a beautiful spot near Warlingham, off the beaten track, with no screaming jets flying over, just an occasional visit of a stately Hannibal.

We settled down to logging the various stations till about 2.30 in the afternoon, when we discovered that our beer had run out. We tossed up to see who would make the trip to the nearest "boozer" some two miles away and my partner lost, so away he went, leaving me strict instructions about the liveliest part of the band.

After logging several stations I turned to one end of the band and could hear music, classical music; appropriately enough Beethoven's Pastoral Symphony. I opened the back of the set, stretched the coil a little, and heigh ho, there was "Ally Pally" spot on!

I listened on and on to the orchestral concert. Suddenly a shadow appeared over my shoulder. It was my partner, who had been lucky enough to get a lift back by car and so arriving back a lot quicker than I had expected. Was my face red and was he mad! Needless to say, we finished well down the field at the end of the day.

I often wonder what has happened to all my acquaintances since then. But one I do know and often hear him, Alvar Liddell. In those far-off days Sunday mornings used to be a busy time and even 2FXT used to "jump" the artificial aerial, but nowadays I think the bands seem empty of local 'phone stations.—P. O. HUBBART (West Croydon, Surrey).

(Out of those licensed amateurs mentioned by Mr. Hubbart G2RD and G3FP are known to be still operating.—Ed.)

A NOVEL ECHO UNIT

SIR,—I wonder if any of your readers have ever tried the arrangement that my friend and I used to obtain an echo. The quality is by no means hi-fi but is suitable for a lot of "science fiction" music.

One tape recorder containing the loaded spool is set to "record" and the other is set to "play". The first one's microphone is placed near the second one's speaker. This system has one serious drawback, though: the distance between the heads is too great for an echo. However, if the first recorder has its pressure pads held off the tape, and the tape is guided over the record head, the second tape recorder can be put on to "fast rewind". Upon pushing the tape on to the head it will play. The effect of the increased speed is the same as decreasing the distance between the heads and so an echo is obtained with no additional equipment.

When played on fast rewind on the second machine (now detached from the first) the echo can be recorded on the first recorder at a more orthodox, less tape-consuming speed. Incidentally, good effects are also obtainable by playing the tape in reverse.—P. RILEY (Croydon, Surrey).

NOT SO OBVIOUS

SIR,—Regarding the 7Mc/s Transceiver (June P.W.), it occurs to me that it might develop a little fault after a few weeks' operation. Those who have studied the circuit of the ex-W.D. No. 19 will have found that almost all the decoupling capacitors in the "A" receiver are 350V wkg. The maximum voltage to which they are subjected is in the order of 250V. It will be observed, however, that the a.g.c. time constant/decoupling capacitor to the r.f. amplifier is of 600V d.c. working (provided the set is post-1942 or modified).

Six hundred volts of a.g.c. does seem a bit much! It bothered the poor wireless mechanics in the early 1940's, too, until someone had the bright idea of putting a valve-voltmeter across the then 350V a.g.c. capacitor and *switching to send*. As the receiver heaters were left on when transmitting and only the h.t. switched off (as in the 7Mc/s Transceiver) the control grid, tuned to the transmitter frequency, acted as a most excellent diode, and the resulting voltage was usually too much for the poor old a.g.c. capacitor.

I'm not sure how much transmitter voltage will be induced into the grid circuit of the triode of the receiver in the "Transceiver" as I have not built this circuit myself but I suggest some tests are made—just to make sure about these voltages.—MAYDAY (name and address supplied).

SIR,—The 19 set runs an 807 to some 25W input, i.e. 500V at 50mA, whereas the 7Mc/s Transceiver runs an ECL86 to some 5W input and with a difference in power of less than a quarter. The corresponding voltage across the capacitors would be very much less. The receiver blocks on keying obviously because of the diode action referred to and I use this as an aural indication when I am sending. "Mayday" doesn't say the value of the a.g.c. capacitor he's referring to but in the grid circuit of the Transceiver the values are 2pF bandpass coupling and 300pF grid leak. I should therefore imagine that a.g.c. decoupling would be 0·05μF or 50,000pF.—D. GIBSON, G3JDG (St. Albans, Hertfordshire).

Sir,—I would be grateful if any reader could sell or loan me . . .

. . . any information at all on the No. 19 Set.—P. I. PETERS, 59 Manvers Road, Swallow Nest, Sheffield.

. . . any circuits, manuals, etc., on the Marconi Canadian No. 52 Set.—P. WOODS, 46 Chaucer Road, Bedford, Bedfordshire.

. . . information dealing with modifications to the Wireless Set 19 Mk.3.—G. FAUNPEL, 86 No Sudley Road, Liverpool 17, Lancashire.

