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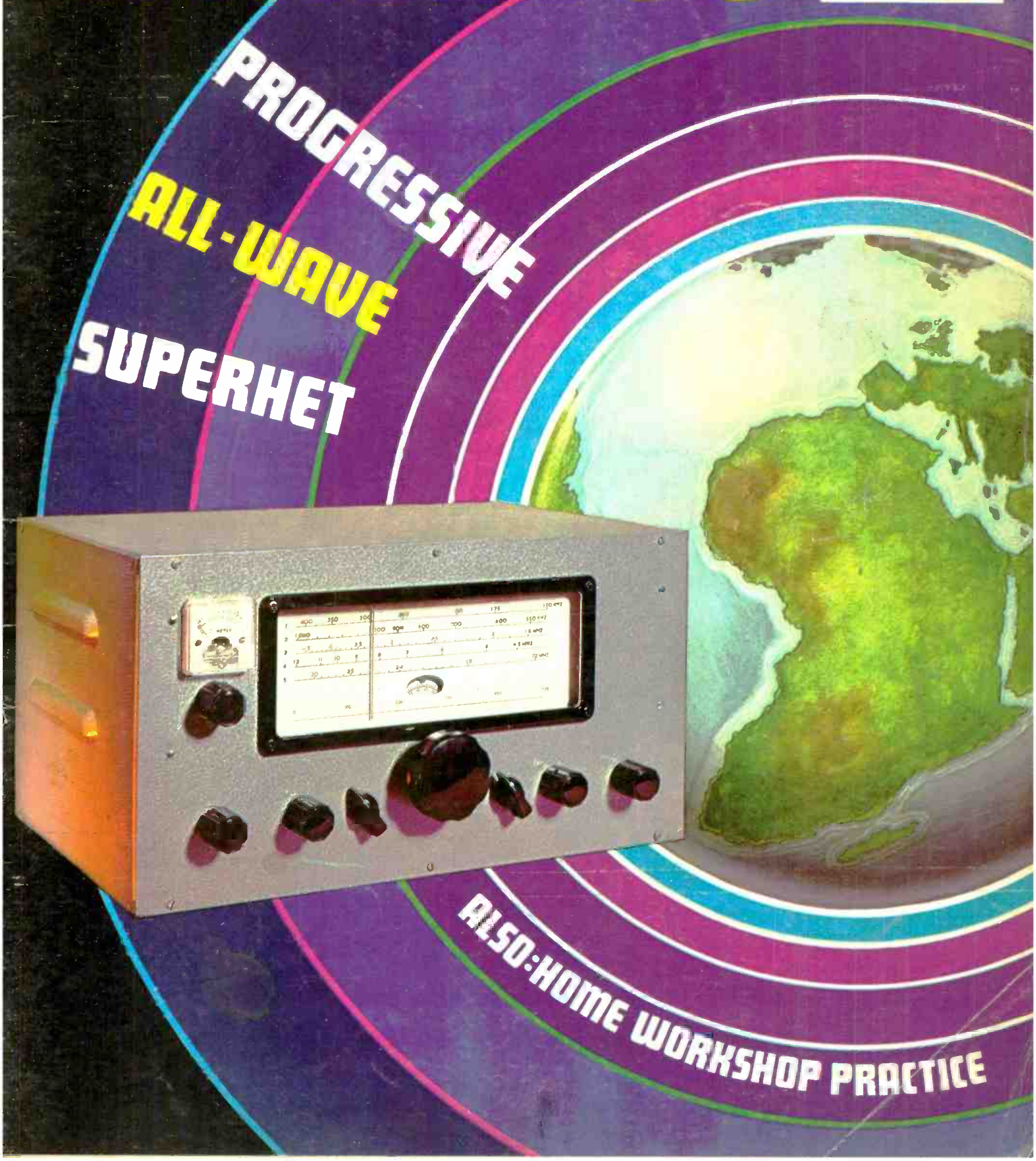

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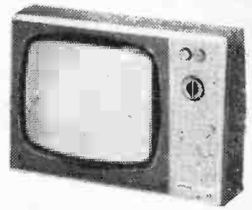

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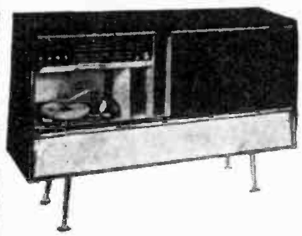

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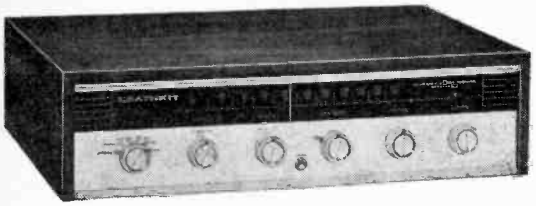

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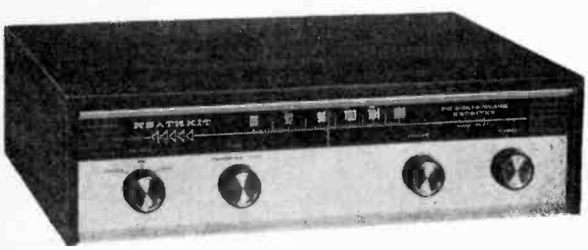

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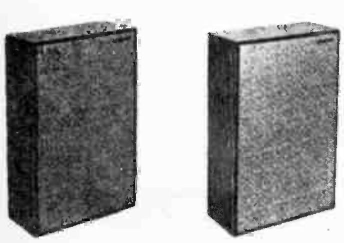

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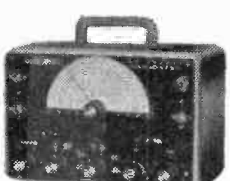

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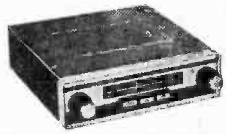

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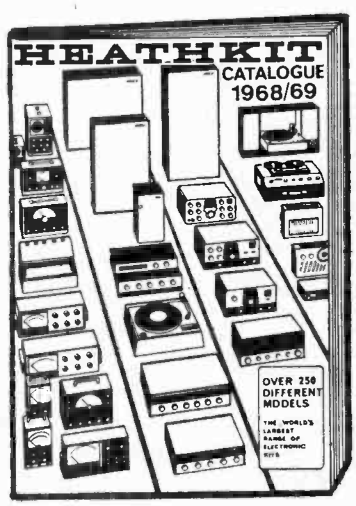

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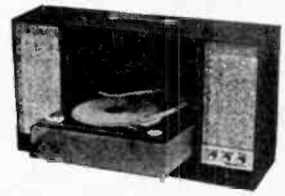

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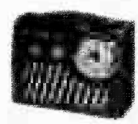

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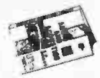

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OC44	1/11
OC45	1/9
OC71	2/6
OC72	2/6
OC73	3/6
OC81	2/6
OC81D	2/6
OC83	4/–
OC139	2/6
OC140	3/6
OC200	5/–
OC201	8/–
2N1302 or 3	4/–
2N1304 or 5	5/–
2N1306 or 7	6/–
2N1308 or 9	8/–

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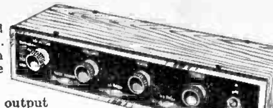


Controls: Selector switch Tape speed equalisation switch (3¾ and 7½ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

Specification: Sensitivities for 10 watt output at 1KHz. *Tape head:* 3mV (at 3¾ i.p.s.). *Mag. P.U.:* 2mV. *Cer. P.U.:* 80mV. *Radio:* 100mV. *Aux.:* 100mV. *Tape/Rec. output:* 100mV. Equalisation for each input is correct to within ± 2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone control range:* Bass ± 13dB at 60 Hz. Treble ± 14dB at 15KHz. *Total distortion:* (for 10 watt output) <1·5%. *Signal noise:* <—60dB. A.C. mains 200–250v.
Size 12½in. long, 4¼in. deep, 2¾in. high. Teak finished case. **Price 8 gns.** + 7/6 p. & p.

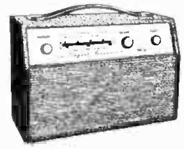
THE DORSET (600mW output)

7-transistor fully tunable M.W.–L.W. superhet portable —with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.

MAINS POWER PACK KIT: 9/6 extra.

PRICE £5.5.0 plus 7/6 p. & p. Circuit 2/6 FREE WITH PARTS.

THE ELEGANT SEVEN MK. III (350mW output)



7-transistor fully tunable M.W.–L.W. portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.

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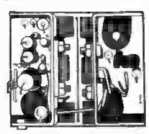
Circuit 2/6 FREE WITH PARTS.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



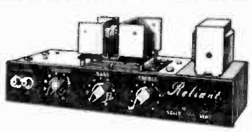
Specifications: *RMS Power Output* (into 3 ohms speaker): 10 watts. *Sensitivity* (for rated ouput): 1mV into 3K ohms (0·33 microamp). *Total Distortion at* 1KHz. at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3–4 ohms (3–15 ohms may be used). *Supply voltage:* 24V d.c. at 800mA (6–24V may be used).

Control assembly: including resistors and capacitors.
1. Volume: PRICE 5/-.
2. Treble: PRICE 5/-.
3. Comprehensive bass and treble: PRICE 10/-.

The above 3 items can be purchased for use with the X101.

Price 49/6 plus 2/6 p. & p.

Power Supplies for the X101:
P101 M (for mono) 35/- plus 4/6 p. & p. P101 S (for stereo) 42/6 plus 4/6 p. & p.



THE RELIANT 10W SOLID-STATE HIGH QUALITY AMPLIFIER

SPECIFICATIONS
Output—10 watts
Inputs—1. -xtal mic 10mV
2. -gram/radio 250mV
Output Impedance—3 to 4 ohms
Tone Controls—Treble control range ± 12dB at 10KH2
Bass control range ± 13dB at 100H2
Frequency Response—(with tone controls central) Minus 3dB points are 20H2 and 40KH2. Signal to Noise Ratio—better than —60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input— —220 —250V. A.C. Size of chassis—10" × 3¾" × 2". A.C. Mains, 200-250V. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram. and mike. Built and tested. 8" × 5" speaker to suit price 14/6 plus 1/6 P. & P. Crystal mike to suit 12/6 plus 1/6 P. & P.
PRICE £5.5.0 plus 5/- P. & P.

THE VISCOUNT

Integrated High Fidelity Transistor Stereo Amplifier

SPECIFICATIONS: Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monoral). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo), P.U., Tuner, Tape and Tape Rec. Sensitivities: All inputs 100mV into 1·8M ohm. Frequency response: 40Hz–20KHz ± 2db. Tone controls: (Baxandall type), separate bass and treble controls. Treble 13db lift and cut at 15KHz. Bass 15db lift and 25db cut at 60Hz. Volume controls: Separate for each channel. AC Mains input: 200-240v. 50-60Hz. Size 12½ × 6 × 2¾in. in teak-finished case. Built and tested.

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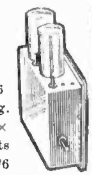

Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4½ × 5½ × 1½in. Complete with circuits diagram. **35/-** p. & p. 3/6

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5¾"	D.P. 1800ft.	18/6	4"	T.P. 900ft.	15/-

P. & P. on each 1/6, 4 or more post free.

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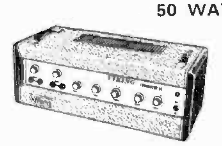

An extremely reliable general purpose valve amplifier—with six electronically mixed inputs. Suitable for use with: mics, guitars, gram, tuner, organs, etc. Separate bass and treble controls.

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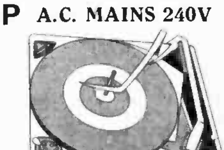

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and insurance 7/6 extra.

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For 6 volt or 12 volt positive earth systems. Comprising special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardwear (screws, washers etc.).
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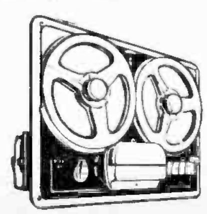

3 Speed 2 track Tape Deck complete with heads, takes 7in. spool.

Incorporating 3 motors.

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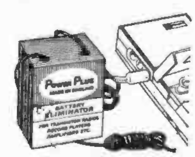

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for Cassette Tape Recorders using 7½v. Complete with DIN plug for recorder power socket. Can also be supplied for a 6-volt output complete with suitable plug. (Please state make, model and voltage required.)
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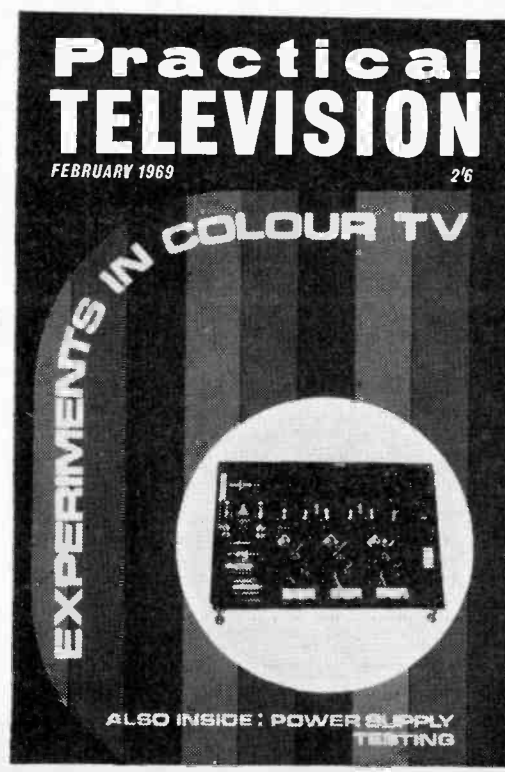

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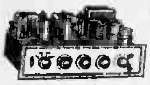

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15 Gns. Carr. 12/6

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300-0-300v. 130mA, 6·3v. 4a., c.t., 6·3v. 1a. For Mullard 510 Amplifier	43/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
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300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
300-0-300v. 130mA, 6·3v. 4a., 0-5-6·3v. 1a. Suitable for Mullard 510 Amplifier	42/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	43/11

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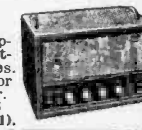
AGENT APPOINTED O. & C. ELECTRONICS 227 CHURCH ST.

R·S·C HI-FI CENTRES LTD.

R.S.C. COLUMN SPEAKERS

Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. 15 ohm matching. **C57 15 watts** inc. five 7 x 4in. speakers **£7.19.11.**
Type C48S, 30 watts. Fitted four 8in. high flux 8 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **16 Gns.**
Type C412S, 50 watts. Fitted four 12in. 11,000 line 15 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/-. **24 Gns.** Or Deposit £4.13.6 and 9 monthly payments of 52/6 (Total £28.5.0).

30 WATT HI-FI AMPLIFIER



for Guitar, Vocal or Instrumental Group
A 2 or 4 Input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **18 Gns.** Carr. 12/6
Deposit 3 gns. and 9 mthly payments of 39/8 (Total £21).

12in. HIGH QUALITY LOUDSPEAKERS

In Teak or Afrormosia veneered covered Cabinets
15 Watt 11,000 lines 3 or 15 ohms. Carr 7/6 **£5.15.0**
20 Watt 10,000 lines 3 or 15 ohms. Carr 8/9 **£8.19.9**

LOUDSPEAKERS

Limited number of heavy duty units at well below list prices. Brand new, guaranteed. Terms available over £8. Carr. 10/- extra.

12in. 30 watt 6-8 ohms	12in. 30 watt 15 ohms impedance	15in. 30 watt 15 ohms DUAL CONE
Normally approx. £12 **£6.19.9**	Normally £10.10.0. **£6.19.9**	Normally over £14 **9 Gns.**

FANE 'POP' 100 LOUDSPEAKER

18" 100 Watt
Fantastic power handling. Guaranteed 2 years. POST FREE **19 Gns**

R.S.C. GRAM AMPLIFIER KIT. 4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit etc. supplied. ONLY **49/11**

POWER PACK KIT Consisting of Mains transformer, Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied with case in lieu of chassis 28/11. Or assembled 39/11. **24/11**

CLEARANCE LINES

HIGH QUALITY 8" x 3" LOUDSPEAKERS 10000 Gauss 3 ohm only **11/9**

14 WATT HI-FI AMPLIFIERS High sensitivity. Two separate Jack inputs. Two vol. controls for mixing purposes. Separate Bass and Treble Controls. Valves ECC83, ECL86, ECL86, EZ80. Output for 15 ohm Loudspeaker. 200-250v 50 c.p.s. A.C. mains operation. Size approx. 8 x 8 x 6in. Factory built and fully guaranteed. Limited number to clear at **£6-19-11** Carr. 10/-

EXTENSION 'SPEAKERS 29/9
Cabinet size 12 x 8 x 5in. attractive grey lizard skin finish. Fitted high flux 6½in. 5w. 3 ohm speaker.

EMI PLAYER TURNTABLES
with P.U. 4 speed. Turnover cartridge. Limited number.
Mono **59/9** Stereo **69/9**

PHONE AMPLIFIERS Speak and listen with both hands free. Standard dry battery operated. Attractive black moulded case. **59/9**

1 WATT TRANSISTOR AMPLIFIERS for 3-5 ohm loudspeakers. Miniature size. Brand new boxed. **37/9**

PRINTED CIRCUIT KITS for making printed circuits. Complete with 72 square ins. laminated board and necessary fluids. **12/9**

J.B. VHF/FM DIAL & DRIVE ASSEMBLIES
Complete with escutcheon. Size 7" x 4½". Escutcheon 7½" x 2½". ONLY **9/9**

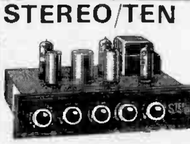
TAPE RECORD/PLAYBACK AMPLIFIERS 4 watts output. Magic Eye Recording level indicator. For 3 ohm L/S. All normal facilities. Less Facia plate. For 200/250 A.C. mains. Carr 8/6. **£7.19.11**

HEAVY DUTY 15in. 40 WATT LOUDSPEAKERS in substantial Rexine/Vynair covered cabinet. Carr. 15/- ONLY **14 Gns.**

MINI-8 HI-FI LOUDSPEAKER UNITS
Teak veneered cabinet, size 9½ x 6½ x 7½in. Peak power handling 8 watts 3 ohms or 15 ohms. Clearance Price **59/11**

JASON VHF/FM TUNER DESIGNS
All parts **FMT1 5 Gns. FMT2 £6.19.11. JTV2 9½ Gns.** Please state channel

STEREO/TEN HIGH QUALITY AMPLIFIER



5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo cartridges. Ganged Bass and Treble Controls. Valves ECC83 (2), EL84 (2), EZ81. For 2-3 ohm speakers. Assembled with 12 months' guarantee Carr. 11/6 **£11.19.6**

R.S.C. 6/12V CAR BATTERY CHARGERS

Complete kit of parts incl. Ammeter and Circuit.
4 amp with variable charge rate selector **49/9**
6 amp heavy duty with variable charge rate selector **69/9**
All types 200-250v. A.C. mains. Ready built 10/- extra.

SENSATIONAL R.S.C. HIGH FIDELITY STEREO PACKAGE OFFERS

"PACKAGE 3" 30 WATT SYSTEM
- ★ Goldring Transcription Turntable on Plinth
- ★ Shure Magnetic Pick-up Cartridge
- ★ Super 30 Amplifier in cabinet.
- ★ Pair of Stanton Loudspeaker Units

Special inclusive price. Fully wired units ready to "plug-in". Carr. 25/-. **85 Gns.**

TERMS AVAILABLE ALL PACKAGE OFFERS

Matched for optimum performance. Send for coloured brochure showing other money saving offers.

Illustrated with TFMI Mk II Tuner fitted

EXTREMELY ATTRACTIVE AND VERSATILE PLINTHS finished in Teak or Afrormosia veneer. Tinted Perspex "hinged" cover with satin chrome handle

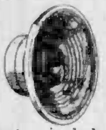
"PACKAGE 2" 30 WATT SYSTEM
- ★ Garrard SP25 Mk II Turntable on Plinth
- ★ Goldring CS90 Ceramic P.U. Cartridge
- ★ Super 30 Amplifier in cabinet
- ★ Pair of Stanton Loudspeaker Units

Special inclusive price. Fully wired units ready to "plug-in". **75 Gns.** Carr. 25/-

"PACKAGE 1" 13 WATT SYSTEM
- ★ Garrard SP25 Mk II 4 speed Player Unit on plinth
- ★ Goldring CS90 Ceramic P.U. Cartridge
- ★ TA12 Amplifier in cabinet
- ★ Pair of Dorset Loudspeaker Units Special inclusive price. **49½ Gns.**

Or Dep. £10 and 9 monthly payments £5.4.0. (Total £56.16.0.) Perspex cover 3gns. extra.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range 40–15,000 c.p.s. Impedance 3 or 15 ohms. Please state choice. Exceptional performance at low cost. Prices include carriage.

HF501L	5"	10W	57/9	HF100D	10"	15W	£5.15.0
HF801D	8"	8W	57/9	HF120	12"	15W	69/9
HF811D	8"	10W	4 gns.	HF120D	12"	15W	79/9
HF102D	10"	8W	59/9	HF126	12"	15W	89/9
				HF126D	12"	15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS

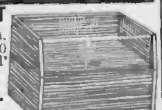
Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled woollen damping. Ported where appropriate. Credit tms available.

DORSET Size 16 x 11 x 9in. Range 45–15,000 c.p.s. Rating 8–10 watts. Fitted High flux 8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£8.19.9** Inc. Carr.

STANTON IIIS Size 18x11x10in. Rating 10 watts. Incorporating Fane 803b speaker with roll rubber cone surround and 15,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 30–20,000 c.p.s. Impedance 3 or 15 ohms. Gives smooth realistic sound output. **16 Gns.** Inc. carr.

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Frequency range 40–20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

E2 EQUIPMENT CABINET



Size 17" wide 14½" deep 11½" high. Cut for TA12, Super 15, Super 30 and other amplifiers. 'Hinged' perspex cover. Satin Teak or Afrormosia veneer finish. Price inc. carr. **8 Gns.**

MOTOR BOARDS cut for Garrard Turntables and many other units. Price **12/9**

RECORD PLAYING UNITS

Money saving units. Ready to plug into Amplifier or Tape Recorder.

RP2 Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Mounted on Plinth. Inc. Perspex cover. Carr. 15/-. Plus 8/7 P.T. surcharge. **22 Gns.**

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Supplied with Perspex Cover. Carr. 21/-. **£28** Inc. P.T. surcharge

R.S.C. PLINTHS

for Record Playing units. Teak finish cut for Garrard **59/9** 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. Available with clear Perspex cover as ill. Inc. Carr. **6 Gns.** Perspex cover sold separately at 3 Gns. Limited number of covers slightly damaged but repaired by makers. **39/9**

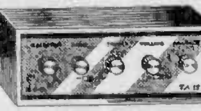
INTEREST CHARGES REFUNDED on Credit Sales settled in 3 months.

BLACKPOOL AGENT APPOINTED

See other page

R·S·C·TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL



Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3–15 ohms ★ For 200–250v A.C. mains ★ Frequency Response 30–20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 50mV (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. Factory built with 12 mth gntee 15 GNS Or Deposit £4.16.0 and 9 mthly pymts 29/- (Total 17 GNS.) **12½ GNS.** Carr. 7/9. Or in Teak or Afrormosia veneer housing 19 Gns. Dep. £4.19.0 and 9 monthly payments 39/-. (Total £22.10.0.)

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.** Or **Senior 15 watt** inc. HF 126 15,000 line Speaker 6 Gns. Carr. 6/6 Carr. 5/9

HI-FI SPEAKER ENCLOSURES

Teak or Afrormosia veneer finish. Modern design. Acoustically lined and ported. Inc. carr.

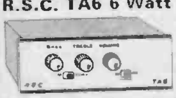
JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **4 Gns.**

SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. **5 Gns.**

SE10 For outstanding results with 10in Hi-Fi 'spkr Size 24 x 15x10in. **£5.10.0**

SE12 For exclnt prfmnce with 12in Hi-Fi 'spkr and Twtr. Size 25 x 16 x 10½in. Pressurised. **6 Gns.**

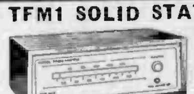
R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER



200-250v. AC mains operated Frequency Response 30–20,000 c.p.s. —2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3–15 ohm speakers. Max. sensitivity 5mV. Fully enclosed enamelled case. 9¼ x 2¼ x 5¼in. Attractive brushed silver finish facia plate 10¼ x 3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 **6 Gns.** Or factory built with 12 months guarantee. 8 Gns.

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Inc. Carr. **14 Gns.** Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.



★ **High-sensitivity** ★ **200-250v. A.C. Mains operation.** ★ **Sharp A.M. Rejection.** ★ **Drift-free reception.** ★ **Output ample for any amplifier (approx. 500 m.v.).** ★ **Simple alignment instructions.** ★ **Output available for feeding tuning meter.** ★ **Output for feeding Stereo Multiplexer.** ★ **Tuner head using silicone Planar Transistors.** ★ **Designed for standard 80 ohm co-axial input.** Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only high grade transistors and components used. A quality product at considerably less than the cost of comparable units. Stereo version, all parts 18 gns. Inc. carr. Assembled 22½ gns. inc. carr.

R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION

SPECIFICATIONS COMPARABLE WITH UNITS COSTING CONSIDERABLY MORE

FULLY TRANSISTORISED 200/250V. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3–4 ohms.
TRANSISTORS. 9 current types of high quality by leading manufacturers.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20–20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10Kc/s. **NEG FEEDBACK:** 52dB.
BASS CONTROL: +17dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·2%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 5¼ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or in Teak or Afrormosia veneer housing as illustrated. 19 Gns.

ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING MANUFACTURERS.

R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. High quality Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector. Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **19½ Gns.**
Unit factory built 28 Gns. or deposit £7.5.0 and 9 monthly payments 56/3. (Total £32.13.3). Or in veneered housing 31 Gns. Carr. 15/- or Deposit £7.3.6 and 9 monthly paymts 64/- (Total £35.19.6). *Send S.A.E. for leaflet.*

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BRISTOL 14 Lower Castle St. (Half-day Wed.) Tel. 22904
BIRMINGHAM 30/31 Gt. Western Arcade opp. Snow Hill Station 021-236-1279 (Half-day Wed.)
DERBY 26 Osmaston Rd. The Spot (Half-day Wed.) Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.) Tel. 68043
EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766
GLASGOW 326 Argyle St. (Half-day Tues.) Tel. CITy 4158; 403 Sauchiehall St. (Opp. Locarno) (Half-day Tues.) Tel. 332-1572
HULL 91 Paragon Street. (Half-day Thursday) Tel. 20505

R·S·C HI-FI CENTRES LTD.

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries please. Hi-Fi Catalogue 4/6.

Open all day Sats. except High Holborn

LEICESTER 32 High Street. (Half-day Thurs.) Tel. 56420
LEEDS 5-7 County(Mecca) Arcade, Briggate (Half-day Wed) Tel 28252
LIVERPOOL 73 Dale St. (Half-day Wed.) Tel. CENtral 3573
LONDON 238 Edgware Road, W2 (Half-day Thurs.) Tel. PAD 1629; 96 High Holborn, WC1. Tel. HOL 9874 (Half-day Sat.)
MANCHESTER 60A Oldham Street (Half-day Wed.) Tel. CENtral 2778
MIDDLESBROUGH 106 Newport Rd (Half-day Wed) Tel. 47096
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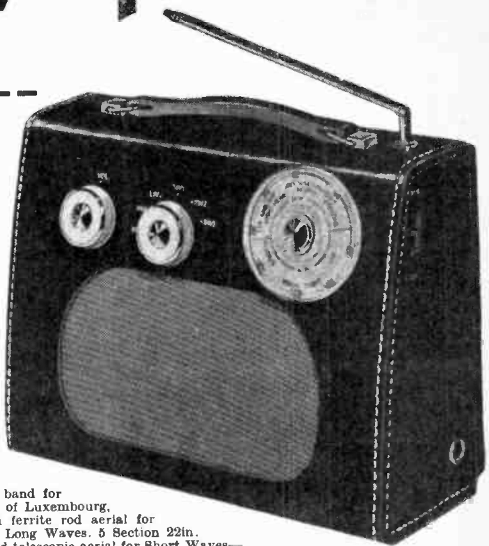
SHEFFIELD 13 Exchange Street (Castle Market Bldgs.) (Half-day Thursday) Tel. 20716

Build yourself a quality transistor radio

backed by our after sales service!



roamer seven mk IV

SEVEN WAVEBAND PORTABLE

SEVEN TUNABLE WAVEBANDS—
MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND.

Extra M.W. band for easier tuning of Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. 5 Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push pull output. 7 transistors and 2 diodes including Micro-Alloy R.F. Transistors. Famous make 7 x 4in. P.M. speaker for rich-tone volume. Air spaced ganged tuning condenser. Separate on/off switch, volume control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. First grade components. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build.

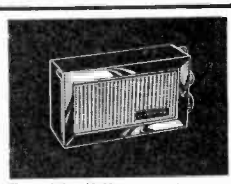
Total building costs **£5.19.6** P. & P. 7/6

Personal Earpiece with switched socket for private listening 5/- extra.

Parts price list and easy build plans 3/- (Free with parts).

pocket five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

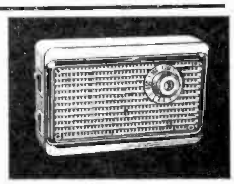


Attractive black and gold case. Size 5½ x 1¼ x 3½in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs **44'6** P. & P. 3/6

transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

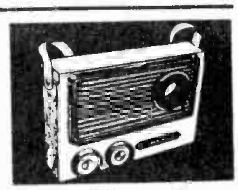


Attractive case with red speaker grille. Size 6¾ x 4½in. x 1½in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. All first grade components. Easy build plans and parts price list 1/6 (FREE with parts.)

Total building costs **47'6** P. & P. 3/9

super seven

THREE WAVEBAND PORTABLE WITH 3in. SPEAKER



Attractive case size 7¼ x 5¼ x 1½in. with gilt fittings. The ideal radio for home or outdoors. Covers Medium and Long Waves and Trawler Band. Special circuit incorporating 2 R.F. Stages, push pull output, ferrite rod aerial, 7 transistors and 2 diodes, 3in. speaker (will drive larger speaker) and all first grade components. Easy build plans and parts price list 2/- (FREE with parts). (Personal Earpiece with switched socket for private listening 5/- extra.)

Total building costs **69'6** P. & P. 4/6

roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

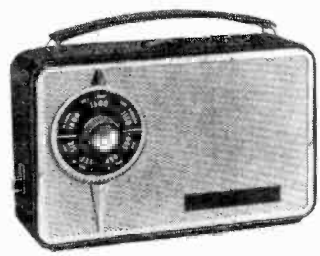
Attractive case with gilt fittings. Size 7¼ x 5¼ x 1½in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. All top grade components. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/- (FREE with parts). (Personal Earpiece with switched socket for private listening 5/- extra.)

Total building costs **79'6** P. & P. 4/6

* *Callers side entrance Stylo Shoe Shop*
* *Open 10-1, 2.30-4.30 Mon-Fri. 9-12.30 Sat*

NEW LOOK melody six

TWO WAVEBAND PORTABLE



8 stages—6 transistors and 2 diodes. Covers Medium and Long Waves. Top quality 3in. Loudspeaker for quality output and also with Personal Earpiece with switched socket for private listening. Two R.F. stages for extra boost. High "Q". Ferrite Rod Aerial. Push-pull output. Handsome pocket size case with gilt fittings. Size 6½ x 4 x 2in. Easy build plans and parts price list 2/- (FREE with parts).

Total building costs **69'6** P. & P. 4/3

RADIO EXCHANGE CO

61 HIGH STREET, BEDFORD. Tel. Bedford 52367

I enclose £.................. please send items marked

ROAMER SEVEN	☐	ROAMER SIX	☐
TRANSONA FIVE	☐	SUPER SEVEN	☐
POCKET FIVE	☐	MELODY SIX	☐

Parts price list and plans for ....

Name ....

Address ....

.... PW3

VALVES/SEMI-CONDUCTORS
BRAND NEW & GUARANTEED

OA2	6/-	6J4	9/-	30FL1	15/-	ECF82	7/6	GZ32	11/6	PY801	8/-
OB2	6/-	6J6	3/6	30L15	15/-	ECH35	11/-	GZ34	11/6	U25	15/-
1R5	6/-	6K8	4/-	30P19	14/-	ECH42	11/-	MU14	8/-	U26	15/-
1S5	4/6	6L6	9/6	30PL1	15/-	ECH81	6/3	PABC80	7/6	U191	14/-
1T4	3/-	6Q7	8/3	30PL13	16/-	ECH83	8/6	PCC84	6/6	U281	8/-
1U4	6/-	6SG7	6/-	35L6	8/-	ECL80	7/9	PCC85	8/-	U301	11/-
1U5	7/-	6SJ7	7/-	35Z4	8/6	ECL82	7/-	PCC88	11/6	U801	22/6
2D21	5/-	6SL7	6/-	35W4	5/3	ECL83	10/6	PCC89	11/6	UABC80	6/-
3A5	10/-	6SM7	5/6	50B5	6/6	ECL86	9/-	PCC189	12/6	UAF42	10/-
3Q4	7/-	6U7	7/-	50C5	6/6	EF37A	8/-	PC86	11/-	UBC41	8/-
3S4	5/-	6V6	5/-	80	7/-	EF40	10/-	PC88	11/-	UBF80	7/-
3V4	6/-	6X4	4/3	AZ31	10/-	EF41	9/6	PC97	8/6	UBF89	7/-
5R4	9/-	6X5	5/-	DAF91	4/6	EF42	10/6	PC900	9/6	UCC84	10/-
5U4	5/-	7B7	7/-	DAF96	7/-	EF80	5/-	PCF80	7/3	UCC85	7/-
5V4	8/6	7C6	6/6	DF91	3/-	EF85	6/6	PCF82	7/-	UCF80	9/6
5Y3	5/9	7Y4	8/6	DF96	7/-	EF86	7/-	PCF84	9/-	UCH42	10/-
5Z4	8/-	10C2	15/-	DK91	6/-	EF89	6/3	PCF86	9/-	UCH81	7/-
6/30L2	12/6	10F1	9/-	DK92	8/9	EF91	4/-	PCF800	15/-	UCL82	8/-
6AC7	4/-	10P13	15/-	DK96	8/-	EF92	4/-	PCF801	10/-	UCL83	10/-
6AG7	6/-	10P14	16/-	DL92	5/-	EF183	7/-	PCF802	10/-	UF41	10/-
6AK5	5/-	12AT6	5/-	DL94	6/-	EF184	7/-	PCF805	14/-	UF80	7/-
6AL5	3/-	12AT7	4/-	DL96	8/-	EL33	17/6	PCL82	7/6	UF85	7/6
6AM6	4/-	12AU7	5/-	DY86	6/6	EL34	11/-	PCL83	9/6	UF89	7/6
6AQ5	6/-	12AX7	6/-	E88C	12/6	EL41	9/9	PCL84	8/-	UL41	10/-
6AS6	6/-	12BA6	6/9	EABC80	7/-	EL42	11/-	PCL85	9/6	UL84	7/-
6AT6	5/-	12BE6	6/3	E180F	15/-	EL81	9/-	PCL86	9/-	UY41	7/6
6AU6	5/9	12BH7	6/6	EAF42	9/6	EL84	5/-	PFL200	12/6	UY85	6/6
6BA6	4/9	12Q7	5/6	EB91	3/-	EL85	8/6	PL36	10/6	VR105/30	5/6
6BE6	5/3	12SQ7	7/6	EBC41	9/6	EL91	4/-	PL81	7/6	VR150/30	5/-
6BH6	8/-	19AQ5	6/-	EBC81	7/-	EL95	5/3	PL82	7/-		
6BJ6	8/-	20F2	14/-	EBF80	7/6	EM80	7/6	PL83	7/-		
6BR7	11/-	20L1	13/-	EBF83	9/-	EM81	8/-	PL84	6/9		
6BZ6	7/-	20P1	12/-	EBF89	7/6	EM84	7/6	PL500	14/6	MANY	
6C4	3/6	20P3	12/-	ECC40	11/6	EM87	7/6	PY33	9/9	OTHER	
6C6	4/-	20P4	22/6	ECC81	4/-	EY51	7/6	PY80	5/6	TYPES IN	
6CD6	20/-	25L6	6/6	ECC82	5/-	EY86	7/-	PY81	6/-	STOCK.	
6CH6	6/-	25Z4	8/-	ECC83	6/-	EZ40	8/6	PY82	6/-		
6CL6	10/-	30C15	13/6	ECC84	6/6	EZ41	8/6	PY83	6/6		
6D6	3/-	30C18	14/-	ECC85	5/6	EZ80	5/6	PY88	7/6		
6E5	8/-	30F5	14/-	ECF80	7/-	EZ81	5/6	PY800	8/-		

TRANSISTORS

2N696	5/-	AF115	4/6	BSY55	15/9	OC71	3/-
2N697	5/-	AF116	4/6	BSY56	17/3	OC72	4/-
2N706	3/-	AF117	4/6	BSY65	4/6	OC73	5/-
2N706A	4/-	AF119	4/6	BSY78	7/6	OC74	5/-
2N708	4/-	AF186	12/-	BSY79	7/6	OC75	4/6
2N743	4/-	ASY28	6/6	BSY95A	3/6	OC76	4/6
2N744	4/-	BC107	4/6	BUY10	12/6	OC77	4/6
2N753	4/6	BC108	3/6	GET106	4/6	OC78	5/-
2N914	4/6	BC109	4/6	GET113	5/-	OC81	4/-
2N916	4/6	BC170	3/-	GET873	4/6	OC81M	2/6
2N929	4/6	BC172	3/3	GET874	4/6	OC81D	3/-
2N930	5/-	BC173	3/9	MAT100	7/9	OC81DM	2/6
2N1613	5/-	BCY31	4/6	MAT101	8/6	OC82	4/6
2N1711	6/6	BCY34	4/6	MAT120	7/9	OC83	5/-
2N1893	8/-	BCY39	4/6	MAT121	8/6	OC139	7/6
2N2160	14/11	BCY42	5/-	NKT210	5/-	OC140	9/6
		BCY43	5/-	NKT211	5/-	OC169	4/6
2N2147	17/6	BCY70	6/6	NKT212	4/9	OC170	4/6
2N2369	5/9	BCY71	10/6	NKT213	5/-	OC171	4/6
2N2646	13/6	BCY72	6/6	NKT214	3/9	OC200	5/-
2N2926	3/-	BF115	4/6	NKT215	3/9	OC201	7/6
2N3053	7/6	BFX12	6/6	NKT216	9/6	OC202	6/-
2N3055	19/6	BFX13	6/6	NKT217	9/6	OC203	6/-
2N3705	5/-	BFY10	4/6	NKT219	4/9	OC204	6/-
2S102	6/6	BFY11	4/6	NKT223	5/-	ST140	4/-
2S103	6/6	BFY17	4/6	NKT224	3/9	ST141	6/-
2S104	6/6	BFY18	4/6	NKT225	3/9	XA104	4/6
AC107	4/6	BFY19	4/6	NKT229	5/-	XA124	4/6
AC126	4/6	BFY50	4/6	NKT240	4/6	XA125	4/6
AC127	4/6	BFY15	4/-	NKT261	4/3	XB112	3/-
AC128	4/6	BFY52	4/6	NKT403	15/6	XC141	7/-
AC165	4/-	BFY90	12/6			PHOTO TRANSISTORS	
AC167	4/6	BSX19	5/6	NKT405	14/3	OCP71	12/6
AC176	5/6	BSX20	5/6				
ACY19	4/6	BSX40	13/9	NKT10439	7/-		
ACY20	4/9	BSX41	17/-				
ACY21	4/6	BSY10	5/-	OC19	7/6		
ACY22	4/-	BSY11	5/-	OC23	8/6		
ACY28	5/-	BSY26	4/6	OC25	7/6		
ACY40	4/3	BSY27	4/6	OC26	6/-		
ACY41	4/6	BSY28	4/6	OC28	8/6		
AD140	8/6	BSY29	4/6	OC35	8/6		
AD149	16/-	BSY38	4/6	OC36	8/6		
AD161	8/-	BSY39	4/6	OC41	5/-		
AD162	8/-	BSY51	7/9	OC42	5/-		
ADT140	15/-	BSY52	8/9	OC44	4/-		
		BSY53	8/3	OC45	3/-		
AF114	6/6	BSY54	9/6	OC70	3/-		

SIGNAL DIODES

IN34A	4/-
OA5	3/6
OA70	2/-
OA79	2/-
OA81	2/-
OA85	2/-
OA90	2/6
OA91	2/-
OA95	2/6

SILICON POWER DIODES

60 P.I.V. 290 MA 2/-	6 AMP 5/6
70 P.I.V. 1 AMP 3/6	400 P.I.V. 8 AMP 7/6
140 P.I.V. 165MA 1/-	700 P.I.V. 100 AMP 35/-
150 P.I.V. 25AMP 10/-	800 P.I.V. 500MA 5/6
290 P.I.V. 6 AMP 5/6	800 P.I.V. 5 AMP 7/6
400 P.I.V. 500MA 3/6	1000 P.I.V. 6 AMP 7/6
400 P.I.V.	1000 P.I.V. 650MA 6/6

THYRISTORS SILICON CONTROL RECTIFIERS

400 P.I.V. 3 AMP 7/6	200 P.I.V. 7 AMP 15/6
100 P.I.V. 7 AMP 13/6	400 P.I.V. 7 AMP 15/6

PLEASE ADD POSTAGE

ZENER DIODES

OAZ200 12/-	OAZ208 6/6
OAZ201 10/-	OAZ209 6/6
OAZ202 8/6	OAZ210 6/6
OAZ203 8/6	OAZ211 6/6
OAZ204 8/6	OAZ212 6/6
OAZ205 8/6	OAZ213 6/6
OAZ206 8/6	OAZ227 15/-
OAZ207 9/6	

STC 1 WATT SERIES 5% 2.4/2.7/3/3.9/4.3/13/16/18/20/30/33 volt, 5/- each.
Z series. All voltages from 3.9–50 volt. 250mW, 2/6 ea. 1.5w. 4/- ea. 7w. 5/- each.

CLEAR PLASTIC PANEL METERS

First grade quality Moving Coil panel meters available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Type MR 38P, $1^{21}/_{32}$in. square fronts.

50µA	37/6	500-0-500µ	25/-	50mA	25/-	150V. D.C.	25/-
50-0-50µA	35/-	1mA	25/-	100mA	25/-	300V. D.C.	25/-
100µA	35/-	1-0-1mA	25/-	150mA	25/-	500V. D.C.	25/-
100-0-100µA	32/6	2mA	25/-	200mA	25/-	750V. D.C.	25/-
200µA	31/6	5mA	25/-	300mA	25/-	15V. A.C.	25/-
500µA	37/6	10mA	25/-	500mA	25/-	50V. A.C.	25/-
		750mA	25/-	3V. D.C.	25/-	150V. A.C.	25/-
		1 amp	25/-	10V. D.C.	25/-	300V. A.C.	25/-
		2 amp	25/-	20V. D.C.	25/-	500 V. A.C.	25/-
		5 amp	25/-	100V. D.C.	25/-	S meter 1mA	29/6
		20mA	25/-			VU meter	38/6

Postage Extra. Larger sizes available—send for lists.

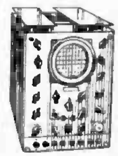
Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid.
High quality construction. Input 230V. 50–60 cycles.
Output full variable from 0·260 volts. Bulk quantities available.
1 amp.—£5.10.0; 2·5 amp.—£6.15.0; 5 amp.—£9.15.0;
8 amp.—£14.10.0; 10 amp.—£18.10.0; 12 amp.—£21.0.0;
20 amp.—£37.0.0.

AVO CT.38 ELECTRONIC MULTIMETERS

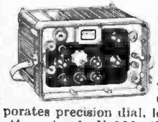
High quality 97 range instrument which measures A.C. and D.C. Voltage. Current. Resistance and Power Output Ranges D.C. volts 250mV–10,000V. (10 megΩ–110 megΩ input). D.C. current 10µA–25 amps. Ohms: 0–1,000 megΩ. A.C. volt 100mV–250V (with R.F. measuring head up to 250 Mc/s) A.C. current 10µA–25 amps. Power output 50 micro-watts-5 watts. Operation 0/110/200/250V. A.C. Supplied in perfect condition complete with circuit lead and R.F. probe. £25. Carr. 15/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



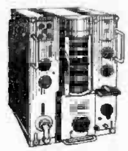
An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid. etc. £25 Carriage 30/-.

AM/FM SIGNAL GENERATORS



Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1µV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/-.

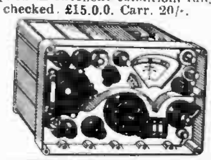
ADMIRALTY B.40 RECEIVERS



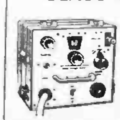
Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, band-pass filter, noise limiter, crystal controlled B.F.O., calibrator. O/F output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19½ × 13½ × 16in. Weight 114 lbs. Offered in good working condition. £22.10.0. Carr. 30/-. With circuit diagrams. A few Brand New £35. Carr. 30/-. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s. £17.10.0. Carr. 30/-.

R209 MK. II COMMUNICATION RECEIVER

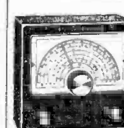
11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, BFO. Aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked. £15.0.0. Carr. 20/-.



CLASS D WAVEMETERS

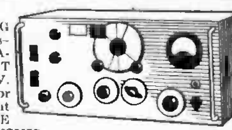


A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.19.6. Carr. 7/6. Or brand new with accessories. £7.19.6. Carr. 7/6.