. . . the circuit diagram and instruction manual of the Collins TCS11 receiver.—G. GREENSLADE, 2 Millham Road, Lostwithiel, Cornwall.

. . . the circuit and any data for the Marconi CR300 receiver. All postage refunded.—E. FORD, 106 Skinner Street, Cresswell, Workso p, Nottinghamshire.

. . . service data or manual for the Hallicrafter Marine Radiophone, Model H.T.11 or 11a.—K. E. LE MASURIER. "Aquir," Feugre, Cobo, Guernsey.

. . . the manual or circuit diagram for the v.h.f. transmitter/receiver type TR1986.—K. ORCHARD, 25 Kenmore Drive, Yeovil, Somerst.

. . . one clean copy of P.W. for December 1962 (with blueprint) for two clean issues of November 1962 (with blueprints).—R. TUPPEN, 122 Old Farm Avenue, Sidcup, Kent.

. . . the issues of P.W. covering the conversion of the No. 19 Set (May and June 1958).—D. L. HUGHES, Mountain Air, Began Road, St. Mellons, Nr. Cardiff.

. . . copies of P.W. for April, May and June 1961, dealing with the P.W. Signal Generator. All postage costs paid.—N. HURST, 7 Marston Road, Silversands Caravan Park, Lossiemouth, Morayshire, Scotland.

. . . the April 1963 issue of P.W.—A WILLIAMS, 24a Gwyddon Road, Abercarn, Newport, Monmouthshire.

. . . information concerning the frequency ranges, crystal frequency, power supplies, etc., and any other information on the W1191A Wavemeter.—W. BOURKE, 33 Victoria Street, Rutherglen, Lanarkshire, Scotland.

. . . manual or any information on the USA Valve Tester/Multi-range Meter, Model No. 774/4, 774/5, or 744/4.—R. HICKLIN, 13 Clive Road, Heath Park, Romford, Essex.

Cabinet Care

—continued from page 354

quicker and easier to remove it and refasten after cleaning. Always use a quick-drying cement, fasten one edge, allow to dry, then stretch to shape.

The deeper scratch may be filled, as with shellac filling of woodwork, but this time a weld is necessary to make the filler hold. If the filler is a piece of similar plastic, this can be chipped to a fine powder, then pressed into the crack, moistening the inner edges of the crack with carbon-tetrachloride—(CTC) which is the basis of most switch cleaners and a solvent for many plastics.

Great care must be taken not to allow the CTC to drip on the exposed surface of the plastic, and the filling should be such that it can be polished down to the normal surface. A break can be treated in a similar way, the raw edges of the crack being brushed with CTC and the parts held together until the solvent evaporates.

This is by no means a perfect joint, and can hardly be expected to take great strain, but gentle care will often save the cost of a new—and expensive—cabinet.

Worn Screws

Worn screw threads when self-tapping screws have been removed and re-inserted too often can give a lot of trouble. The common mistake is to use a larger screw. This is no good—for the hole must be exactly drilled to clearance first, or the plastic will crack. A better way is to make a plug of sleeving, to fit the hole easily and take up the slackness of the screw.

Use p.v.c. sleeving, and slit it along its length, so that the screw can get a good start and as it tightens it will press the p.v.c. to the walls of the hole and ensure a good fit. See Fig. 3.

Special plastic cements are available, for different kinds of material, but a good general purpose contact adhesive is often as effective for both wood and plastic breakages, where no strain has to be placed on the mended parts. ■

End Fed Aerials

—continued from page 343

satisfactory. Tinned copper wire is more easily tapped than enamelled wire.

Capacitor C1 should be wide spaced, and equipped with an insulated extension spindle. It can be 100pF to 200pF. Spacing equal to that of the p.a. anode capacitor (C1, Fig. 5) is usually sufficient. For the h.f. bands, fewer turns are needed, so the capacitor is tapped equal amounts towards the centre of the coil, by transferring clips from A-A to B-B, etc., or by using a double pole rotary switch.

L2 is three turns, adequately insulated, and overwound on the centre of L1. This number of turns should generally do for 3·5—28Mc/s, but if the 3·5Mc/s band is not worked, two turns may be used instead. A convenient length of 75Ω or similar co-ax goes from L2 to the transmitter pi output (C2 in Fig. 5).

When the aerial is of such a length that it is near a ½-wave, or multiple of ½-waves, on all bands, it may be connected directly to point C. It is then only necessary to change the taps A-A. when changing bands.

If the aerial impedance is low on some bands (due to its length) the aerial should be tapped down the coil. This is most easily done by moving the aerial tapping a turn at a time away from the centre, until sufficient transmitter loading is obtained. If possible, an aerial length that is fairly high impedance on all bands is recommended.

If the tuner is in circuit for both transmitting and receiving, C1 may be adjusted for maximum signal strength on the receiver. If the receiver aerial input impedance is low, and the aerial impedance high, an actual increase in signal strength will be obtained.

Loading of the transmitter is accomplished as previously described, but as the transmitter is working into the low impedance of L2, C2 will need to be at relatively high capacity for the l.f. bands. If a standing-wave indicator is used, it should be included between transmitter and L2, and tuning is adjusted for minimum reflected power. When an r.f. meter is favoured, it should be included in the aerial lead, *not* in the lead from transmitter to tuner. ■

sinclair NEWS

No. 4 JULY/AUGUST 1964

A CHANCE FOR PHOTOGRAPHERS

Completely built Micro-6 sets are a rarity at head office which is why a couple of our secretaries slipped into the test room to listen for themselves and got caught in the act by the works manager who had his camera handy. If you have any amusing or interesting pictures of the Micro-6 in use, let us see them. 3 gns. will be paid for each one published. Brief details should accompany each print sent. Unused photos will be returned to readers.

DESIGNS WITH A PEDIGREE

It is but little more than a year ago that the name Sinclair Radionics appeared to the public for the first time, offering entirely new concepts in micro-radio receiver design. The impact was fantastic. There had never been anything like it before. Various other designs were introduced, leading up to the world's smallest radio, the Micro-6 and then the TR 750 Power Amplifier. Today, Sinclair is the best known and most quoted name in anything to do with transistor designs for constructors.

There are two simple, but exclusive principles behind this triumph—firstly the extraordinary efficiency of Sinclair Micro Alloy Transistors (Golden MATs). These make possible standards of performance far ahead of anything the public can obtain from other transistors. Secondly, there are the designs themselves. These come from a team accustomed to working to very high standards in transistorised electronics, for this group is but part of Sinclair Radionics Ltd. who are in fact industrial electronic consultants!

So we are well used to solving problems and every design we produce for you is exhaustively tested long before being advertised. That is why Sinclair Micro Transistor Designs have completely captured the imagination and enthusiasm of constructors everywhere. They have never had the chance to build to these professional levels in the transistor field before, to say nothing of the pleasure and satisfaction to be obtained from their wonderful performance.

There are other intriguingly efficient designs using MATs which are well worth trying. These will be found in three books advertised on the following pages. In the meantime we learn that a number of constructors wearing Micro-6 receivers on their wrists, on being asked the time have replied with a somewhat far away look, "Half past Housewives' Choice" or words to that effect. Why not? The Micro-6 on its "Transrista" Strap is setting a new and original fashion in listening.

THE WAY TO LUXEMBOURG

It is interesting to note that having applied band-spread to higher frequency end of the Medium wave band to make it easier to tune in Luxembourg, other manufacturers are now doing the same thing—but no other set compares in size with the Micro-6.

BRINGS IN PIRATES!

We receive enthusiastic letters from Micro-6 builders with such regularity that we could be forgiven for taking them as a matter of course. But a new note begins to appear in our correspondence. T.F.C., Windsor, among many, reports excellent reception from "Caroline" and "Atlanta" anchored in the North Sea, whilst it is interesting to note that J.M., Bromley, Kent, listens nostalgically to Athlone at the other end of the scale.

sinclair Micro-

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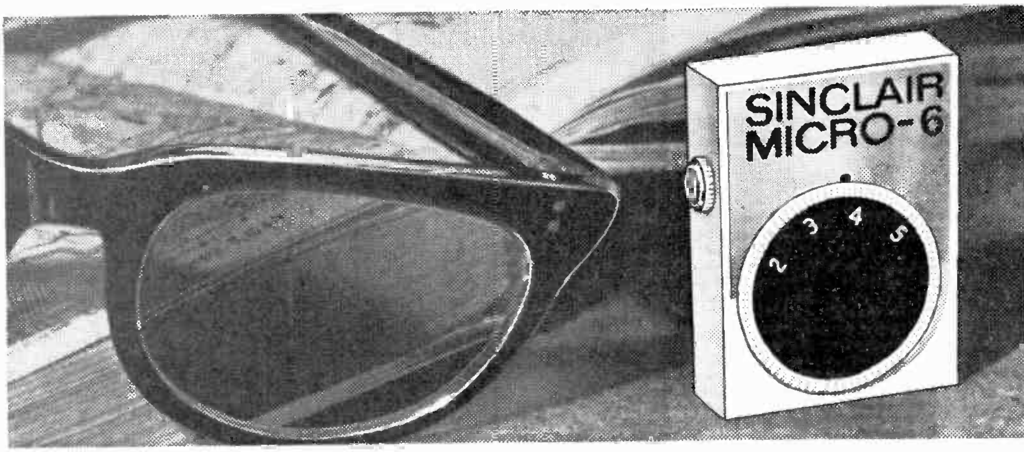