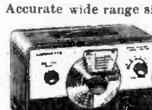
TE-16A Transistorised Signal Generator. 5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¾ × 3½in. Complete with instructions and leads. £7.19.6. P. & P. 4/-.

MARCONI TEST EQUIPMENT



EX-MILITARY RECONDITIONED. TF.144G STANDARD SIGNAL GENERATORS. 85 Kc/s–25 Mc/s, £25 Carr. 30/-. T.F.885 VIDEO OSCILLATOR 0–5 Mc/s, £45 Carr. 30/-. T.F.195M BEAT FREQUENCY OSCILLATOR 0–40 Kc/s. 200/250V. A.C., £20 Carr. 30/-. T.F.142E Distortion Factor Meter, £20 Carr. 20/-. All above offered in excellent condition, fully tested and checked. T.F.1100 VALVE VOLTMETER, Brand New, £50 T.F.1267 TRANSMISSION TEST SET, Brand New. £75 T.F.1371 Wide Band Millivolt Meter. Brand New, £50.

TE-20RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240V. A.C. Brand new with instruction. £15.0.0. P. & P. 7/6. S.A.E. for details.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2 pF–2,000 mFd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. Brand New £17.10.0 Carr. 7/6.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons.

VM.76 VALVE VOLTMETER R.F. measurements in excess of 100 Mc/s and D.C. measurements up to 100V. with accuracy of ±2% D.C. range 300 MV to 1 KV. A.C. range 300 MV to 300 V RMS. Resistance ·02–500MΩ. Price £72.

VM.78 A.C. MILLIVOLT METER Transistorised 1 MV–300V. Frequency 1 c/s to 1 Mc/s. Price £55.

VM.79 UHF MILLIVOLT METER Transistorised. A.C. range 10 MV–3V. D.C. current range ·01µ/A–3MA. Resistance 1 ohm–10 megohms. Price £125.

H1B AUDIO SIGNAL GENERATOR 15 c/s–50 Kc/s, sine or square wave. Price £30.

J1B AUDIO SIGNAL GENERATOR 15 c/s–50 Kc/s. Price £30.

J2B AUDIO SIGNAL GENERATOR As per J1B except fitted with output meter. Price £35.

TT1S TRANSISTOR TESTER £37.10.0

Carriage 10/- per item.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads, £16.10.0. Carr. 7/6.

RECORDING HEADS

Reuter ¼-track. As fitted to Collaro Mk. IV and Studio Decks. High imp. record play back, low imp. erase. Lower track only. Brand new 19/6 pair. **MINIFLUX** ¼-track record 12/6. **COSMOCORD** ¼-track heads. High imp. record/playback 65/-. Low imp. erase 20/-. **MARRIOTT** ¼-track heads. High imp. record/playback 65/-. Low imp. erase 20/-. Post extra.

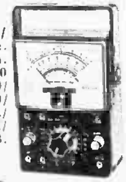
G. W. SMITH & CO (RADIO) LTD.
3-34 Lisle St., W.C.2
Also see oppos. page

MULTIMETERS *for EVERY purpose!*

LAFAYETTE DE-LUXE 100K Ω/VOLT "LAB TESTER" Giant 6½in. scale Built-in meter protection 0/·5/2·5/10/50/250/500/1,000V D.C. 0/3/10/50/250/500/1,000V A.C. 0/10/100 μA/10/100/500mA/2·5/10A. 0/1K/10K/100K/10M/10M Ω. – 10 to 49·4dB £18.18.0. P. & P. 5/-

TE-900 20,000 Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000v A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C. 0/50μA/1/10/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £15. P. & P. 5/-.

LAFAYETTE 57 Range Super 50k Ω/volt Multimeter. D.C. volts 12 mV -1000V. A.C. volts 1·5V -1000V DC current 25μA–10 amp Ohms 0–10meg Ω dB –20 to +81 dB. Overload protection £12.10.0. Carr. 3/6.

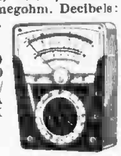


MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10 μA/6/60/300mA/12 amp. 0/2K/200K/2M/200M Ω. –20 to +17dB. £12.10.0. P. & P. 3/6.

NEW MODEL 500 30,000 O.P.V. with overload protection, mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg./60 Meg. Ω £8.17.6. Post paid.

PROFESSIONAL 20,000 opv LAB. TYPE Multitester. Automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts. D.C. and A.C. 0–500μA, 10mA, 250mA. Current: 0/20K,200K, 2 megohm. Decibels: –20 to +22dB. £5.19.6. P. & P 2/6.

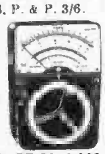
MODEL TE-90 50,000 O.P.V. mirror scale overload protection 0/3/12/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. ·03/6/60/600mA. D.C. 16K/160K/1·6/16meg Ω. –20 to +63dB. £7.10.0. P. & P. 3/-.



MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 Meg. μ £5.10.0. P. & P. 3/-.

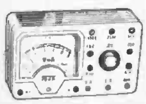
MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0·2mFd. £5.19.6. P. & P. 3/6.

TE-51. NEW 20,000 Ω/VOLT MULTIMETER with overload protection and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0-60μA/12/300mA. D.C. 0/60K/6 meg. ohm. 92/6. P. & P. 2/6.

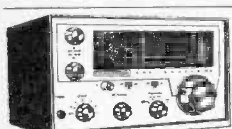


MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000v. A.C. 0/5/25/50/250/500/1,000v. D.C. 0–50μA, 5/50/500mA. 0/6K/60K/600 K/6meg. £4.17.6. P. & P. 3/-.

MODEL TE-10A. 200k Ω/Volt 5/25/50/250/500/2,500v. D.C. 10/50/100/500/1,000 v. A.C. 0/50μA/2·5 mA/250 mA D.C. 0/6K/6 meg. ohm. –20 to +22dB. 10·0, 100mFd. 0·100-0·1mFd. 69/6. P. & P. 2/6.



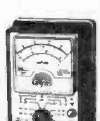
MODEL PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000v. A.C. and D.C. 0/1/100/500/mA. D.C. 0/150K Ω. 39/6. P. & P. 1/6.



NEW STAR SR-200 SSB AMATEUR RECEIVER

An exciting new receiver covering 6 amateur bands 160/80/40/20/15/10 metres. Illuminated slide rule dial ● S meter ● Crystal calibrator ● Product detector ● Automatic noise limiter ● RF tuning and gain controls. ● Speaker or phone outputs ● 8 valves, 2 transistors, 2 diodes 220/240V. A.C. Supplied brand new and guaranteed. £40.0.0. Carr. 10/-.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.-2Mc/s. Decibels –40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0. Carr. 5/-.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions. Model 7 £13.10.0. P. and P. 7/6.

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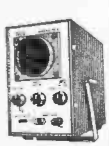

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS–1 MHZ. Input imp. 2 meg Ω 25 PF. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240V a.c. Supplied brand new with handbook. £22.10.0. Carr. 10/-.

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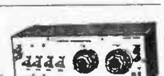
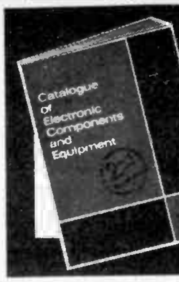


Variable range 0–111dB. Connections. Unbalanced T and Bridge T. Impedance 600 Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0·05dB. +Indication dB × 0·01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new £27.10.0. P. & P. 5/-.

NEW CATALOGUE



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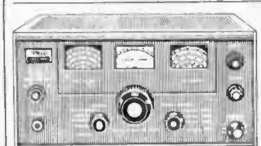
UNR-30 4-BAND COMMUNICATION RECEIVER

Covering 550 Kc/s–30 Mc/s. Incorporates variable BFO for CW/SSB reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

LAFAYETTE SOLID STATE HA600 RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s–400 Kc/s and 550 Kc/s–30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limited ● S meter ● 24in. Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8¼in. Weight 18 lbs. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.



TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 550 Kc/s to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. £39.15.0, carriage paid.

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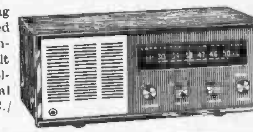
LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER



A completely new transistorised receiver covering 152–174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. £37.10.0. Carr. 10/-.

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19 transistors, 8 diodes, IHF music power, 30W at 8 Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV Output 3–16 Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10½ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. £28. Carriage 7/6.

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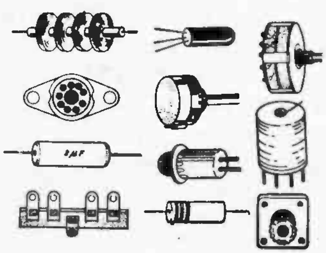

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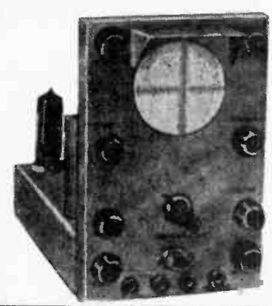

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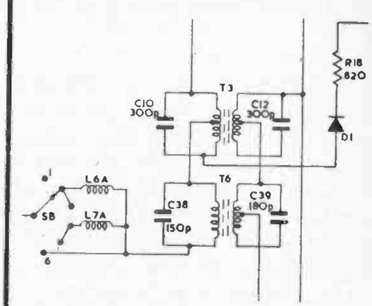

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PRACTICAL WIRELESS

VOL 44 No 11

Issue 745

MARCH 1969

TOPIC OF THE MONTH

Ancient and Modern

WE would dearly like to meet the character who coined the phrase *"the customer is always right"*. Many organisations are either blissfully unaware of this sentiment or feel that such consideration is below their dignity. As readers of *Practical Wireless,* you who are (we hope) eagerly scanning these lines are in a sense customers of the Editor. And before you all rush for pens and typewriters, let it be said that all of us on the editorial staff are anxious to please our customers—at least to the extent that as we have so many customers it is impossible to please everyone all the time!

In recent months it has been our policy to lay a greater emphasis on semiconductor devices. Most of the industry, including the domestic equipment field, is using semiconductors; not only that but as the months go by more and more sophisticated devices become available. It is obvious that the home constructor generally wants to be as up to date as possible and we hope that the articles we publish give him the raw material to achieve this end.

However, the postbag during this period has contained a large number of letters from readers deploring the fact that we appear to be debarring the humble valve from our pages. The readers who write thus have perfectly valid arguments for their case. The valve champions say that they have plenty of valves in their spares boxes which are still capable of giving good results; they say that they *prefer* using valves to semiconductors; they point out that in some applications, valves can still give as good a service, or better, than transistors.

There is no doubt that the valve is far from obsolete to the home constructor or to those who repair equipment either as a hobby or professionally. People are still buying valves in some quantity and they are cheap and plentiful; as an exercise take a look through the advertisement pages and see how many valves are being offered for sale!

As the customer is (nearly) always right, we will therefore make a point of incorporating information on valve projects (and the main article this month describes a valve receiver) but must bear in mind advancing technology and place the main emphasis on more modern circuitry. We might then please *all* readers—though we doubt if this is strictly possible!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

APRIL ISSUE WILL BE PUBLISHED ON MARCH 7th

NEWS AND COMMENT...

FILMSHOW 1969

The annual filmshow, organised jointly by Mullard Ltd., *Practical Wireless* and *Practical Television* magazines is to be held once again at Caxton Hall, Caxton Street, Westminster, London, S.W.1. The date this year is 28 March and the show will start at 7.30 p.m. prompt.

The programme will include a lecture on Colour Television, covering the setting-up procedure and dealing in detail with degaussing, purity, convergence and grey-scale tracking.

The film is entitled *It's the Tube that makes the Colour* and describes the manufacture of Mullard Colour Screen TV picture tubes.

Refreshments, free of charge folks, will be served at half-time.

Application for tickets—which are also FREE—should be made to "Filmshow", Practical Wireless, Tower House, Southampton Street, London, W.C.2. A stamped, addressed envelope enclosed with all applications please.

MOBILE RALLIES SO FAR

APRIL 20—North Midlands at Drayton Manor Park, near Tamworth, Staffordshire.
MAY 18—Northern Mobile Rally.
JUNE 1—Amateur Radio Mobile Society.
JUNE 29—Longleat at Longleat Park, near Warminster, Wiltshire.
JULY 6—South Shields Mobile Rally.
AUGUST 10—RSGB Mobile Rally at Woburn Abbey.
AUGUST 17—Derby and District.
AUGUST 24—Torbay Amateur Radio Society.

Club Secretaries: if you want us to publish details of your Mobile Rally, drop us a line and we'll try and put information in the next issue.

AH, THAT'S BETTER!

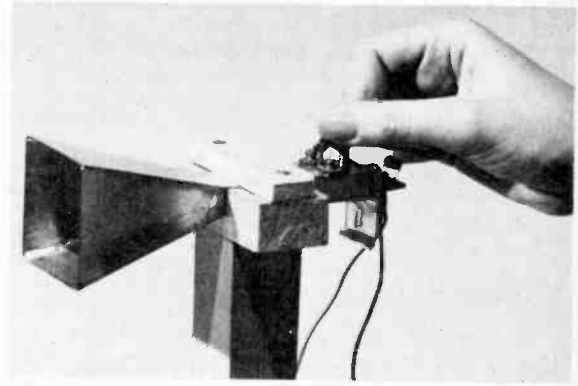
There is a persistent, boring, increasing pain about a burn that won't let you forget it and it can turn into a nasty sore, if neglected.

The beginner dealing with tools with which he isn't familiar is apt to have a burning accident, and the professional, with all his know-how, sometimes gets a trifle careless.

All sorts of domestic remedies can be tried and fail—butter, baking powder, iodine. The answer now is a quite new product—"Burneze", price 7s 3d.

Burneze is neither sticky, messy nor glutinous and to spray for 8 to 10 seconds, which thoroughly chills the area, is sufficient. It is a scientifically developed product which takes the heat out of the burn immediately so that tissue damage is reduced. A topical anaesthetic is included to soothe pain. It also reduces the over-release of histamine which causes blisters, and inhibits the spread of toxic molecules.

MULLARD AT BRISTOL SCIENCE EXHIBITION



At the exhibition arranged by the Association for Science Education in the School of Chemistry, Bristol University, from 1st to 3rd January 1969, Mullard Educational Service demonstrated a simple high-impedance d.c. voltmeter and microwave system, both primarily intended for construction by schools and technical college pupils or staff.

The voltmeter can measure up to 500V d.c. in eight ranges. It incorporates a d.c. amplifier using a field effect transistor type BFW64, so that on every range the input impedance exceeds 10MΩ. It requires a supply voltage of 9V and takes a current of approximately 6mA.

The Gunn effect device greatly facilitates the construction of a simple, compact microwave system for demonstrating the properties of radio waves. The transmitter consists of a transmitting horn attached to a short length of waveguide containing a Gunn effect device. An adjustable screw in the cavity behind the device provides a means of tuning the transmitter by matching the wave guide to the device. Power is supplied by a 9V battery and the current drain is approximately 100mA. With a Gunn effect device type CXY11A the output is about 6mW at 10Gc/s.

The receiver has a horn and a waveguide similar to those of the transmitter. The signal is detected by a microwave diode and is indicated on a 50μA meter.

The microwave transmitter being tuned in the photograph consists simply of a Gunn effect device inside a short length of waveguide attached to the transmitting horn. A resistor in series with the Gunn device and a zener diode in parallel with it ensures that the applied voltage is of the correct value.

NEW WELLER CATALOGUE

Weller Electric Ltd., the manufacturers of soldering tools, have just published a new catalogue which deals with their range of temperature controlled soldering tools.

This four page, coloured catalogue deals with many aspects of soldering with temperature-controlled soldering pencils and their inherent advantages over more conventional tools. Details are given on the curie point principle—the control factor behind these soldering pencils, with information concerning cost saving Wellertips, safety aspects, and temperature and tip size choices for the TCP range. A price list for the complete range of Weller soldering tools and accessories is included with the catalogue.

This catalogue is available on request to Weller Electric Ltd., Redkiln Way, Horsham, Sussex.

NEWS AND COMMENT...

GET IT BOXED

The complete range of Electroniques die-cast boxes now extends from 4 x 3 x 1in. to 11 x 7 x 6in.

The new larger sizes incorporate the slot guide system unique to Electroniques boxes used on the original range.

The four larger sizes, which are not available elsewhere, will prove useful in housing equipment for which fabricated steel cases are currently used.

The greater depth offered by the new boxes also permits the inclusion of larger components such as wafer switch assemblies and multi-ganged potentiometers.

Further inquiries to: Electroniques, Edinburgh Way, Harlow, Essex. (Manufacturing industry inquiries to Electronic Services, same address).

RADIO, TV AND ELECTRONICS BOOKS

The Modern Book Co., 19-21 Praed Street, London, N.W.2 announce their new catalogue of technical books. Price of this invaluable booklet is 2s.

COMPONENT SHOW IN MAY

Space for the 21st London Electronic Component Show in May which celebrates its majority in 1969 by going fully international is now completely booked up.

The organisers, Industrial Exhibitions Limited, report that a substantial influx of foreign exhibitors, added to the fact that many of the UK firms taking part have increased their stand space, means that the show is 25% bigger than before.

NORTHERN POLYTECHNIC AND MULLARD LTD. RUN JOINT COURSE ON I.C. LOGIC SYSTEM DESIGN

This picture shows members of the first one-week course in the theory and practice of integrated circuit logic system design at Northern Polytechnic, London. The courses are organised jointly by Mullard Ltd. and the Northern Polytechnic. The picture was taken on the last day when members took part in individual projects involving the use of integrated circuits. Typical examples included a traffic light control system, vending machine sequence logic and adder circuits. One course a month is planned until May of next year. December and January courses had their full complement of members and bookings for the remainder of the courses are coming in.

A YEAR OF ACHIEVEMENT

During 1969, BSR Ltd., the makers of record changers, confidently expect to achieve over 50% of the world's market following 1968's 47% share. In Great Britain nine out of ten record changers are made by BSR, yet this accounts for only a fifth of the output, the remainder are exported to over eighty countries throughout the world.

The photograph shows record changers of the MA 65, MA 70 and MA 75 range being manufactured at Old Hill, one of their three British factories.

LATEST HEATHKIT CATALOGUE

Heathkit will be pleased to forward a free catalogue to readers who care to write to them at their factory at Gloucester.

MORE GEN FROM MULLARDS

Pamphlet No. 21 in the series Educational Electronic Experiments issued by Mullard Educational Service describes a simple motor speed controller using a thyristor.

The circuit described is intended for the speed control of fractional horse power, a.c. series motors of the type normally used in electric hand drills and food mixers ($\frac{1}{2}$ h.p. maximum). The controller not only enables the speed of the motor to be varied but also maintains a reasonably constant speed under varying load conditions.

Also available from Mullard Educational Service is a pamphlet entitled *Introducing silicon planar transistors*. Its description of how silicon planar transistors are manufactured will be of use to teachers and students of electronics, and of interest to engineers using semiconductor devices.

Copies of these two pamphlets can be obtained from Mullard Educational Service, Mullard Limited, Mullard House, Torrington Place, London, W.C.1.

WITH the larger type of receiver, progressive stage-by-stage construction has several advantages. A simple but efficient working receiver is first obtained without very complicated construction, reducing chances of wiring errors and also initial expense. Extra valves and other circuitry can be added later, each being tested when fitted.

This receiver is built initially as a 4-valve (plus rectifier) superhet, having frequency changer, intermediate frequency amplifier, detection and output stages. In this form, it gives excellent results, covering one chosen waveband, without the complication of band-switching, a straightforward project of this kind should not present any difficulty even for a beginner.

F. G. RAYER G3OGR

progressive SUPERHET

Band-switching is then added, so that the receiver has five switched ranges, as follows: (1) 150-400kc/s, (2) 525-1500kc/s, (3) 1·7-4·6Mc/s, (4) 4·1-12Mc/s, and (5) 11·5-31Mc/s. These cover long, medium and short waves. The receiver can be used on any of these bands as the coils are added and by testing it on each band as the coils are wired, difficulty or confusion in switching is eliminated.

A radio frequency amplifier is then added, without disturbing existing work. This r.f. stage increases sensitivity, and greatly reduces second channel interference on the h.f. bands; again the receiver can be tested as each r.f. coil is added. As the complete circuit has fifteen coils to cover the five bands, with associated switching, padders, etc., this method of proceeding step-by-step is very helpful in avoiding errors in wiring.

The complete coil and switch section is built into a screening box easily made from "universal chassis" flanged members, giving complete screening and a rigid assembly. The oscillator and mixer coils have small trimmers incorporated, and this saves space and work. The aerial coils have no pre-set trimmers, but a panel variable aerial trimmer, which is almost essential for best results with any aerial. All unused coils are shorted to avoid absorption losses.

To increase sensitivity and selectivity, a further i.f. amplifier can then be added. The other additions described can be added later. They include a signal-strength or S-meter with panel zero control, manual control for r.f. and i.f. gain, heterodyne oscillator for c.w. and for s.s.b. carrier insertion, and headphone jack. The dial allows direct calibration for all frequencies and also has a 0-500 logging scale. A ready-made, sprayed aluminium cabinet and panel are used resulting in a finished receiver of quite professional appearance and performance.

Basic Circuit

This is shown in Fig. 1, and it can be wired in this form before adding the band-switching. Assuming that the r.f. stage will in any case be added later, VC1 and VC2 are two sections of a 3-gang tuning capacitor. V1 is the frequency changer, and the grid coils are temporarily used as aerial coils by taking blue to aerial, and red to chassis. When the r.f. stage is present, blue goes to r.f. valve anode and red to h.t. positive supply.

Each oscillator coil has its own particular padder capacitor value, as listed, and these are added with each coil, as the coils are wired in later. The grid and oscillator coils each have a small trimmer (TC) incorporated. The layout allows trimmers to be adjusted from below the chassis, and coil cores from above.

The aerial coils for the r.f. stage, when added, have no pre-set trimmers, and their cores are adjusted from under the chassis. V2 is the usual i.f. amplifier, V3 provides automatic volume control bias from one diode (pin 6), this being applied to V2. In the completed receiver, a.v.c. is applied to the r.f. stage and both i.f. stages. V3 also gives audio amplification, and finally the output stage V4 drives a speaker (or phones when required). V5 is an indirectly heated rectifier, and this avoids high initial surge voltages, a fuse protects this valve and the transformer. The final receiver requires a 100mA h.t. supply, this is easily provided by the transformer recommended. With this transformer, R15 and R16 (150Ω) are fitted to reduce the h.t. voltage a little, especially when fewer valves impose a lighter load, and to limit peak rectifier anode current.

When the r.f. stage is added, it does, of course, come in before the existing stages V1, the extra i.f. amplifier is placed between V1 and V2 in Fig. 1, the S-meter is operated by V2 cathode circuit, so could, if wished, be added to Fig. 1.

Chassis Dimensions

The chassis measures 13 × 8in. by 2½in. deep, the depth being needed to clear the coil box. Figure 2 shows the most important dimensions. The easiest method is to fix a piece of paper 13 × 8in. to the chassis with tape or a few spots of adhesive, and mark out on this in pencil then pierce through all drilling positions with a centre-punch or pointed tool, the paper is then removed and the chassis is drilled.

The 9-pin holders require ¾in. diameter holes (ECH81, 6BW6 and EZ81), and other holders need ⅝in. holes, these sizes are easily made with a screw-up chassis punch. It is wise to make the holes for the r.f. stage, extra i.f. stage, and b.f.o. at the

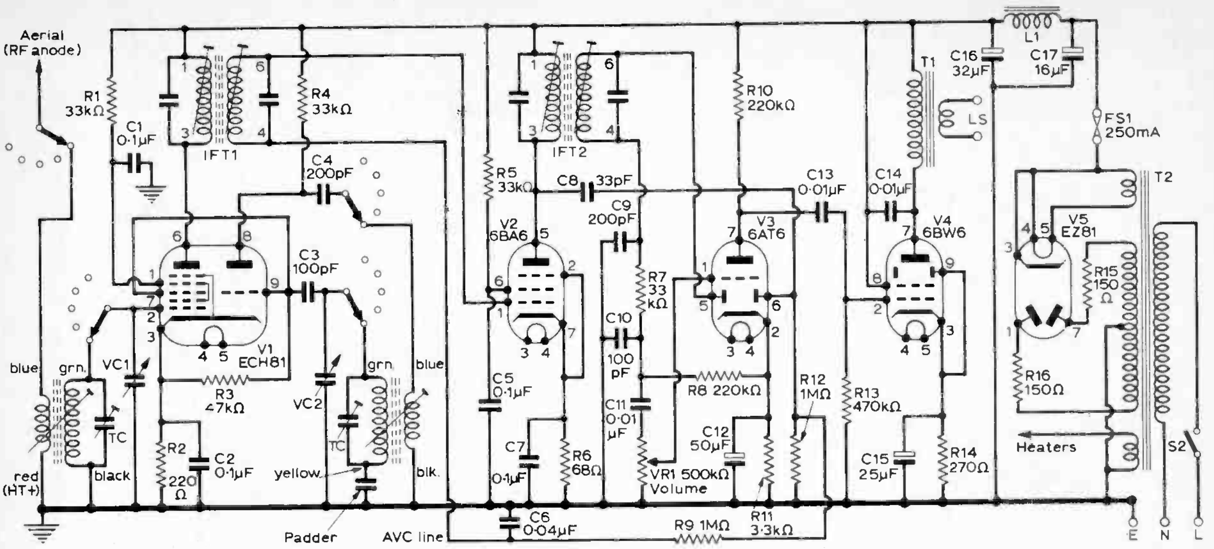


Fig. 1: The basic circuit of the Progressive Superhet; only one set of coils are shown.

same time. All coils occupy ¼in. diameter holes, aerial coil 1 is under the ganged capacitor, but does not have to be adjusted from above. Mixer grid and oscillator coils for band 3 have to be reached from above with a core tool, with the ganged capacitor nearly closed.

Seven holes are necessary for each of the i.f. transformers, those to clear the four tags should be $\frac{3}{16}$in while two ⅛in. holes take fixing screws. A central $\frac{3}{16}$in. hole allows one core to be reached from below. The mains transformer is bolted over a hole which will clear all tags and a piece 3 x 1½in. is cut from the front of the chassis to take the tuning drive mechanism A paper template is provided with the drive, this is placed on the panel so that holes etc, can be marked and the large aperture is made by sawing between corner holes. Fixing holes should be cleared of burr with a countersink bit or a few turns with a larger drill, and all fragments and filings, etc., should be cleared away before fitting the switch, ganged capacitor, and other items. The ganged capacitor is raised by threaded spacers, long bolts with extra nuts, or some similar means, so that capacitor shaft and drive shaft are in line. Before fitting the capacitor, solder a lead to the bottom tags of each section (Fig. 2) and

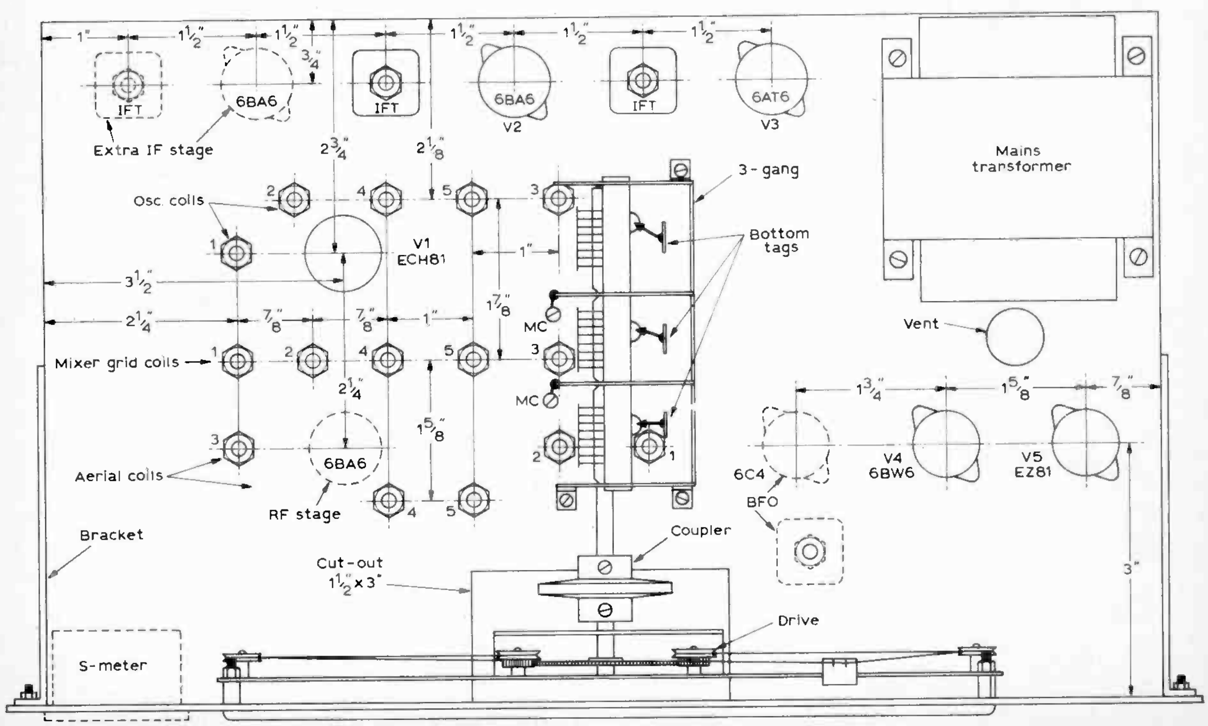


Fig. 2: The layout and details of the chassis viewed from the top.

take these wires down through holes in the chassis. If preferred, the receiver can be wired before actually fixing the panel and drive on.

Under the Chassis

The first step is to complete the circuit as in Fig. 1, and test this to make sure it performs correctly on the one waveband for which coils are connected. Band 2, or medium waves, is probably most suitable.

Figure 3 shows the underside of the chassis, and a few points should be noted. The mains transformer T2 and rectifier V5 are wired first, and the smoothing choke L1 is then bolted to the side of the chassis, over the position occupied by V5. Negative tags or leads of the smoothing capacitors C16 and C17 are soldered to a tag bolted to the chassis. A tagstrip with two insulated tags is bolted near the positive ends of the capacitors to support them.

The mains lead is 3-core flexible cord, taken through a grommet placed in a hole near the "speaker" sockets and soldered to a tagstrip near T2, Fig. 3; the switch of VR1 is included in the live lead to T2 primary. The transformer shield is wired to the chassis.

As the transformer has a separate 6·3V 1A winding, this is used for the rectifier heater, which is *not* earthed to the chassis, the 6·3V 4A winding supplies all other heaters. The fuse-holder is bolted near L1, a little clear of the chassis. Heater, power circuit and similar leads are run against the chassis. It is helpful to use various colours to identify certain circuits, such as blue for heaters, red for h.t. positive, etc., the central spigots of the valveholders are earthed to the chassis.

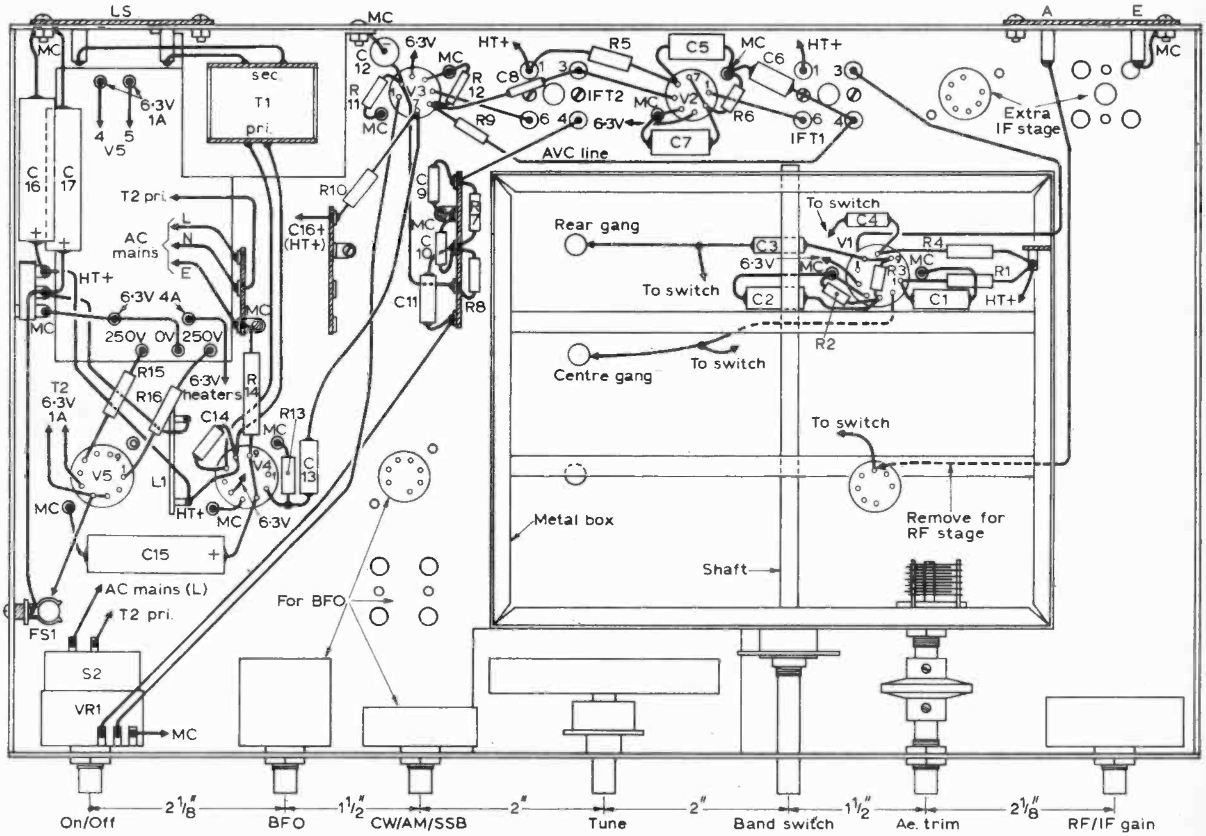
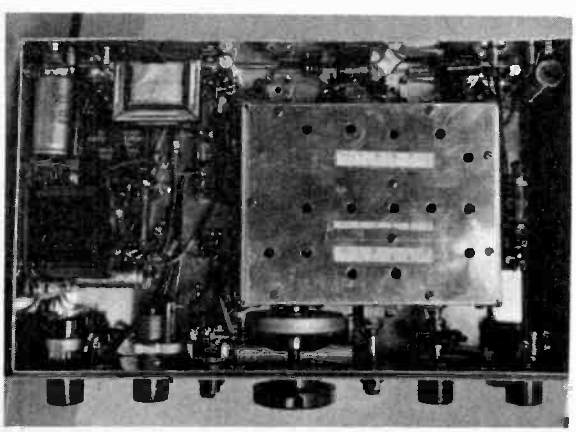


Fig. 3: The wiring of the basic receiver. Note that the smoothing choke L1, when in position, lays beneath V5; this is clearly shown in the photograph below.



Underside view of the chassis with the coil box cover in position.

The connection from tag 1 of V3 to VR1 slider, and from VR1 to C11, should be screened, the brading is taken to the nearest chassis connecting point at both ends of each screened lead. The triode section anode resistor, R10, is supported by a tagstrip which serves as an anchor point for other leads. The small components R7, R8, C9, C10, C11 are wired on a further tagstrip which is then bolted in place.

Take care that the i.f.t.s are bolted so that their tags are arranged as shown in Fig. 3, short pieces of insulated sleeving on the tags will prevent possible shorts to the chassis due to fragments of solder etc. Figure 3 shows the position occupied by the coil box, but the holder for V1 (Fig. 1) is wired before making and fitting this box. When the box is fitted later, run V1 anode lead out through a hole as shown, as this will later be taken to the adjacent extra i.f.t. The 6·3V heater lead then passes through the rear of the box to V2, while the h.t. positive lead will go through the box to the strip holding R10.

When the wiring of the basic circuit is completed, as in Fig. 3, it is wise to test the circuit. Figure 3 shows the positions of the b.f.o. pitch control, c.w./a.m./s.s.b. switch, band switch, aerial trimmer, and r.f./i.f. gain controls, but these will not yet be present; the coil box is also absent.

Take range 2 (medium wave) oscillator coil and the 270pF padder, the tags are identified by colours. Connect green to C3, using the lead marked "switch" in Fig. 3, similarly take blue to C4, yellow to the padder, and black to chassis. Assuming that the r.f. stage will be added later, connect the m.w. mixer grid coil blue to aerial, green to V1 pin 2, and red and black to chassis. The receiver can now be aligned and tested, and should give good results on this waveband.

If any wiring errors are made, these are most likely to be in the band-switching, so when the coil box and switch have been assembled and fitted, it is recommended that the set is tested again with only the same m.w. mixer and oscillator coils, but this time selected by the appropriate switch position, results should be the same as before. This is better than making a mistake which perhaps would result in a whole series of other coil connections being made incorrectly.

Coil Box

The coil box is made from a 6 × 5 × 2in. "universal chassis" with the addition of two extra 6 × 2in. runners. The chassis has two 6 × 2in. runers, two 5 × 2in. runners, and a 6 × 5in. flat plate. The two extra 6 × 2in. runners have about $\frac{3}{8}$in. removed from the *flanges* at each end, so that they will fit inside the flanges of the 5 × 2in. runners. They can then be bolted together to form a box with three sections as shown in Fig. 3.

Drill 6BA clearance holes and punch a $\frac{1}{2}$in. hole so that the switch mechanism can fit against the front runner. Similar holes are made in each 6 × 2in. runner, including the back one, this allows the switch shaft to pass through all runners and also two 6BA screwed rods, to hold the switch wafers. To avoid any inaccuracy, the box is taken apart and the front runner used as a template to mark drilling holes on the other runners, if this is done all holes will be exactly in line when the box is assembled.

Drill the flanges so that the box can be bolted to the chassis, position it with the switch shaft in the panel hole, mark through the flange holes on to the chassis and drill. Also drill or punch holes in the box sides for the heater, h.t. and other leads. One flange is cut to clear the r.f. valveholder.

The box, with switch, is assembled complete before bolting it to the chassis. The mixer stage

★ components list

Resistors:

R1	33kΩ 1W	R9	1 MΩ $\frac{1}{2}$W	
R2	220Ω $\frac{1}{2}$W	R10	220kΩ $\frac{1}{2}$W	
R3	47kΩ $\frac{1}{2}$W	R11	3·3kΩ $\frac{1}{2}$W	
R4	33kΩ 1W	R12	1 MΩ $\frac{1}{2}$W	
R5	33kΩ 1W	R13	470kΩ $\frac{1}{2}$W	
R6	68Ω $\frac{1}{2}$W	R14	270Ω 1W	
R7	33kΩ $\frac{1}{2}$W	R15	150Ω 1W	See text
R8	220kΩ $\frac{1}{2}$W	R16	150Ω 1W	See text

VR1 500kΩ log pot with switch

Capacitors:

C1 0·1μF 350V
C2 0·1μF 150V
C3 100pF silver mica
C4 200pF silver mica
C5 0·1μF 350V
C6 0·04μF 150V
C7 0·1μF 150V
C8 33pF silver mica
C9 200pF silver mica
C10 100pF silver mica
C11 0·01μF 150V
C12 50μF 25V
C13 0·01μF 350V or mica
C14 0·01μF 350V
C15 25μF 25V
C16 32μF 450V
C17 16μF 450V

Padders:

Band	*Value*
1	110pF
2	270pF
3	1000pF
4	3000pF
5	3900pF

silver mica

Trimmers TC: Built on coils
VC1/VC2 2 sections of 3-gang Jackson JB/4507 /10/320, 320pF

Coils:

Band	*Aerial circuit* Qoilmax:	*Mixer grid* Stabqoil:	*Oscillator* Stabqoil:
1	MZ8	MX8	OS8
2	MZ9	MX9	OS9
3	MZ10	MX10	OS10
4	MZ11	MX11	OS11
5	MZ12	MX12	OS12

(Electroniques)

1FT1 S3D/6/460
1FT2 S3D/1/460 (Electroniques)
Switch (to include R.F.)
Four TSW6/2/S six-way all unused shorting wafers
TSW/SH/5/2 mechanism
Studding (6BA rod) (Electroniques)
Eddystone No. 898 drive. Flexible coupler
Aluminium case 15 x 9 x 8in. Type W (H. L. Smith & Co. Ltd.)
L1 P3141 120mA 5H smoothing choke (Electroniques)
T1 45:1 60mA speaker transformer
T2 P2931 250/0/250V 150mA, 6·3V 1A, 6·3V 4A (Electroniques)
Chassis 8 x 13 x $2\frac{1}{2}$in. Pair 4 x 4 in. Type C brackets (H. L. Smith & Co. Ltd.) Coil box, "Universal Chassis" 6 x 5 x 2in. with two extra 6 x 2in. sides (Home Radio, Mitcham)

V1	ECH81	V4	6BW6
V2	6BA6	V5	EZ81
V3	6AT6		

Two B7G holders with cans
Three B9A holders, one $2\frac{1}{2}$in. can
PLH2 bracket bulbholder and 6–8V 0·15A bulb (Home Radio, Mitcham)
E895 $\frac{7}{8}$ x $\frac{7}{8}$in. black round knobs (Home Radio, Mitcham)
KN38 black pointer knobs (Home Radio, Mitcham)
250mA fuse and holder, tagstrips, etc.

valveholder is wired before the box is fitted, as described, flying leads being left for heater and anode circuits.

Later, when all wiring is finished in the box, take a scrap piece of transparent sheet about 6 × 5in. and place it on the box. Put a dot with paint or ink directly over the centre of each coil core and trimmer, place the sheet on the 6 × 5in. aluminium plate, mark through at the dots, and punch or drill fifteen ¼in. holes. The plate is fixed to the box flanges with self-tapping screws. Drill these holes in the plate first, mark through on to the runner flanges, then drill these to take the screws.

The 50pF trimmer occupies a ⅝in. diameter hole, with a washer each side, this allows a little freedom to line up the shaft with the panel bush.

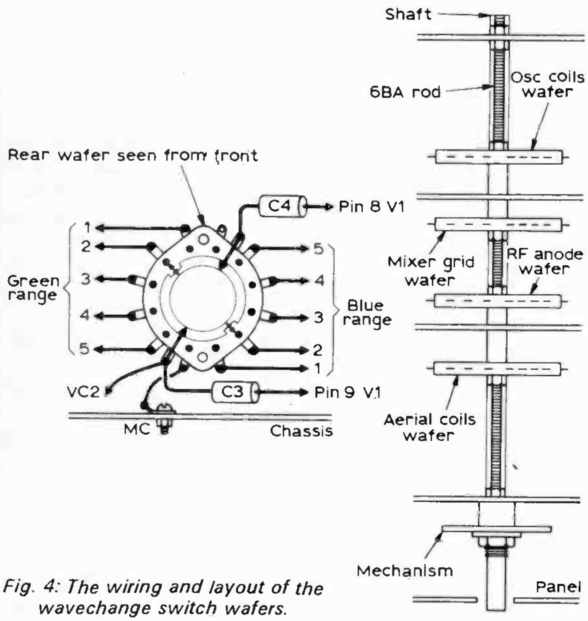


Fig. 4: The wiring and layout of the wavechange switch wafers.

Switch Assembly

The switch mechanism has a stop plate which can be loosened and this is set so that there are five positions; each wafer has two poles, six ways, one way being unused. Each wafer has shorting contacts included, so that all coils not in circuit are shorted to chassis, the sixth tag of each set is earthed to the chassis for this purpose. Since the shorting contacts are common to both poles of a wafer, two separate wafers are necessary to isolate h.t. positive and earthed circuits in the mixer grid position, the h.t. positive wafer is *not* earthed to chassis.

Place the wafers so that contacts come as in Fig. 4, for each wafer, when viewed from the front. If there is any doubt about working, check for continuity with a meter for each position. Errors should in any case be avoided if the receiver is tested with coils for one band only, other coils afterwards being added systematically.

The switch mechanism, 6 × 2in. runners, and switch wafers are all secured together by two lengths of 6BA screwed rod, with extra nuts, washers or spacers, as required. A fibre or spring washer is placed against the wafers, and nuts holding them should not be overtightened. Those switch contacts which will lie near the underside of the chassis cannot be reached when the box is fixed, so solder on leads which can join those to pass through chassis holes to the ganged tuning capacitor. Also solder on leads for the three wavebands where the contacts will be near the chassis, and for the tags which short all unused coils to the chassis.

The box is then arranged on the chassis, with leads passing through and is bolted. The ganged capacitor, mixer, oscillator and aerial circuits can then be wired. When this has been done, replace the oscillator and mixer grid coils for one band. Place the switch in the correct position, and check that proper results are obtained.