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59/6

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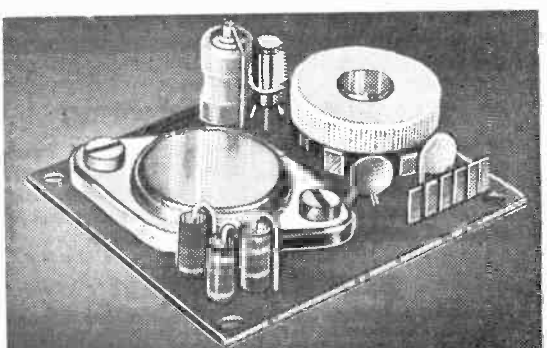

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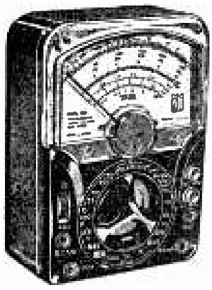

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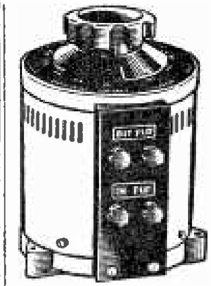

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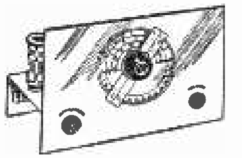

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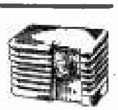

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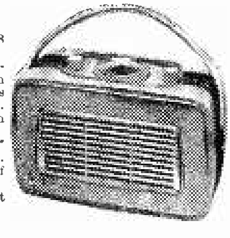

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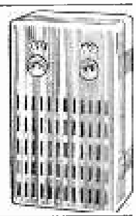

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Made for a famous company intending to make a Battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the 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.

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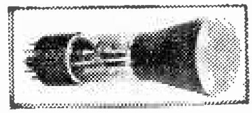

3in. oscilloscope tube. American made type No. 3FP7, 6.3 v. 0.6 amp. heater electrostatic deflection, brand new and guaranteed with circuit diagram of 'scope. **15/-** each. Plus 2/6 post and insurance.

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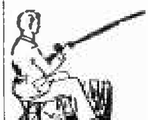

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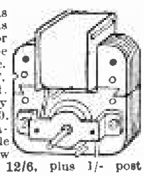

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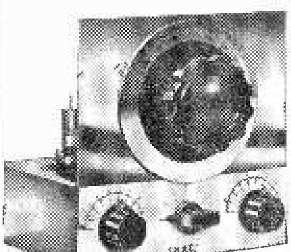

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5Y3GT	5/6	6U4GT	9/6	42	6/6	ECC84	7/6	N78	17/-	UBC81	7/9
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6F6	7/6	12K8	9/9	DF91	3/-	EL81	8/9	PY82	5/9	X66	7/9
6F6G	4/6	12K8GT	11/6	DF96	7/3	EL84	6/6	PY83	6/9	X76M	11/-
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6F32	4/9	12SJ7	5/6	DK91	5/6	EM80	7/6	R19	9/6	Z63	4/9
6F33	4/-	12SK7	4/6	DK92	7/-	EM81	8/6	RL18	11/-	Z66	8/6
6H6	1/6	12SN7GT	6/9	DK96	7/9	EM84	8/9	SP41	2/3		
6J5	4/3	12SQ7	8/6	DL33	7/6	EM85	9/6	SP61	2/-		
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Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London W.C.2.

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Dual-wave Crystal Diode	PW95	2/6
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All-dry Three	PW97	3/6
Modern Two-valver	PW98	3/6
A.C. Band-pass Three	PW99	4/-
A.C. Coronet-4	PW100	4/-
A.C./D.C. Coronet	PW101	4/-
The PW Pocket Superhet		5/-

MISCELLANEOUS

The PW 3-speed Autogram	8/-
The PW Monophonic Electric Organ ...	8/-
The PW Roadfarer *	5/-
The PT Band III TV converter	1/6
The Mini-amp *	5/-
The PT Olympic *	7/6
The PT Multimeter *	5/-

SOME EARLIER DESIGNS

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

Experimenter's Short Wave	PW30a	2/6
Midget Short Wave Two	PW38a	2/6
Simple S.W. One-valver	PW88	2/6
Pyramid One-valver	PW93	2/6
BBC Special One-valver	AW387	2/6
A One-valver for America	AW429	2/6
Short-Wave World Beater	AW436	3/6
Standard Four Valve S.W.	WM383	3/6
Enthusiast's Power Amplifier ...	WM387	3/6
Standard Four Valve	WM391	3/6
Listener's 5-Watt Amplifier	WM392	3/6

QUERY COUPON

This coupon is available until 7th August, 1964, and must accompany all queries in accordance with the notice on our "Letters to the Editor" page.

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