Coil and switch connections can be more readily checked if a different coloured wire, or sleeving, is employed for each band. For example, blue for

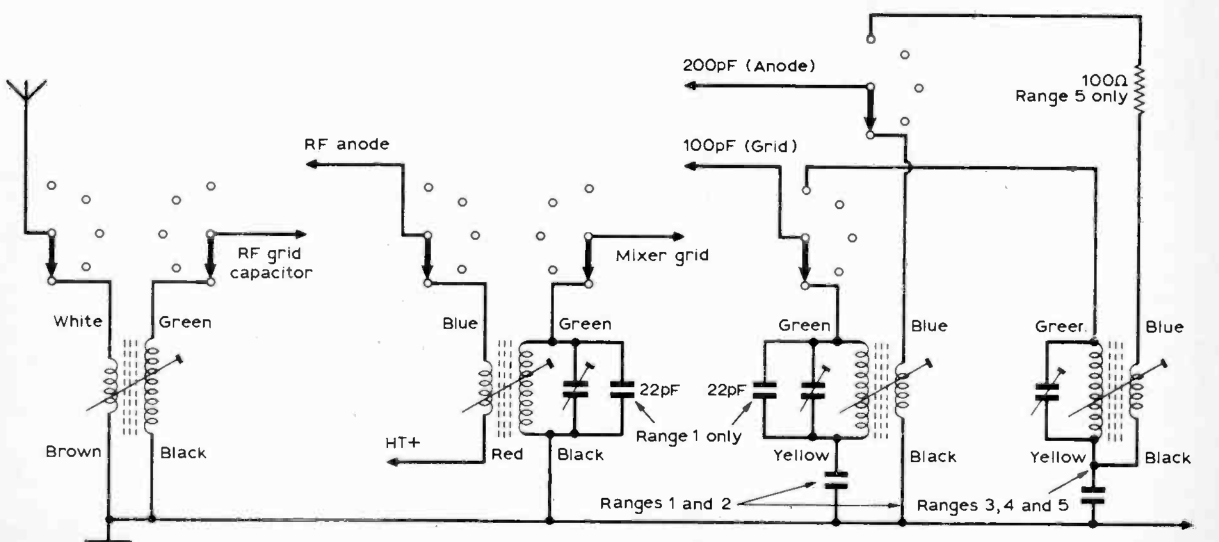


Fig. 5: The skeleton circuit of the r.f. and oscillator coils. Note the wiring differences in the oscillator section between ranges 1 and 2 and 3, 4 and 5.

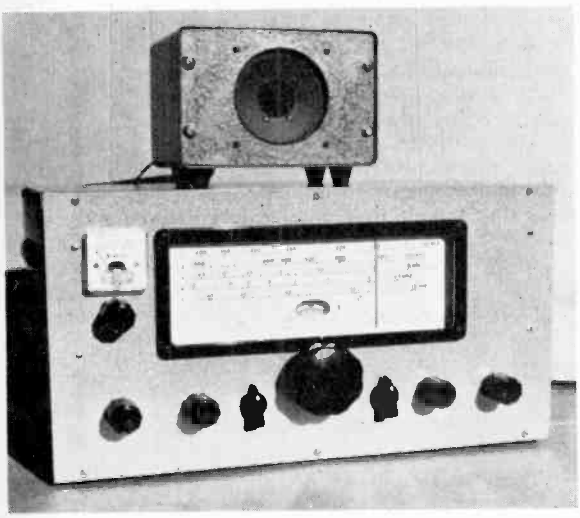
all long wave coil leads from switch to coils, yellow for all medium wave leads, and so on.

Coil Wiring

Note that for long and medium bands (ranges 1 and 2) the oscillator feedback windings go to the chassis, but with ranges 3, 4 and 5, these are joined to the tuned windings and padders. Mixer grid and oscillator coils are placed so that the cores can be reached from above with the correct tool. These coils have small trimmers already fixed and these are reached through the holes in the 6 × 5in. plate, as described. (The aerial coils have no trimmers, the cores are reached through the cover plate holes.)

It is best to wire m.w. coils (range 2) first, followed by l.w (range 1), then ranges 3, 4 and 5, in that order. Range 4 and 5 coils are immediately adjacent to the switch wafers, so if wired first the switch tags are not easily reached for other bands.

Leads from the ganged capacitor rotor contact tags are connected directly to two tags bolted to the chassis. These bolts also secure tags under the chassis which are used as earth return connecting points for the h.f. coils. These leads need to be short and those in the switch and grid circuits are also short and away from earthed items, if not, the upper frequency limit may not be reached on band 5.



The completed receiver with the loudspeaker mounted on top.

The specified l.w. padder is 110pF, but correct alignment was found possible with either 100pF or 120pF. Note that the oscillator and mixer l.w. coils each have a 22pF or similar fixed capacitor in parallel with the trimmer. These are necessary, for the h.f. end of this band falls near the receiver i.f. of 460kc/s.

The band 5 oscillator coil has a 100Ω resistor in series with the feedback winding. It is wise to mark the range numbers on the coil box plate for later identification when aligning. Test the receiver on each waveband, when the coils for it have been connected to the switch, Fig. 5 shows the coil circuitry.

Next Month: Aligning the receiver and adding the R.F. Stage, the extra I.F., the S-Meter and the B.F.O.

THE MW COLUMN

THE North American path opened up late in November after a period of unsettled reception during the autumn. Conditions were outstanding during the early hours of 1st December. WOAI (1200) San Antonio, Texas, was clear and steady at 0240hrs GMT, WLS (890) Chicago was weak while KMOX (1120) St. Louis was fair at 0300hrs. Tentative loggings were made of WLW (700) amid strong QRM and of KOMA (1520) Oklahoma City behind WKBW. Conditions were still good in mid-December (the time of writing). Among the better loggings during this period were WGN (720) Chicago; tentative; WSB (750) Atlanta, Georgia; WJR (760) Detroit, *"The Great Voice of the Great Lakes"*; WGY (810) Schenectady, N.Y.; WCFL (1000) Chicago; CFRB (1010) Toronto; KDKA (1020) Pittsburg; CKBL (1250) Matane, Quebec. Stations heard consistently at good strength were CBN (640); WNBC (660); WABC (770); WCBS (880); WINS (1010); CBA (1070); WBAL (1090); WKBW (1520); WQXR (1560). Two US stations have changed their callsigns recently. WAVY (1350) is now WCVU while WZOK (1320) has changed to WVOJ.

Other North American and Caribbean loggings were Godhavn, Greenland (650); CMGN (720) *Radio Rebelde*, Cuba; *Radio Belize* (830) British Honduras; ZBM-1 (1235) Bermuda; WBMJ (1190) San Juan, Puerto Rico, in English; WMDD (1480) also in San Juan, in Spanish. Little of note was heard from South America, probably because of the predominance of signals from the north. The only loggings were SRS (725) Surinam and HJDK(750) Medellin, Colombia, relaying the Caracol programme.

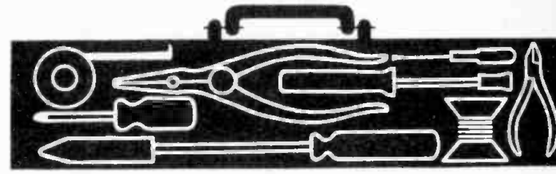
Local radio is well established in Spain, every main town possesses at least one low power commercial station. There are four major networks operating groups of stations under the callsign prefixes EFE, EFJ, EAJ, ECS, CES. There are also a number of high power regional stations run by the Government (RNE). The commercial stations—there are about 150 of them scattered across the country—can be a source of interesting DX to the newcomer to the MW band. Stations to look for are: EA17 (800) *Radio Madrid;* EAJ5 (809) *R. Seville;* EAJ1 (827) *R. Barcelona;* EAJ101 (872) *R. Zaragoza;* EAJ8 (1025) *R. San Sebastian;* EFE14 (1097) *La Voz de Madrid;* EAJ3 (1259) *R. Valencia;* ECS1 (1385) *R. Centro;* EAJ28 (1412) *R. Bilbao.* The shared channels—1133, 1394, 1412, 1475 are interesting after midnight when stations close down in succession, generally with full identification. Some rare catches can sometimes be made under these conditions.

Youthful reader Alan Mercer of Wigan, Lancashire sends in a log of recent DX which includes WINS, WBAL, CBA and KMOX. Well done, Alan, welcome to MW DXing. Alan, aged 12, is probably our youngest medium wave enthusiast. Can anyone claim to be the oldest? It would be interesting to hear from someone with experience of MW DXing in the early days of radio. **CHARLES MOLLOY**

repairing radio sets

PART 3 (Third Series)

REPAIRING THE UNKNOWN SET



H. W. Hellyer

WE are faced with the unknown set and a damaged transformer. The next question is: 'What do we use to replace it?' And it is no use quoting matching formulae to us, for the shop down the road sells us a multi-ratio job designed to match anything to anything else. Which ratio to use?

First, we need to know the loudspeaker impedance. This will normally be about one-third to a half more than the measured d.c. resistance. Remember that impedance is an arbitrary figure, varying with frequency, and normally taken at 800 to 1,000 Cs. Our task is made considerably easier by the habit of manufacturers to keep within the brackets of 3, 7·5 and 15 ohms. Next, we need to know the output impedance of the valve. Recourse to valve tables is the correct way, but, of course, we have left the valve tables behind, so we need to remember a few popular values and relate our experiments to these. The table below gives anode impedances, anode currents and voltages of some common valves, with the transformer load impedances and ratios for 3 and 15 ohm loudspeaker speech coil matching. Remember that the higher the anode impedance, the more exact the match should be, but to make this less critical, and improve matters all round, some negative feedback can always be added.

				Turns Ratio	
Valve type	Va.	Ia.	Ra. Load	3Ω	15Ω
ECL80	200	17·5mA	11k	60:1	28:1
ECL82	250	28	9k	55:1	25:1
ECL83	200	27	7.5k	50:1	22:1
ECL86	250	36	7k	48:1	22:1
EL34	250	100	2k	22:1	10:1
EL84	250	48	4·5k	38:1	18:1
EL95	250	24	8k	62:1	22:1
ELL80	250	24	10k	58:1	25:1
UCL82	200	35	5·6k	42:1	20:1
UCL83	170	30	5·5k	42:1	20:1
UL41	200	45	4·3k	38:1	18:1
UL84	200	60	2·4k	30:1	15:1

Turns ratio $= \sqrt{Z_1/Z_2}$ where Z_1 = anode impedance and Z_2 = loudspeaker impedance

Commonly used output valves giving typical working conditions and output transformer ratios.

Two small practical points: the output transformer is an electro-magnetic device and can contribute greatly to your hum problems unless you (a) mount it in the same plane and with the same axis as the old one, and (b) make sure the clamp has a good earth contact and is tight. Second point: in accordance with Henry's First Law, as I once heard it described, "the fixing holes of the new component will never line up". Do not be tempted to mount it precariously with a single screw; neither, I implore you, drill holes in the loudspeaker casting for a new fit. (In accordance with the Second Law, "the swarf will always descend to the least accessible place".)

The correct method is to cut a piece of metal long enough to encompass the transformer base or mounting bracket, whichever is the greater, then drill this so that it can be mounted on the speaker, with the new transformer screwed to it and thus taking up approximately the same position as the old. This is to assume that the transformer is mounted, as so often, on the speaker casting. If it is on the main chassis, all that is needed is a new fixing hole.

TRANSISTORISED OUTPUTS

Test procedures around the output stages, and throughout the audio section of the set, have been adequately covered in previous articles. But before leaving the subject, it is perhaps wise to insert a warning again about transistorised output stages. Except on the higher quality audio amplifiers, protection circuits will not be fitted—they are too expensive. The loudspeaker then, if it fails, needs replacing with one of exactly similar impedance unless one is prepared to alter the circuit to suit the new one. Quite a few of the earlier "little-uns" had transformer output stages, and speakers will usually be 3-8 ohms and matching is not quite so critical. But with many transformerless output stages, the impedance of the transformer is a vital part of the current balance of the stage, and reducing it from the 25 ohms or more that was often used will result in transistors over-running.

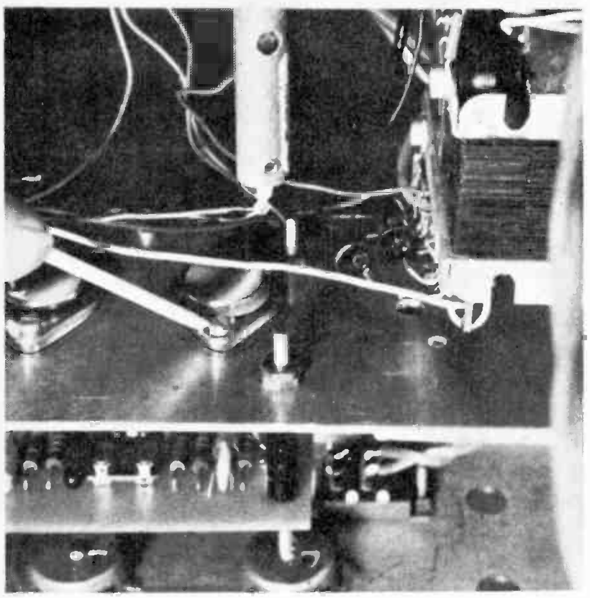
For the same reason, the adding of an extension loudspeaker by paralleling with the old one is not a feasible proposition. As we have already seen, it is fairly common practice to fit an earphone socket which will usually isolate the internal speaker. If we know the impedance, or can work it out, then an external loudspeaker will almost invariably improve matters.

On the subject of protection, some readers have asked about the simple matter of fusing the common line of the output stage, especially of the transformer type of circuit, usually Class B. This is in order as long as it is remembered that even a fuse has resistance and signal currents cause a varying current to flow through it, which can upset the bias if we are not careful. The answer is to tap off the bias equalising resistor from the "inner" end of the fuse, that is the negative voltage end. This resistor, which limits the base-emitter current, is vital for prevention of crossover distortion—a prevalent fault with these circuits.

Output transistors, especially in these push-pull circuits of older design, tend to run hot. They should be adequately heat-sinked (if that term may be excused), but there may still be some doubt about the ambient temperature. One particular car radio had a high incidence of output transistor failure simply because it was a convenient size to mount under dashboards and in glove compartments where there was not adequate ventilation or where the air-stream from the heater did an unnecessarily good job in warming up the back of the set.

For added heat dissipation in unavoidable locations, a coin taped to the collector casing can sometimes make all the difference. Before halfpennies get out of date completely, you might consider this additional use for them—they won't buy much, so may as well earn their keep.

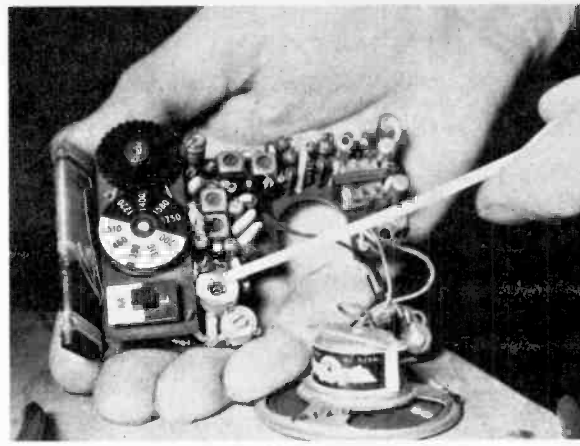
Again, the insulator between collector (i.e. transistor casing), and chassis has to be a good heat conductor; this is imperative. Mica is often used, or some form of plastic that is fine enough to



Good heat conductivity is essential for power output transistors. Check that fixing screws are correctly insulated from chassis by sleeves and washers when remounting. Outer case is the collector.

afford good heat conduction yet still able to act as an insulator. It is rather easy to damage—or even lose when the transistor is removed from its mounting. If no mica is available—and this material has a habit of being generously abundant when not needed—then a piece of thin varnished cambric, such as is used for transformer protection, may do the job quite well, and is easily cut to shape. When fitting this, and also when fitting the mica after handling, make sure the surfaces are clean, and smear a thin layer of silicon grease over the heat-sink, this helps heat conduction enormously.

Of the i.f. and frequency-changer sections of the receiver, little remains to be said. The problem when tackling an unknown set is to identify which is which! Layout of a transistor radio seldom follows any given pattern, being a matter of production convenience, and valved sets are more and more turning to unit panel designs. So the best bet is to trace



Oscillator coils can usually be identified by different construction, mounting or colour coding. Note in this picture the use of a simple slide switch of the type described in the text.

from the tuning capacitor, remembering that the oscillator coil is likely to be identified by a colour spot and will have a switch connection, whereas the i.f. transformers will be interstage units whose connections can generally be traced directly to the succeeding transistor.

Aerial circuits and the practical aspects of both rod and external aerials have been treated pretty fully and should need no further remarks from me. From the practical point of view, one has only to identify the coils of the rod aerial, remembering that the more turns the higher the wavelength (lower frequency), then patiently trace through the switch circuits, there are no real short-cuts. But on the contrary, much time can be lost if one omits to make a rough sketch of connections, colour codes, layout, and so on when removing multi-connection components. I speak with feeling, having had to rebuild many pieces of equipment thus butchered.

TRANSISTOR SUBSTITUTES

Unlike valves, whose equivalences are well documented, transistors fall into less neatly defined categories. There are several substitute lists, hedged about with provisos, but as is the way of life, the particular transistor we wish to replace will never be mentioned (Third Law?). Our correspondence shows that readers get a bit worried about the Japanese and American types with strings of apparently meaningless numbers as their only identification.

First thing to determine is what the function of the transistor may be, and whether it is an n-p-n or p-n-p device. The stage of the receiver gives us the first clue and voltages will tell us the second fact. All the popular bases have been given in previous articles and wall charts, and the collector and base connections will be identifiable. If the collector is negative to the base, the transistor is p-n-p, and if positive to the base, n-p-n.

Next, we need to know something about ratings. Maximum collector-base voltage is one of the limiting factors, and the circuit voltages will give us a clue. Most designers keep well within this rating, and our replacement needs to have a V_{CB} greater than the measured voltage. Collector current must also be great enough to be safe, and this is not so easy to determine if—taking the gloomiest view—

the transistor we wish to replace is not conducting at all to give us a clue. The collector voltage will then, of course, be equal to the rail voltage. The collector load is our next clue. If we work out what current through this load would drop the collector volts to about two-thirds of the rail voltage, this again should give us a clue.

TRANSISTOR RATINGS

Total dissipation is the next factor, and here we are limited to common sense. Obviously, we are not going to try an a.f. driver with a P_{tot} of 50mW in place of a silicon planar device with a 300mW rating, or an output type of 6 watts power dissipation. Again, intelligent assessment of the stage of the receiver will be needed.

For radio frequency types, the f_T rating will also be important, and again we need to know what the circuit is expected to do. Luckily for us, most of the germanium alloy-diffused types are quite generously rated, and mixer-oscillators for a.m. receivers with an f_T figure of 75Mc/s are well within specification for our substitution. Even those designed for i.f. amplification will have an f_T of 30Mc/s or more. But for f.m. oscillators, we need to be more careful. The important thing to remember is that lead length at these higher frequencies plays its part and our replacement may tend to be unstable. If so, reduce the value of the emitter bias. Often, this will be derived from a pair across the voltage line, and in this case, the upper resistor should be changed. The emitter feedback capacitor may also need changing to suit our new transistor. This is a matter for trial.

Likewise, the i.f. transistors are substituted in f.m. receivers, the upper resistor of the emitter bias network may be increased to reduce bias, but this reduction should not be to less than half of the value first noted. If instability persists, check the neutralising capacitor (not always fitted on later receivers), and experiment with values near the original. As a final expedient, damp the i.f. coil with a resistor across it; value again a subject for experiment.

FAILURE TO OSCILLATE

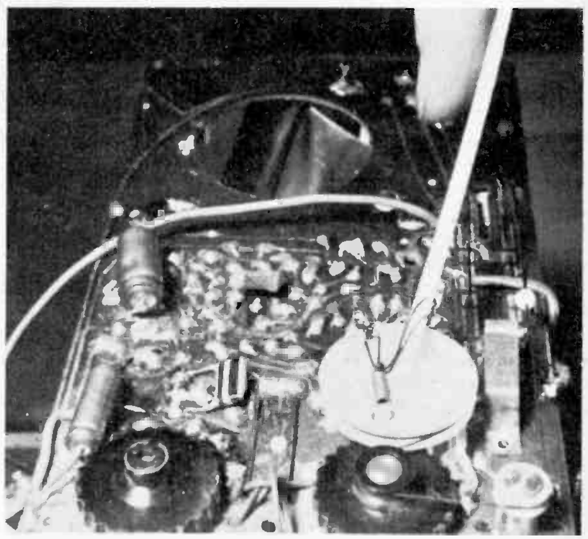
With a.m. mixer stages, the usual trouble is a reluctance to oscillate. This may indicate we need a little more emitter current, and a compromise between no oscillation and squegging will have to be reached. If there is no leeway, and squegging persists, reduce the emitter decoupling capacitor or even, in desperation, damp the oscillator tuned circuit with a resistor.

It may seem a retrograde step to fit a neutralising capacitor where a designer has managed to do without it, but we are plunging into the unknown and are forced to "suck it and see". Gordon King has dealt with these components, and there is no need for me to draw out details of the circuitry. A value of between 1 to 10pF should do the trick. More than this will indicate we need try another transistor. But before admitting defeat, try the transformer damping trick also, especially with i.f. stages.

CORD DRIVE SYSTEMS

Finally, a purely practical point. In the fourth article of the original series, way back in April 1967,

A quick test for noisy components is a squirt of freezer from an aerosol.

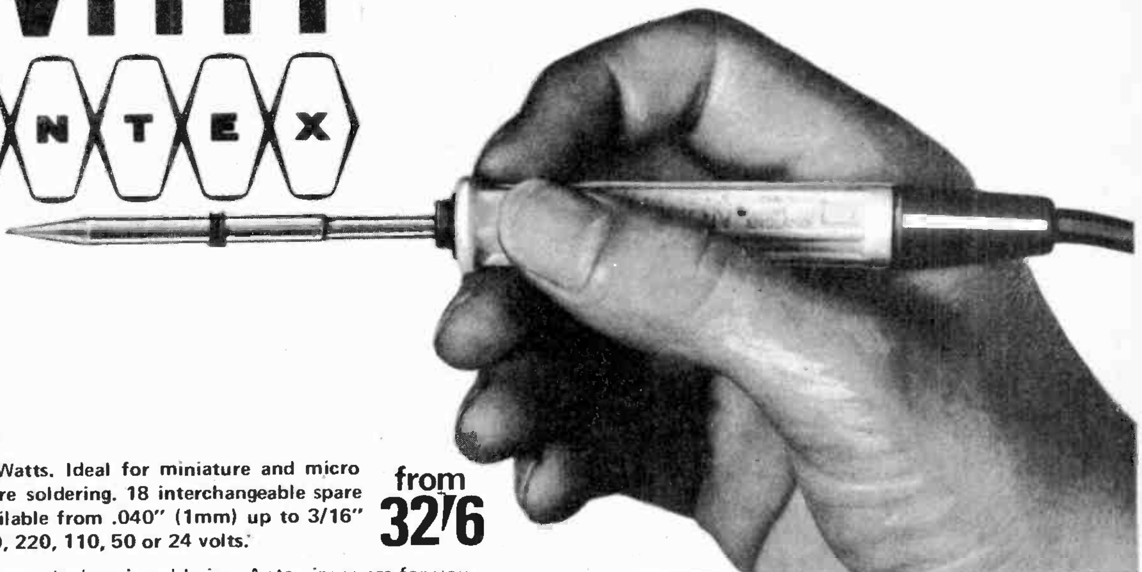


Even the simplest of drive cords can be troublesome if spring tension is lost or the wrong relationship of drum to spindle prevents sufficient cord 'wrap' to turn the drum at the end of its travel. Note that in this view, the slide switch has been removed to show printed circuit connections (right of P.C. board).

I gave as much advice as I could muster about the fitting and adjustment of drive cords, and included a few typical diagrams. Correspondence shows that readers are often faced with the problem of restringing a drive cord with no clue at all as to its run or the desired number of turns around spindles and drums. To help matters somewhat, I include a few typical drive cord systems, drawn in the flat dimension to show cord run and spindle and drum turns. From these, it should be possible to work out a clue, even if the exact type is not depicted.

Indeed, that has been the purpose of this whole series of articles, and I am sure my colleague Gordon King will join with me in expressing the hope that they have proved helpful in solving some of the ticklish problems of radio repair, both theoretical and practical. ■

SOLDER ON WITH ANTEX



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OAZ210 7/-
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OC29 23/6
OC30 5/-
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OC36 7/6
OC38 11/6
OC41 10/-
OC42 6/9
OC43 23/6
OC44 2/-
OC44PM 8/3
OC45 1/9
OC45M 8/-
OC46 3/-
OC65 22/6
OC70 2/3
OC71 2/-
OC72 2/-
OC73 16/-
OC74 2/6
OC75 2/-
OC76 2/6
OC77 2/6
OC78 3/-
OC78D 3/-
OC79 3/-
OC81 2/-
OC81D 2/-
OC81M 5/-
OC82 2/3
OC82D 2/3
OC83 2/-
OC84 3/-
OC123 4/6
OC139 12/-
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OC170 2/6
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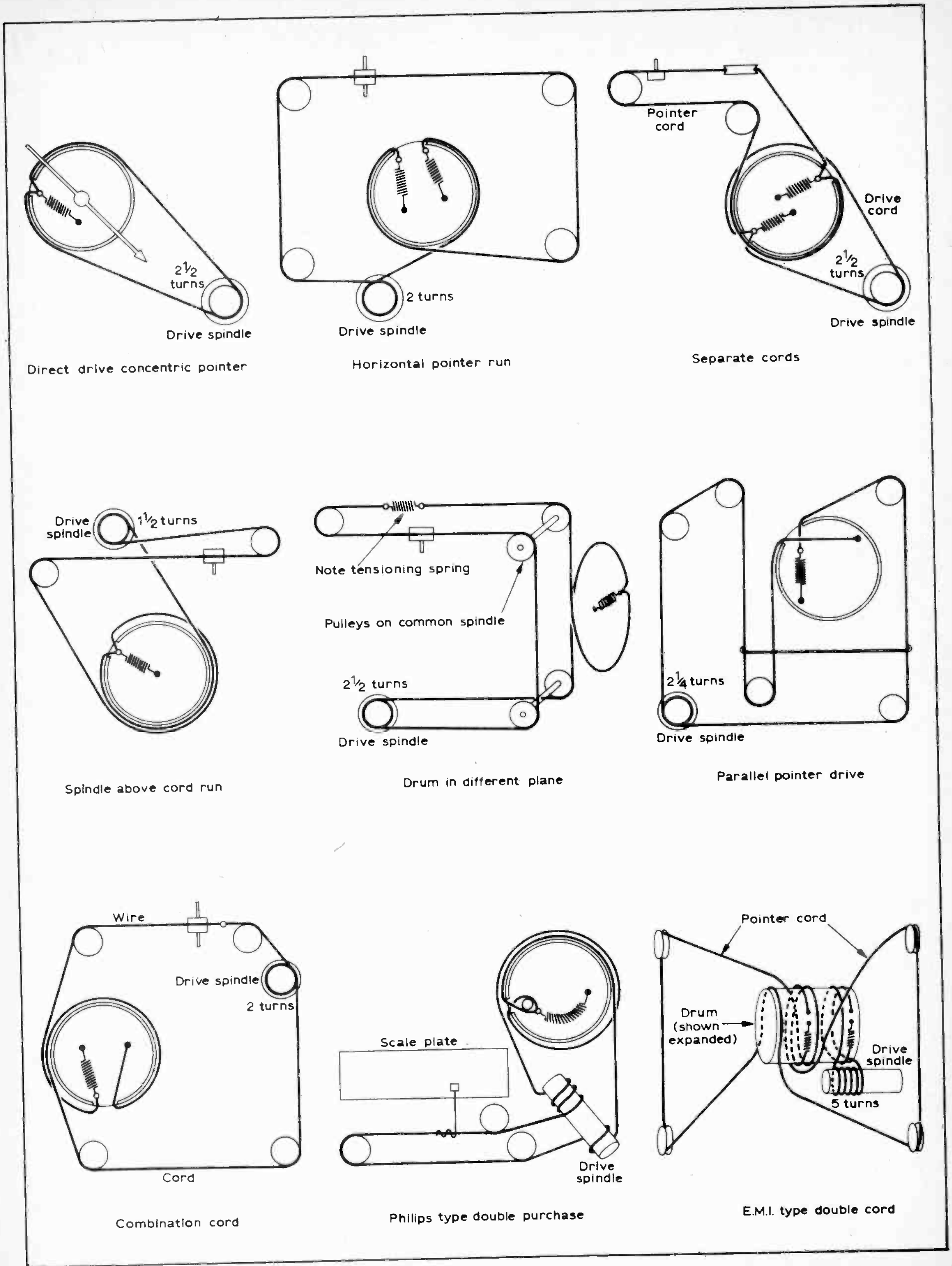

Fig. 11: Collection of cord drive systems from popular receivers, old and new. Note the importance of correct number of turns around spindles, drums, etc., and relative direction of cord run to main gang.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

WITH the winter now coming to an end and spring around the corner this is the time of the year to hear stations in the Pacific area and Far East in the mornings and afternoons. But now here are this month's propagation conditions.

West Africa: 0800-1400 25, 21, 17 and 15Mc/s; 1400-1600 25, 21, 17, 15 and 11Mc/s; 1600-1800 25, 21, 17, 15, 11 and 9Mc/s; 1800-2000 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2000-2200 17, 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 2200-2400 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 2400-0400 11, 9, 7, 6, 5, 4 and 3Mc/s; 0400-0600 9, 7, 6, 5, 4 and 3Mc/s; 0600-0800 15, 11, 9 and 7Mc/s.

South Africa: 0800-1400 25, 21 and 17Mc/s; 1400-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15 and 11Mc/s; 1800-2000 17, 15, 11, 9, 7 and 6Mc/s; 2000-2200 15, 11, 9, 7, 6, 5 and 4Mc/s; 2200-0200 11, 9, 7, 6, 5 and 4Mc/s; 0200-0400 11, 9, 7, 6 and 5Mc/s; 0400-0600 11, 9 and 7Mc/s; 0600-0800 17 and 15Mc/s.

East Africa: 0800-1200 25, 21, 17 and 15Mc/s; 1200-1400 25, 21, 17, 15 and 11Mc/s; 1400-1600 25, 21, 17, 15, 11 and 9Mc/s; 1600-1800 21, 17, 15, 11, 9, 7 and 6Mc/s; 1800-2000 17, 15, 11, 9, 7 and 6Mc/s; 2000-2200 11, 9, 7, 6, 5 and 4Mc/s; 2200-0200 11, 9, 7, 6, 5 and 4Mc/s; 0200-0400 9, 7, 6 and 5Mc/s; 0400-0600 11 and 9Mc/s; 0600-0800 17, 15 and 11Mc/s.

South Asia: 0800-1200 25, 21, 17 and 15Mc/s; 1200-1300 25, 21, 17, 15, 11 and 9Mc/s; 1300-1400 21, 17, 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 1400-1600 17, 15, 11, 9, 7, 6, 5, 4, and 3Mc/s; 1600-1800 11, 9, 7, 6, 5, 4 and 3Mc/s; 1800-2000 11, 9, 7, 6, 5, 4 and 3Mc/s; 2000-2200 9, 7, 6, 5, 4 and 3Mc/s; 2200-2400 7, 6, 5, 4 and 3Mc/s; 2400-0200 7, 6, 5, 4 and 3Mc/s; 0200-0400 7 and 6Mc/s; 0400-0600 9Mc/s only; 0600-0800 17, 15 and 11Mc/s.

South East Asia: 0800-1000 25, 21 and 17Mc/s; 1000-1200 25, 21, 17 and 15Mc/s; 1200-1400 25, 21, 17, 15, 11 and 9Mc/s; 1400-1600 21, 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 1600-1800 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 1800-2000 11, 9, 7, 6, 5, 4 and 3Mc/s; 2000-2200 9, 7, 6, 5 and 4Mc/s; 2200-2400 9 and 7Mc/s; 2400-0600 circuit closed; 0600-0800 17 and 15Mc/s.

North East Asia: 0700-1000 21, 17 and 15Mc/s; 1000-1200 15 and 11Mc/s; 1200-1400 11 and 9Mc/s; 1400-2000 9Mc/s only; 2000-0600 circuit closed; 0600-0700 15Mc/s only.

Australia via Asia: 0700-1000 21Mc/s only; 1000-1200 17Mc/s only; 1200-1400 17, 15, 11Mc/s; 1400-1600 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 1600-1800 11, 9, 7, 6, 5, 4 and 3Mc/s; 1800-2000 9, 7 and 6Mc/s; 2000-0700 circuit closed.

West Coast South America (North of Chile): 1200-1800 25 and 21Mc/s; 1800-2000 21 and 17Mc/s; 2000-2400 15Mc/s only; 2400-0400 11 and 9Mc/s; 0400-1000 9Mc/s only.

Now on to this month's DX-tips, but first please note that on Sunday, 2nd March, most international stations will change over to spring/autumn schedules and information in this column will be liable to alteration on that date.

AUSTRALASIA

New Zealand: *Radio New Zealand* is now operating to the Pacific Isles from 1700-1945 on 11,780 and 9,520; 2000-0545 on 15,110; 0600-0800 daily on 11,780 and 9,540; 0800-0845 weekdays on 11,780 and 9,540; 0800-0845 Sundays on 11,780 only. To Australia from 2000-0545 on 17,770; 0900-1145 on 11,705 and 9,520. To the Antarctic on Sundays only from 0815-0845 on 9,520.

AFRICA

Ruanda: *R. Deutche Welle* relay at Kingali is now operating as follows. To East Africa and Central Africa from 0300-0530 on 9,565; 1015-1045 Sundays only on 11,785; 1045-1145 daily on 11,785; 1415-1445 on 15,435; 1500-1730 on 9,735. To West Africa from 0545-0745 on 11,905; 1200-1400 and 1745-2015 on 17,765; 2030-2325 on 15,380.

EUROPE

Denmark: *Voice of Denmark*, Copenhagen, is now on the following schedule. 0730-0845 on 15,165; 1015-1030 Saturdays only on 9,520; 1030-1100 Saturdays and Sundays on 9,520; 1100-1145 Sundays only on 9,520; 1130-1315 on 15,165; 1330-1345 on 15,165; 1400-1515 on 15,165; 1730-1815 on 15,165; 1830-1945 on 15,165; 2100-2215 on 15,165; 0100-0215 on 9,520. English is broadcast for last 30 minutes on weekdays only 0730, 1200, 1400, 1830 and 0100. The 1015 and 1030 transmissions at weekends are all in English. On weekdays the last 30 minutes of the 2100 transmission is in Spanish.

MIDDLE EAST

Israel: *Kol Israel*, Jerusalem, is now operating as follows: 1530-1600 Russian, 1600-1630 in Yiddish, 1630-1700 in Persian, 1700-1730 Russian, 1730-1745 Hungarian, 1745-1800 Rumanian, 1800-1815 Ladino, 1815-1830 Mograbit, 1830-1900 Yiddish, 1900-1930 Hebrew, 1930-2000 in Russian, all on 9,725 and 9,009. 2015-2030 on 9,725 and 9,009; 2030-2045 on 9,725; and 2045-2100 on 9,725 and 9,009 in English; 2100-2130 in French; and 2145-2200 in Russian on 9,725 and 9,009.

Well that's about it for this time. Deadline this month is 10th February, so good DX-ing and 73s.

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BC 109	3/6	BC 182L	4/–	2N 706A	3/2	2N 3706	3/7
BC 115	10/–	BC 183L	3/3	2N 2926	2/6	2N 3707	3/10
BC 116	12/–	BC 184L	4/9	2N 3053	6/–	2N 3708	2/6
BC 167	3/–	BFY 50	5/3	2N 3054	15/6	2N 3709	2/4
BC 168	2/6	BFY 51	4/4	2N 3055	21/–	2N 3710	2/7
BC 169	2/9	BFY 52	5/3	2N 3391A	7/–	2N 3711	3/–
BC 170	3/–	BFY 53	4/4	2N 3702	3/6	2N 3793	3/3
BC 171	3/8	BSY 95A	3/9	2N 3703	3/2	2N 4292	3/3

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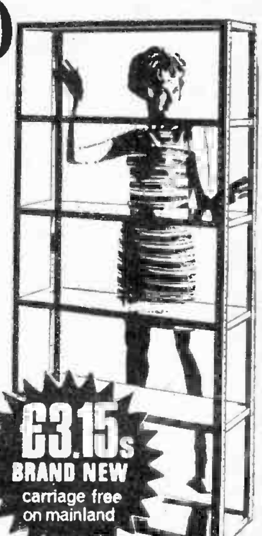

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THE AMATEUR BANDS by DAVID GIBSON, G3JDG

MY thanks this month to the eighteen thousand s.w.l.s, ironmongers, watercress pickers and everyone who has written in to inform me that LG5LG is legit. Please fellas, I'm convinced.

Each year a new flock of people arrive at the s.w.l. door armed with various types of receivers and antennas. Judging by the many queries raised in the mail this month, the invasion is already in full swing. In answer to the commonest inquiries—you can obtain a list of countries and their prefixes from the RSGB at 35 Doughty Street, London W.C.1. There is no such thing as "the best aerial". The "best" receiver is a matter of opinion, although there are some very nice solid state marine receivers going these days—for around £800.

If you want the latest news on the Amateur scene with the accent entirely on Ham Radio, then you should listen out every Sunday morning when the RSGB transmit a bulletin especially for this purpose. These transmissions are on 80 metres and 2 metres. Exact frequencies and times are as follows: South-East England, listen at 0930 hrs. on 3·6 Mc/s or for the station in the S.E. beaming North on 145·1Mc/s at the same time; at 1000 hrs., a station in the Severn area on 3·6Mc/s and also on 145·1Mc/s beaming West. Also at 1000 hrs., there is a 2 metre station at Aberdeen beaming West on 145·8Mc/s; at 1030 hrs., on 3·6Mc/s the Midlands is covered while at the same hour, two stations on 2 metres are—Aberdeen, beaming South-West and Birmingham on 145·3Mc/s beaming North-West; for North-West England listen at 1100 hrs., on 3·6Mc/s or on 145·3Mc/s for a signal from the Birmingham area beaming South-West; at 1130 hrs. (they get up later up North), there is a 145·5Mc/s Leeds signal beaming North and a 3·6Mc/s transmission for South-West Scotland; finally, at 1200 hrs., a transmission for North-East Scotland on 3·6Mc/s and a 145·5Mc/s transmission from Leeds beaming East. Thus the whole of England is covered and you should be able to hear one of these signals. The call sign to listen for is GB2RS.

For those who haven't heard, they're mucking about with the callsigns again. The PJ prefixes have been given a shuffle (Netherlands Antilles) so they now read: special stations—PJ1; Curaçao—PJ2; Aruba—PJ3; Bonaire—PJ4; St. Eustacius—PJ5; Saba—PJ16; Sint Maarten—PJ17. Visitors to islands with a PJ5, 6 or 7 prefix will use PJ8, while visitors to PJs 2, 3 and 4 will use PJ9. Wonder what prefixes will be given to those "novice licences" which the GPO were rumoured to be giving a ruling on last year? I suggest the prefix TVI or BCI might be a sensible choice (even my transistor grid-dipper can flatten channel one right down the road if I'm not careful.

A very good month for all six bands although, as usual, some periods were better than others. Twenty metres dies the death at around 2100hrs., while 10 metres has been very good but with its now established temperamental nature. My two best on this band were ZD9BE and VQ9DH both between 0900 and 1100 using phased verticals in the loft.

What about all these DXpeditions these days. Amsterdam Island, Chatham Island, Kerguelen and Tromelin were all rumoured to be waving antennas around but it seems that no one has heard an r.f. dickie bird from any of them, although a couple of PYØ stations were at it from Santa Barbara Island.

G. Taylor writes from S.W.6 and confesses envy at some of the logs printed. Some months I'm green too but that's just how it goes. Being able to read c.w. helps as often there's quite a bit of DX readable on key, while the phone signals are virtually impossible to interpret.

Messrs. **Littlefield** and **Sams** (Essex), query the call ZX3HX. Wonder if that might not be ZS misread?

John Moore (Leicester), tells of 80 metres opening up and 75 metres loaded with W and VE stations. John's log is a good illustration of persistence and keeness. You have to listen often and diligently and not just a quick QRX now and again expecting the DX to be there just waiting for the privilege of adorning your lugs.

John's log reads: 160 metres—EI7AF, GI6TK, GM3BQA, GW3SRG, OH5SM: 80 metres—K2AAS, K2MPK, LG5LG (I know, I know), OY2Z, PAØDX/M, W1EBC, W1SZJ/KP4, W3BMS, W4BUV, VE1AAW, VO1FG, ZB2A; 40 metres—EA8EC, IS1DMN/P, PX1BW (Andorra), ZC4MO, 9Y4TA; 20 metres—CE6EZ, ET3USA, HI3MPW, HP1HXG, K4PHY/YV5, LG5LG (nuff sed), OD5BU, OX5BA, PY7ACQ, TF3BV, VE3CBG, VO1HH, YV5AG, 5A3TE, 5Z4LG, 9K2AM, 9K2CF: 15 metres—EA6AR 9 (Majorca), JA2GES, KA2NY, MP4BGY, PY8YZ, TF2WLM, U1A (?), VE2AFC, VE3GHL, VK2FA, VK2XT, WØVXO/KV4, YA5RG, YN1UR1, YV1WX, ZF1EP (Grand Cayman Is.); 10 metres—ET3USA, HV3SJ, KR6NR, KV4AD, OD5FA, PJØMM, PZ1BI, VE2DJR, VE3CVX, W1—WØ, YA1HD, YV1LA, YV5CPA, 9K2BJ, 9Q5DS. All the log on s.s.b. and with a CR100/2 plus 60ft. end fed.

L. Boucher (Near Swansea), has a virgin 1155 and 75ft. of wire. Twenty s.s.b. produced audibilities from—CE8CP, CN8CS, CR6LF, CT2AA, EA6AR, EA7ID, EA8FM, EP2DA, KL7EBK, MP4TCE, OD5FM, PY1TX, PY5AJ, PJØCC, PZ1DF, SVØDD, TA3AR, VE5BF, VK2AZ, VK4PX, VK6XW, W6HYG, W7KQ, YV5BFK, ZB2A, ZB2BC, ZE6JM, ZL3LE, ZS1NU, ZS6OY, 3A2EE, 4X4HT, 5A3TX, 5A4TE, 7P8AR, 8P6CC, 9J2VX, 9K2AV, 9Y4VT.

R. Dinning (Ayrshire), HA350 and PR3OX, 380ft. long wire logged these on 10 metres s.s.b.—CR7FM, EP2JP, HR1JMS, HV3SJ, IS1GS, KP4AQX/KG6, KV4AD, LU6DRB, MP4BVX, VK6XX, YN1HSM, YN1GLB, 5A5TH, 9J2DT, 9K2CC, 9N1MM plus ". . . millions of JAs". Fifteen metres with the same set up raised—CT2AM, EL2BD, HR1JS, KG4AM, KG6ALY, KP4BCL, KR6JT, KV4FQ, KZ5WL, MP4MBB, OX3LP, TA3AR, VK2ADV, VK3SM, ZL1AJU.

Activities and happenings in February include: 15th—16th, topband contest; 16th, 4 metre fixed station contest: 22nd—23rd, YL/OM phone contest (see how many YLs you can log); March 1st—2nd, 2 metre contest.

ONE-SIXTY SUPERVERTER

A.S. CARPENTER G3TYJ

DESIGNED for "Top Band" mobile working in conjunction with a 12V transistorised car radio receiver, this rugged solid-state Superverter has proved to be completely satisfactory. Consuming but 3·5mA of current the prototype is so quiet in operation that under no-signal conditions one wonders if in fact it is operating. Doubt on this point is rapidly eliminated, however, on receipt of a signal!

The Superverter is designed to accept signals in the 160m. Amateur Band (1800-2000kc/s), converting them to a new frequency—1·6Mc/s or thereabouts—so that they may be heard on the car radio, the tuning of which is adjusted to the high frequency end of the Medium waveband. The car radio then performs as a second amplifier. The output from the unit could alternatively be fed to other types of receiver capable of being tuned around 1·6Mc/s subject to a point being located on the scale where no spurious unwanted signals break through.

Power can be in the form of a small dry battery—and adequate space exists in which to incorporate one—or the car battery may be used. Switchery for various operating modes will be included later.

Physical size is of importance in connection with items used for "mobile" usage and although dimensions associated with the prototype Superverter will be given these can be modified considerably to suit the needs of the individual.

The Superverter is not a "general coverage" design for the simplified tuning system adopted restricts frequency coverage to a few hundred kilocycles to provide a "one band" affair. Two bands could perhaps be catered for by introducing switching; an alternative method is to use plug-in coils. Plug-in coils—but rigidly located—are in fact embodied in the prototype Superverter and suggestions regarding other frequency bands will be given in a later article.

Although no 3-gang tuning capacitor is used the Superverter does employ an r.f. amplifier stage ahead of its mixer/oscillator stages. This is possible because the frequency bands available to radio amateurs are but 200kc/s or so wide overall and the phone section is considerably less. Top Band covers 1800-2000kc/s but few QSOs take place near the band edges.

The prototype Superverter cannot resolve single-sideband (s.s.b.) transmissions nor can c.w. be made intelligible since a b.f.o. is not fitted. The inclusion of a b.f.o. is not entirely a practical proposition, for "on the move" operators usually find it difficult to adjust the control to the correct point. Fortunately, on "Top Band", a.m. is used mostly for daytime QSOs.

Since the required i.f. output is approximately 1600kc/s, local oscillations generated by the Superverter in the range 3400-3600kc/s will supply the necessary product. The purist may prefer to fully tune the three circuits simultaneously (this entails use of a 3-gang variable capacitor) but the practical-minded find it more convenient to preset tune the r.f. and mixer stages around mid-band position—say 1900kc/s—and to tune only the oscillator over the necessary 200kc/s segment. This is the method adopted, the oscillator being tuned from the panel by means of a reduction drive legended "Tune".

Circuitry

The complete circuit of the Superverter is shown in Fig. 1 where TR1 is the r.f. amplifier with TR2 the combination mixer/oscillator. The emitter-follower, TR3, is included to isolate the i.f.t. secondary tuned winding from the associated receiver which is connected to socket SK2. Panel controls are associated with T1 (R.F. Trim), VC1 (Tune) and VR1 (R.F. Gain).

In order to strengthen signals receivable higher or lower in frequency than the 1900kc/s mid-band position the core of T1 is made adjustable from the panel. The safety diode D1 is only needed when a transmitter is being used nearby.

Plenty of decoupling is included and all values specified are as used in the prototype unit. The value of R11 is governed by the power supply to be used; a negative potential of 9V d.c. at TR3 collector is suitable and remembering that the unit requires about 3·5mA the value of R11 is easily calculated.

If improved selectivity and higher gain are desired TR3 can be used as an additional amplifier by adopting the final circuitry of Fig. 2 when an additional i.f. transformer (a Denco type IFT17) is required plus the other items as legended in the diagram.

Constructional

The prototype Superverter is made to stand on top of the car radio receiver with which it is used and is secured thereto firmly. All metalwork is of 18 s.w.g.

—continued on page 846

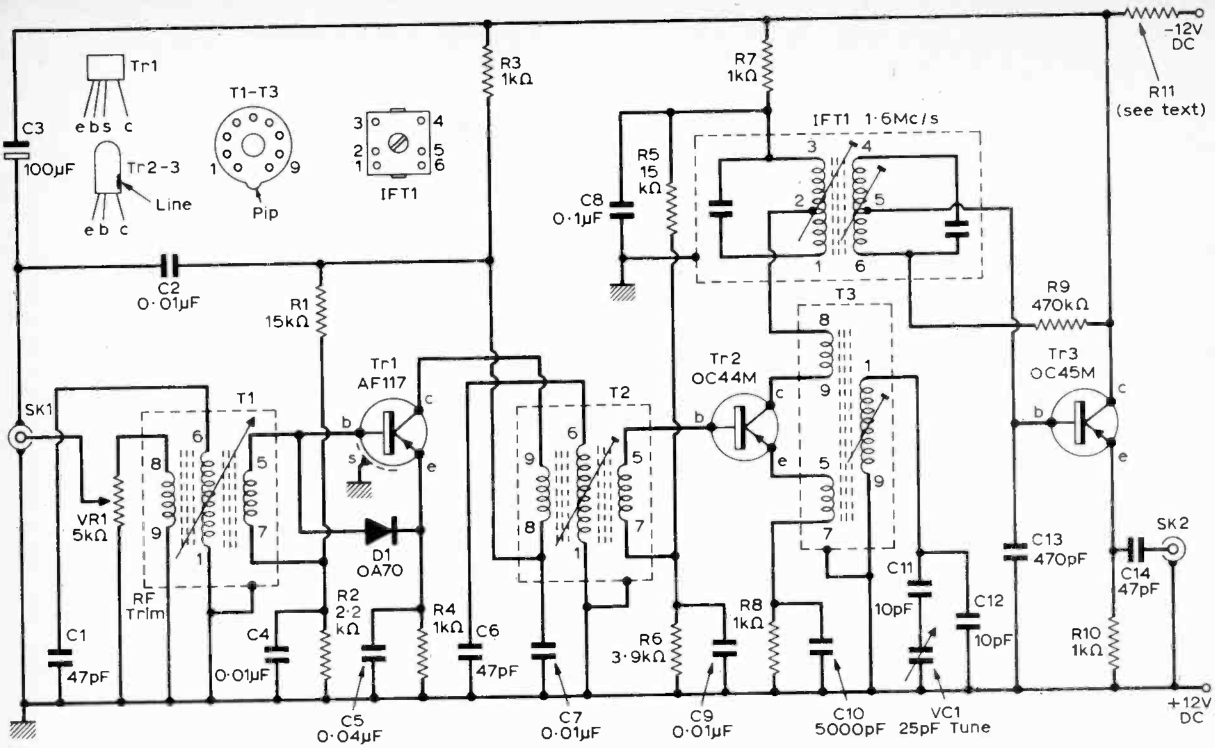


Fig. 1: The circuit of the Superverter.

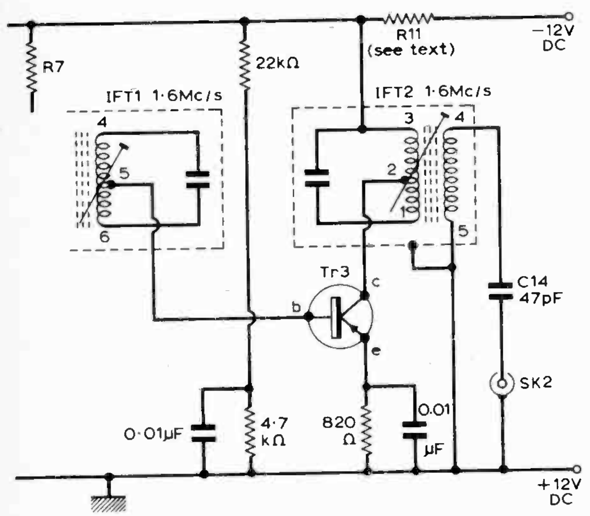


Fig. 2: An alternative output stage.

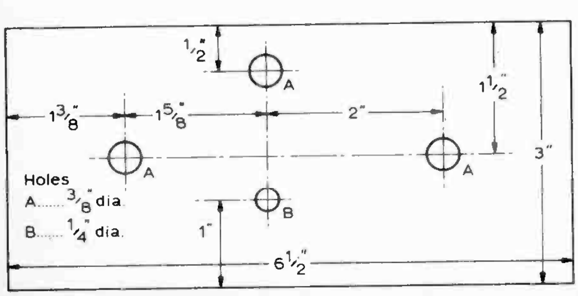


Fig. 3: Front panel dimensions.

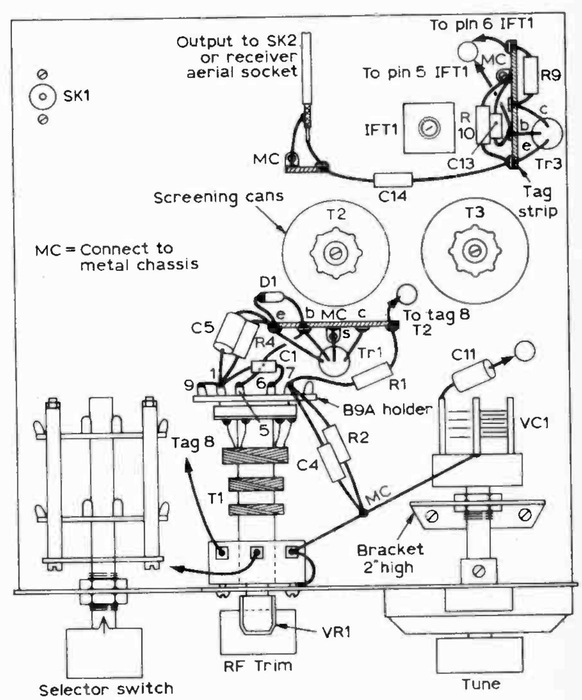


Fig. 4: Above-chassis layout and wiring details.

—continued from page 844

aluminium and front panel dimensions are given as a guide in Fig. 3. The top of chassis layout can be seen in Fig. 4 where the location of T1 should be noted, the coil being locked to the front panel with its brass core adjusting stem projecting and fitted with a brass bush to accommodate a small control knob. A Noval valve holder is then "push-on" fitted to the spills at its other end. All three coils are so designed that they may be plugged in to Noval valve holders and one holder is required for each. The selector switch shown will be mentioned later.

Essential dimensions of the main chassis are given in Fig. 5 which also shows the orientation of the two coil holders associated with T2 and T3. The screening cans associated with these two coils (these are the containers the coils come in) are not fitted initially. It should be noted that the chassis dimensions shown allow of no bends and front and back flanges should thus be added. The rear flange need be no more than ¾in. deep. A simple L-shaped bracket is also made to carry VC1.

The i.f. transformer is simply fitted by cutting a square in the chassis to afford a firm fit for the screening can without distorting it. The i.f.t. can is then pushed through the chassis a short distance and its mounting lugs bent *outwards* to be soldered to tags suitably positioned. Three small tagstrips are located as shown and wiring up carried out along the lines indicated.

All items used must be of modern design and miniature in type. Coil T1 can also be mounted vertically if preferred when a small variable capacitor may be panel fitted for peaking purposes and connected across its tuned winding.

The Coils

Ready-made coils are used and for the oscillator coil T3 a Range 2 "White" specimen is selected from the Denco range of transistor types. The inductance of this coil is approximately 66μH. At the mid-band position for an input r.f. signal of 1900kc/s the oscillator must be tuned to 3500kc/s for 1600kc/s output and a tuning capacitance of about 30pF is thus called for; components C11, C12 and VC1 are appropriate in value.

Denco Range 2 Aerial and Interstage coils (Blue and Yellow respectively) are also used for T1 and T2 but have to be modified since their inductance is too great. The coils are easily modified. A side view of the signal frequency coils is shown in Fig. 6, the aerial coupling winding being "A" plus a 2-pie tuned winding at "B" and "C". A transistor base coupling

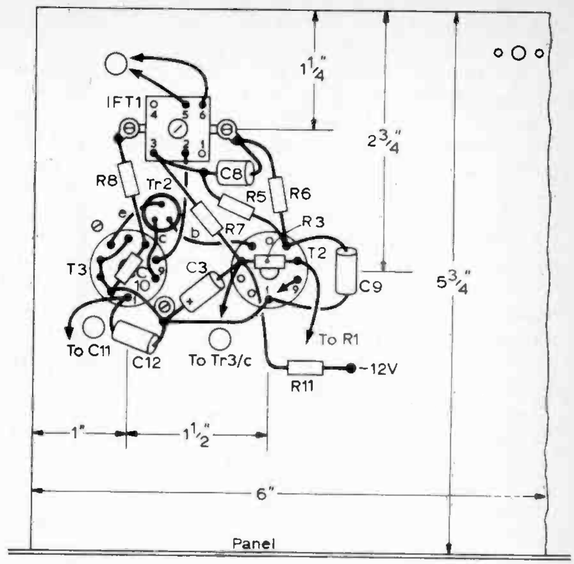


Fig. 5: Below chassis layout and wiring with dimensions.

★ components list

Resistors:

R1	15kΩ	R7	1kΩ
R2	2·2kΩ	R8	1kΩ
R3	1kΩ	R9	470kΩ
R4	1kΩ	R10	1kΩ
R5	15kΩ	R11	See text
R6	3·9kΩ	VR1	5kΩ pot.

All ¼ watt, 10%.

Capacitors:

C1	47pF ceramic	C9	10,000pF ceramic
C2	10,000pF ceramic	C10	5,000pF ceramic
C3	100μF, 15V	C11	10pF ceramic
C4	10,000pF ceramic	C12	10pF ceramic
C5	0·04μF paper	C13	470pF ceramic
C6	47pF ceramic	C14	47pF ceramic
C7	10,000pF ceramic	VC1	25pF trimmer type Jackson Bros. C804
C8	0·1μF		

Semi-conductors:

TR1	AF117	TR3	OC45M
TR2	OC44M	D1	OA70

Coils:
T1 Miniature Blue Transistor type Denco range 2
T2 Miniature Yellow Transistor type Denco range 2
T3 Miniature White Transistor type Denco range 2
See text for above three coils.
IFT1 Miniature transformer Denco type IFT18/1·6Mc/s.

Switch:
See text

Tuning Unit:
Vernier Drive, 2in.—Eagle T502

Miscellaneous:
Chassis and panel material 18 s.w.g. aluminium, Tagstrips (3), Noval valve holders (3), Control knobs (3), Coaxial sockets, etc.
Note: In cases of difficulty all items can be obtained from: Alpha Radio Supply Co., 103 Leeds Terrace, Wintoun Street, Leeds.

winding associated with spills 5 and 7 is not shown: this is wound on top of winding "B".

To modify the Blue and Yellow coils for 160m. band working the wire is cut free from spill No. 6 tag and turns are carefully removed from winding "C" without causing damage to connections running from winding "A" to spills No. 8 and 9. Turns are slowly removed until only one-quarter or slightly less of the winding remains when compared to winding "B". The loose end of the winding is then soldered to spill tag No. 6 after cutting off the wire freed. The precise number of turns left on the winding need not be known since the core is adjustable and affords compensation. It may be thought that the next coil "down" in the maker's range could be used unmodified and although this is true—using Range 3 Blue and Yellow coils—a large shunt capacitor is required across each tuned winding; the approximate capacitance value is 270pF. It should be noted that the Range 2 White oscillator coil specified for T3 must not be modified in any way!

The Yellow and White coils are each screened by means of the metal containers they are supplied in. These containers are cut off to a length of 1½in. as is shown in Fig. 7a; a ¼in. diameter hole is also cut as shown. The two coils are plugged in to their appropriate holders, the lock nuts removed and the containers inverted over them. The lock nuts are then screwed on thumb tight and a 6BA brass lock nut is screwed lightly on to each core stem. A length of twin nylon cord attached to a pair of small springs of the type used for cord drives is used to hold each container firm under all mobile conditions. The coils can, however, be easily removed very quickly if this is required. The mounting method is shown in Fig 7b.

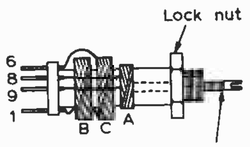


Fig. 6: Aerial and inter-stage coils.

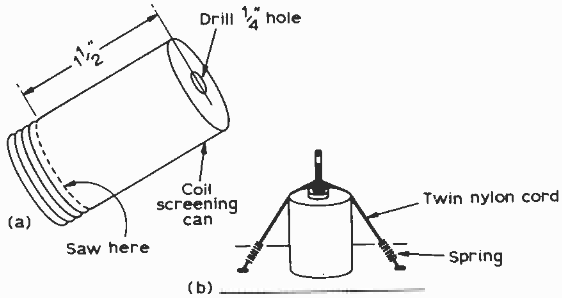


Fig. 7a: Screening can modifications; 7b: Mounting method

TO BE CONTINUED

YOUR ? QUESTIONS ANSWERED

Ripple Current

With reference to the higher voltage types of electrolytic capacitors and some obscurities that seem to exist. There seems to be no indication on the majority of them to indicate permissible ripple current. Is there any way by which this can be determined?—J. Wackett (Devon).

Details of the ripple-current rating of electrolytic capacitors can normally be obtained from the manufacturer concerned. A useful rule of thumb for determining whether or not the leakage current of a capacitor is excessive is: $mA = V \times \mu F/2000$, in other words, the permissible leakage current in mA is taken as the product of the working voltage and the capacity in μF divided by 2000.

Speaker Damage

I have an all-transistor tuner/amplifier. Would any damage be done if it were switched on with all speakers disconnected? Also, would any damage occur if too many speakers were switched in?—H. Smith (Perth).

Loading of transistor amplifiers can be regarded as "roughly" the opposite of valved amplifiers in that they will usually suffer no damage by disconnecting the loudspeaker/s, but short-circuiting of the output increases the current in the output stage dangerously. An inadvertent short-circuit of loudspeaker wiring has ruined many an output transistor, and there is generally no leeway—thus the utmost care is necessary. From this it follows that the addition of extra loudspeakers reducing the load impedance, also increases the output current. In fact, this is sometimes used to boost, artificially, the output from an amplifier. For example, where an amplifier is rated to deliver ten watts to a fifteen ohm speaker and actually delivers more like four watts (!) the device of connecting a well-rated 4Ω speaker gets more output with comparative distortion figures. But it is not to be recommended—for the reasons I have stated. If more speakers are needed, it is advisable to equalise the load. For example, a single speaker of nominal X ohms impedance can be replaced by four similar impedances in series parallel.

Volume Control

I should be grateful if you could give me some advice regarding the fitting of a tone control to my transisitor set. The output is class B push-pull with one OC81D and two OC81s, transformerless with a 30Ω speaker.—G. Lawton (Herts).

You can probably alter the tone of your transistor radio by connecting an $8\mu F$ 6V or a $4\mu F$ 6V capacitor in series with a variable resistor, say, 5kΩ, and connecting this combination across the volume control. It might also be wired from the base of the driver transistor to the positive line. However, this must be a matter for your personal experiment.

PART 1

HOME WORKSH

IN order to construct radio and electronic apparatus, hand tools are required. The problem confronting the beginner to radio construction is to know which tools to buy initially and which tools may be left until more ambitious projects are undertaken. The purpose of this article is to outline a kit of tools which the author considers to be the minimum necessary for starting serious construction work; with these tools, additional tools can be made at home and details of these will be given in subsequent articles. Finally, more sophisticated tools will be mentioned.

In the main the raw materials are copper, aluminium and their alloys, and it is to cut, join, shape, pierce, measure and smooth these materials that tools will be required. The basic tools required by the beginner are: **Vice, clamps, hacksaw, chisel, tinsnips** or **shears, scissors, rule, punches, trysquare, hammers, hand-drill** complete with **twist drills, spanners, screwdrivers, pliers** and **soldering iron.**

Unfortunately for the beginner, many of these tools can be obtained in a variety of forms and sizes, and the author will attempt, in the brief discussion of each item which follows, to indicate the type of tool most suited to the beginner in terms of value and versatility. Before leaving the subject of value, a word of warning here. No matter how limited the budget, on no account should *quantity* of tools be allowed to take precedence over *quality* of tools.

Good quality tools are actually easier to use than inferior tools, and have an immeasurably longer useful working life. The British market is flooded with inferior tools imported from Europe and the Far East, as experience is gained, these cheap tools can be made to work within their limitations but the beginner is strongly advised to start with good, branded British products.

Returning now to our list, we start with the **vice.** This is one of the most useful tools in the workshop and an engineer's vice with 3in. or 4in. interchangeable jaws is preferred. A possible drawback with this type is that it has to be bolted down through the workbench and where it is intended to use the kitchen table as a makeshift workbench, a clamp-on portable vice makes a good substitute. A range of excellent aluminium alloy vices is currently available, and the constructor can make his own jaws to suit from scraps of wood, etc.

To augment the vice, a pair of **"G" clamps** are invaluable, although one will do for a start. In normal use, "G" clamps are subjected to severe tensional stresses, and cast-iron clamps should be avoided because these are very weak in tension. Good clamps are made of forged steel, and will withstand considerable abuse indefinitely. A 5in. clamp is a good size to start with.

The **hacksaw** should be of the adjustable type, ranging between 8in. and 12in. Imported hacksaws often have fixed adjustments corresponding to metric sizes and will not accept English blades unless modified.

A range of **cold chisels** is useful in the workshop but where it is intended to purchase only one, a 6in. chisel of about ½in. diameter will serve. More will be said about chisels later.

Metal-cutting **shears or tinsnips** are available in a range of sizes, with either flat jaws, straight or curved, or with plump jaws, invariably straight. This latter type is known as a *Goosebill* shear because of its shape. Both types have their uses, but the *Goosebill* is recommended for its ability to cut a straight line through sheet metal. A 10in. shear will cut 20 gauge aluminium without undue effort, and if it is necessary occasionally to cut heavier gauges, one handle of the shear can be gripped in the vice, whilst the other handle is *pumped* to obtain the required leverage.

A pair of **scissors** is included in the list to cover those occasions when aluminium foil, cardboard, fabric, fuse-wire, etc., need to be cut.

A six-foot extending **rule** is a useful accessory in the workshop and a cheaper type with printed graduations will be accurate enough for most marking out.

A steel **trysquare** is included in the list, but if a combination square is obtained it will have a number

OP PRACTICE BY P. HAMLEY

of additional features such as a removable rule with engraved graduation with which more accurate measurements can be made. Most squares of this type also incorporate a useful little scriber and a spirit level.

Punches for use in the workshop include centre punches, pin punches and piercing punches. One of the uses of the centre punch is to make a small conical indentation in a surface that is to be drilled, the small *pop* mark guides the drill accurately into the desired position. Centre punches do not vary much in size, but a punch of square section, or with an enlarged square head, is less likely to roll off the workbench. Pin punches are used to drive cotter pins and retaining pins and could probably be left out of the basic kit without too much inconvenience. On the other hand, the piercing punch is one of the most useful, but neglected, tools in the constructor's kit. Proprietary punches are quite expensive to buy, but fortunately satisfactory substitutes are not at all difficult to make, as will be described later. The piercing punch is a round piece of tool-steel with a concave relief in the cutting end which is driven through the panel by a firm blow from the hammer, taking a small slug of metal with it, the panel is supported on a piece of softwood to prevent damage to the punch as it breaks through.

Holes can be produced more accurately and quickly with a punch than with a drill and, with careful planning and marking out, a complete radio chassis can be punched in the flat before the sides are raised into the box shape. Large holes are difficult to punch by this method, however, and for this reason a set of screw-up type chassis punches is specified. These are available as a set of the most popular sizes and full instructions are included.

Many workshops have a large selection of **hammers**, but for our purpose only two are considered to be essential. These are a perfectly standard one pound ball-pein, and a fibre, plastic or rubber hammer for sheet metalwork. The resilience of the latter hammers helps to prevent damage when soft metals are being worked.

The **hand-drill** should have well-fitted bearings, preferably including a proper thrust race, and an idler pinion to balance the crown wheel. A $\frac{1}{4}$in. capacity chuck is usual, although a larger drill with a $\frac{3}{8}$in. chuck has much to commend it.

A set of **twist drills** with the diameters increasing by increments of $\frac{1}{64}$in. from say $\frac{1}{32}$in. to $\frac{1}{4}$in. should be obtained. Beware the very cheap imported sets often labelled "Hi-carbon" or similar, which are in fact made of iron wire and will not drill even hard wood satisfactorily. A good British set is indicated here, the extra cost is easily justified.

A set of **BA extension socket spanners** will be required right from the beginning, and is especially useful when dismantling scrap equipment to reclaim parts. Look for neatly broached sockets when purchasing, and a long clearance hole inside the shaft is useful when running nuts on to long screws. The type with an interchangeable plastic handle is convenient to use and takes up little space.

Screwdrivers are obtainable in sets especially prepared for the radio worker. Make sure your set includes at least one of the Phillips type blade.

Of the many types of **pliers** available, three are preferred for a start, these are combination, side-cutting, and long-nosed. Insulated handles can be obtained if desired, although the author has a strict rule that metal tools will not be used in the vicinity of live power circuits. Cheap side-cutters rapidly become blunt and cannot be sharpened.

The last of the basic tools is the **soldering iron**, these are obtainable at prices ranging from 10s upwards, and wattages from about 25 upwards. The writer prefers a big, powerful, soldering iron, but the choice is rather a matter for the individual. The beginner might be well advised to start with a 30 watt iron and to consider others as dexterity is acquired. A solder gun should be the ultimate goal, of course. The elements of the cheaper irons usually burn out after a couple of hours, and are often irreplaceable. Other cheap irons have recently been found to be lethal owing to faulty insulation. A well-known brand name is the best safeguard.

As the projects undertaken become more complex, the need for more tools will be felt, and these can be bought when necessary. Other tools might already be knocking around the house or garage such as files and oilcans.

SOURCES OF COMPONENTS

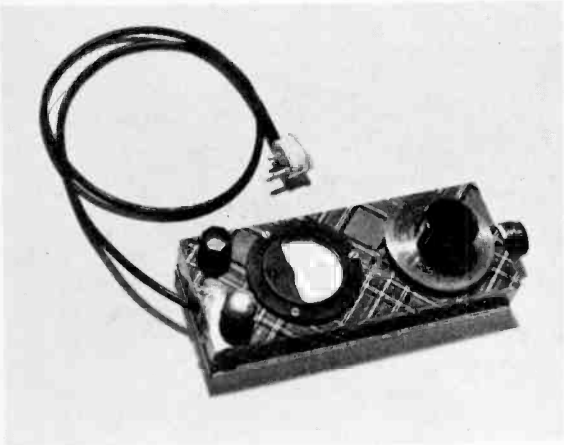
Armed with the kit of tools described the would-be constructor now requires components and materials with which to work. It is possible, of course, to purchase all that one requires, brand new, from the radio supplies shop, but the expense involved often imposes a serious limitation on the number of projects which can be undertaken. Often the necessary materials and components can be obtained free of charge or at a purely nominal cost.

The most prolific source of components is the scrap TV or radio chassis, any number of which can usually be obtained from the local radio and TV repair shop simply for the asking. More than once the writer has had the boot of his car filled with scrap chassis by the grateful proprietor of the local repair shop, who would otherwise have had to pay to have these removed. Old radios and radiograms can often be picked up for a couple of shillings at second-hand furniture stores or jumble sales.

Those fortunate enough to live near a war surplus shop will find that a few shillings will buy a complicated piece of apparatus which undoubtedly cost the Government hundreds of pounds when new. The writer particularly remembers buying an ex-W.D. valve-tester and having a large box of valves "thrown in to practice on".

Most electronic projects are built on a chassis of some sort or other. It is often found possible to utilise a chassis salvaged from an old set, but where this is not posssible, a new chassis can either be purchased ready made up or fabricated by the constructor from sheet material. A cheap substitute used by the author is the oven meat tin obtainable from all chain stores. Unlike aluminium, components can be soldered directly on to the tin-plate chassis and wiring, is greatly facilitated since earth leads can be kept short and direct by soldering to the chassis at the nearest point.

Biscuit tins can sometimes be pressed into service, as the photo of the G.D.O. shows. Larger biscuit tins can be cut into panels which in turn are formed into small chassis as required. A slight disadvantage with ordinary tin-plate is that it lacks rigidity and special attention must be given to stiffening up tin-plate chassis.



The Authors' Grid Dip Oscillator built in a biscuit tin.

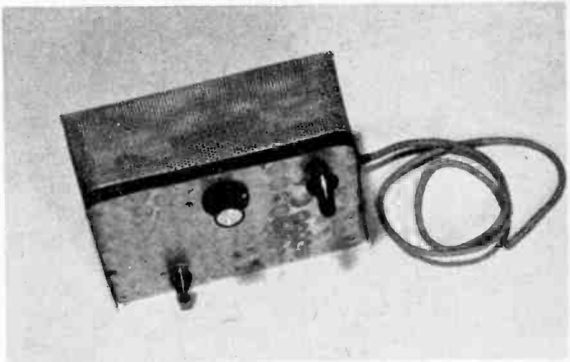
Inevitably the constructor will come across a design where a definite shape and size of chassis is called for. Here, a sheet of aluminium will be required for making up and most good radio shops will stock this. However, anyone living near a coachbuilder or caravan building works should first try a visit to the works manager with a view to buying offcuts of aluminium at the scrap rate. The writer was able to buy 7lb. of 20 gauge aluminium in useful size sheets for a shilling from such a source. Before leaving the subject of chassis and chassis materials, consideration should be given to sandwich tins, tobacco and mustard tins and similar containers, the choice is limited only by the imagination of the constructor.

Having found the necessary components and built a chassis, the constructor will require wire to wire up the project. Single- and multi-stranded copper wire, PVC covered, can be purchased on small drums for a few shillings, but owing to political troubles in the copper producing areas of the world, copper is today rather an expensive commodity and economies can be made by using wire stripped from scrap sets. When insulation is needed, the wire can be threaded into rubber or plastic tubing, obtainable in bundles for a few pence; another very good sheath goes under the trade name of "Systaflex" and is a varnished cambric and it is somewhat easier to thread than rubber or plastic. For insulating fairly straight lengths of wire, an ordinary plastic drinking straw can be tried and will be found to possess a resistance of 500MΩ at quite high potentials. In the absence of heat or physical abrasion it will last for ever.

FINISHING IT OFF

Summarising our discussion so far, we have considered some methods by which components can be obtained; assembled to a chassis; wired up; and tested under power. All that remains is to fit the project into a housing of some description. A wooden or plastic cabinet can be made or purchased, but the author's preference is to make a metal cover, the main reason being that the equipment is then screened to r.f. both ways. In the vast majority of cases, the equipment will consist of a chassis with components above and below deck, and a vertical front panel to which tuning and volume controls, inputs and outputs, meters and lamps etc. are attached, depending on the type of equipment.

An attractive cover for the remaining three sides and top of the equipment can be fabricated from expanded metal available in many anodised finishes from trade advertisers in this journal. However, the really dedicated improviser will find that perforated zinc, sold in rolls by most hardware shops, makes an excellent substitute for expanded metal at rather less than half the price. The zinc is extremely easy to cut and form into any shape, and is joined merely by pressing adjacent pieces together with a hot soldering iron. The accompanying photo of a homemade preamplifier shows one application of this material.

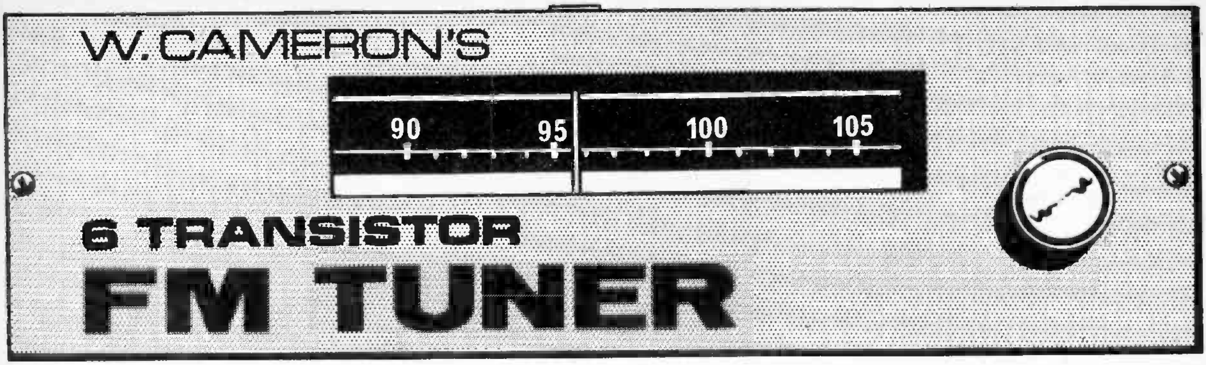


The cover of this pre-amp is made from perforated zinc. Note the finish on the front panel, made by rubbing with steel wool.

The edges of aluminium and similar sheets and panels can be bound quite attractively with plastic tape. Other possibilities include gilded plastic strip such as is sold for edging hardboard, etc., and possibly the simplest way is to file and smooth the edge and spray the panel. Decorative finishes can be applied to the natural metal in various ways—for instance a pad of steel wool rubbed firmly round and round in small adjacent circles on the surface produces an attractive finish. Another method of achieving a similar result is to attach a small piece of medium emery cloth to the end of a $\frac{1}{4}$in. diameter wooden dowel and revolve the dowel between the hands, pressing the emery cloth lightly against the surface.

So much then for the ways and means of gathering together the raw materials for the constructional project. Next month special techniques for dismantling, reclaiming and rebuilding components and equipment will be described, and finally a list of more advanced hand and power tools for the guidance of those fortunate enough to have the space to provide themselves with a fully-equipped home workshop.

TO BE CONTINUED



PART 2 — continued from February

Work may now proceed on the wiring and soldering of the small components (see underchassis layout details, Fig. 7). It is as well to start at the output end, TR6, working forward to the first i.f. TR3, up to the dotted line on the circuit diagram Fig. 1. The i.f. amplifier must now be checked and given the rough alignment described below, after which the front end can be completed.

Initial I.F. Alignment

The i.f. amplifier is now ready for testing and rough alignment. Plug the output into an amplifier and connect the supply leads to a 9 volt battery. Check all voltages with Table 1. Clicks should be heard during these tests, perhaps becoming progressively louder as the tests proceed towards the first i.f., particularly when collector and base voltages are measured. Any fault that may be apparent at this stage must obviously first be located and corrected before proceeding to the actual alignment. Disconnect the battery, disconnect capacitor C15 and connect a length of 3 or 4 yards of wire to the emitter of TR3. Re-connect the battery. The i.f. amplifier can now be considered as a rather wideband t.r.f. receiver, the length of wire connected to TR3 emitter being the aerial, and provided no fault exists short wave signals, mainly Morse, on a frequency somewhere between 10 and 11Mc/s will be clearly heard.

The nominal frequency to which the i.f. transformers should be tuned is 10·7Mc/s, but any frequency within the tuning range of the transformers (approx. 10–11-Mc/s) will do just as well. With a trimming tool and starting with the core of L11, adjust for maximum output, progressively working forward adjusting each of the cores in turn for maximum, finishing with L6. Precise tuning does not matter at this stage, but it will help if one signal can be singled out and the adjustments made to bring out this one at maximum, disregarding others. The final adjustments to the i.f. come later, when the front end is completed and operating. Now re-connect C15.

For those with access to a signal generator, a 10·7-Mc/s signal is injected into the emitter of TR3 via a capacitor of 0·01 μF, and the i.f.'s adjusted for maximum as above, the output from the signal generator being reduced to prevent overloading as the i.f.s come into alignment. The discriminator can also be adjusted at this stage in the manner described next under "Tuning and Alignment". Use an unmodulated signal and meter the output as described in this method.

No mention will be made of wobbulator alignment as it is assumed that the limited number of constructors who might have access to one of these instruments will know how to use it.

The front end wiring should now be completed and voltages checked with Table 1.

TABLE 1 — Transistor Voltages

Transistor	*E*	*B*	*C*
TR1	8	7·25	0
TR2	7·8	7·2	0
TR3	2·2	2·4	8·4
TR4	1·6	1·8	8·4
TR5	1	1·2	8·6
TR6	0·4	0·58	6·2

The total current is 11mA. All voltages were measured with a 20kΩ/V meter.

Tuning and Alignment

Connect a shorting link of wire across C12 to cut the a.f.c. Connect a d.c. voltmeter, 2·5 volt scale to start with, across C27 and in the same polarity. Connect the aerial. The type of aerial will depend on location and distance from the transmitter, but a simple dipole mounted in the correct direction will be suitable in most cases. The author, who lives 20 miles from a transmitter, found a 2ft. 6in. length of wire to be sufficient, but this is not recommended. Adjust the tuning gang until a signal is received, when a reading will be seen on the voltmeter. Adjust all the i.f.t. cores in the order L11 to L6 for maximum reading on the meter, switching the meter to the next highest range if necessary. As a guide, the reading should finally be about 4V if the received signal is of reasonable strength.

With a signal being received, the discriminator is correctly tuned when the d.c. voltage from each diode of the ratio detector is equal and opposite with respect to chassis, or in other words, when the voltage across C27 is maximum and the voltage between the test point (junction of C26 and R22) and chassis is zero.

To tune the discriminator, transfer the meter (2·5V scale) to between T.P. and chassis. The reading will be either positive or negative depending on whether L11 is detuned higher or lower than the i.f. Adjust the core of L11 until the reading is zero, at the point where further adjustment of the core will swing the reading positive or negative depending on which way the core is turned. The i.f. alignment is now complete.

The r.f. and oscillator stages will now require some adjustment. The oscillator coil L4 is adjusted by squeezing the turns closer together, or by widening the spacing between the turns as required, to get the tuning gang and hence the scale pointer in the correct position. Squeezing the turns together will result in less tuning capacitance being required, and vice versa. The calibration will be approximately correct when Radio 2 (Light Programme) is received with the gang at about seven-eighths full capacity (plates almost fully in).

The r.f. coil is also adjusted by squeezing or widening, and is adjusted to give maximum on the meter connected across C27. A plastic trimming tool is useful for making these coil adjustments as it will have little self-effect on the tuning when touching the coils.

The coil L2 on the aerial coupling T1 may be tuned if necessary, by optimising the value of C1. Capacitors of between 12pF and 20pF should be tried, choosing the value which gives greatest reading on the meter.

Remove the shorting link from C12 to restore a.f.c.

The diode will be at its nominal capacitance when the d.c. voltage from the discriminator is zero. Any frequency drift would result in this voltage becoming either negative or positive depending on whether the drift was to the high or low frequency side of the received signal. The diode capacitance would then be either increased or reduced, maintaining the oscillator on a set frequency.

In this receiver where the oscillator is highly stable and frequency drift is unlikely, the main advantage of the a.f.c. is the easy and positive tuning it provides. When tuning, it will be noted that this is quite broad. Tuning through a signal will produce a "plop" when the a.f.c. locks onto the signal, and again when tuning through the signal and beyond the range of the a.f.c.

Scale and Drive

Two pulleys are fitted to the front panel with 4BA screws, and two nuts, one on each side of the panel, lock the screws while allowing the pulleys to run free. Approximately 30 inches of nylon drive cord are required for the drive, details of which were shown in Fig. 4.

The scale may simply be a strip of good quality paper marked appropriately where the BBC stations appear,

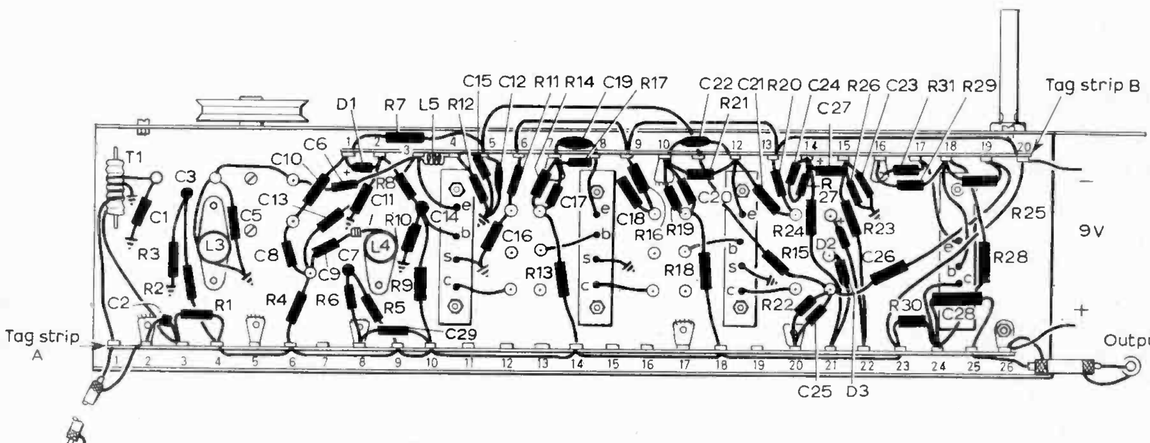


Fig. 7: Component wiring diagram of the basic tuner.

Automatic Frequency Control

The diode D1 is a special variable capacitance diode, type BA102. Other silicon diodes have been tried but without much success, except for the type BA100 which gave reasonable results.

The diode is biased by the fixed voltage provided by the potential divider R9–R10. The fact that this divider also supplies bias to TR3 is of no consequence as the junction is at chassis potential to r.f. via capacitor C14.

The a.f.c. control voltage is taken from the centre point of the discriminator via R7 and R15. The junction of these resistors is by-passed to a.f. by C12. Improved linearity at the expense of gain can be obtained by leaving out C12, when the audio component will swing the oscillator in opposition to the received f.m. signal, giving in effect negative feedback, but more correctly volume compression.

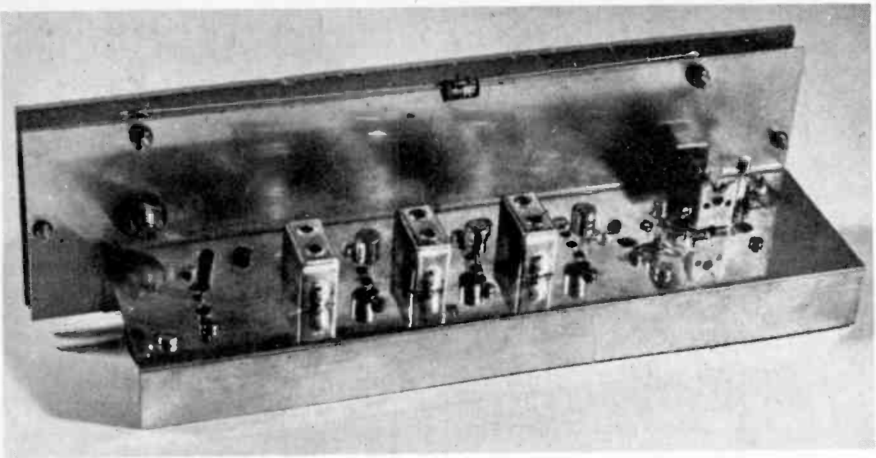
The diode, in series with C10 and C11, is across L4 and in parallel with the tuning capacitor C4b.

or else calibrated in frequency. On the model, the scale is a strip of black plastic tape, lettered with Radiospares white marking transfers.

A second front panel of ⅛in. Perspex is fitted over the scale, using countersunk 4BA screws and distance pieces to clear the pointer drive and drum. The back of the Perspex is painted, or preferably, sprayed, using a flat paint or aerosol primer. A 1in. wide strip of masking tape or Sellotape is placed in the scale position before painting, and when removed provides the scale window. If a case is to be fitted over the unit, the Perspex should be the same size as the aluminium front panel, but if the tuner is to be installed in a cabinet, the Perspex should be made larger than the cabinet aperture to facilitate fixing.

Power Supplies

A 9 volt dry battery is very suitable for supplying



power to the tuner, and will have a long life as the current requirement is modest. It does, however, have the disadvantage that it must be replaced occasionally, and the performance of the tuner will fall off as the battery voltage falls. Even so, the tuner will perform satisfactorily until the voltage falls to 6 volts.

The tuner can be conveniently powered from the mains supply using the circuit Fig. 8. The mains transformer can be a small type with a centre tapped secondary supplying any voltage between 8–0–8 volts and 12–0–12 volts. The resistor R is chosen to give 9 volts at the output of the supply with the tuner connected, and will be approximately 180 Ω with an 8 volt transformer and 390 Ω with a 12 volt transformer. The capacitors C1 and C2 will both be 12 volt working with an 8 volt transformer, but should be 15 v.w.g. with a 12 volt transformer. Almost any general purpose type of diode will serve for the rectifiers.

With either of these supplies, it will be desirable to fit an on-off switch.

If the tuner is to be used with a transistor amplifier, the supply can be taken from this provided it is either regulated or very adequately decoupled. For example, with an amplifier such as the PW Low Cost Hi-Fi, power can be taken from the 12 volt negative line via a 270 ohm ½ watt resistor, and decoupled with a capacitor of not less than 5000μF. The large decoupling capacitor is necessary to remove all trace of a.f. from the amplifier supply.

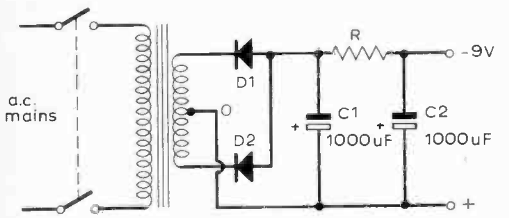


Fig. 8: An a.c. mains power supply. C1, C2—1000μF. D1, D2—BA100, OA202 etc. R—180Ω–390Ω, ½W, to give 9V output.

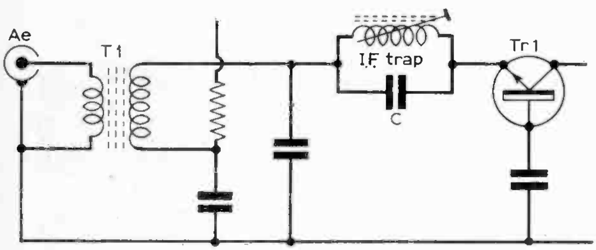


Fig. 9: If signals on 10·7Mc/s are being received this i.f. trap can be included. Details are provided in the text.

I.F. Rejection

In fringe reception areas where a particularly good aerial is a necessity, trouble may be experienced with i.f. breakthrough, as in the unit described no i.f. trap is incorporated.

An i.f. trap is shown in Fig. 9. L consists of 25 turns of 26s.w.g. enamelled wire close wound on a Radiospares former with core. C is a 30pF capacitor. The trap should be mounted on the chassis top adjacent to TR1 and connected between the emitter and feedthrough insulator.

The core of L is adjusted to the point where i.f. breakthrough is completely eliminated.

Automatic Gain Control

A.g.c. was not found necessary as the maximum output is set by the limiting action of TR5.

In areas of very high signal strength where overloading might occur, a.g.c. may be desirable and a suitable arrangement is suggested in Fig. 10.

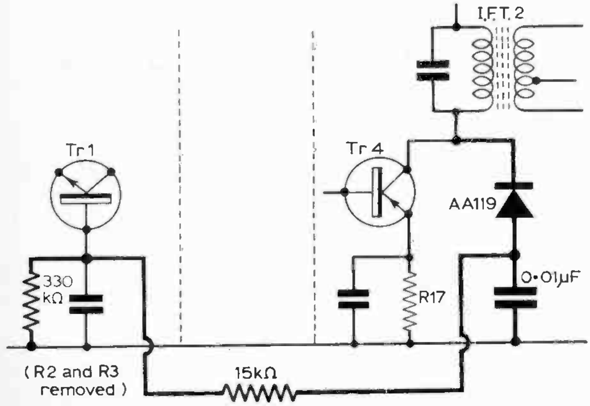


Fig. 10: An a.g.c. system which is a useful addition in high signal strength areas.

Acknowledgements

The author wishes to thank: C & D Electronics Ltd for their assistance and for supplying all of the components for the prototype.

Jackson Bros Ltd and Weyrad Ltd for their very willing and helpful co-operation. ■

practically wireless commentary by HENRY

No. 54

Anti-Fubble Device

SORTING through some papers to learned societies. Came across a blatant case of ideas piracy. Shocking: Henry is hurt.

You know how it is. Some guy blazons a scheme for making millions out of rubberised magnets or reversible diodes, just after you had the whole invention perfected, produced and packaged. All you wanted was the time to actually *invent* it. Henry's bright notion was an anti-fubble device.

Fubble, I should mention, is not a patentable description. If Revox can coin the term "Wobble" to describe Wow and Flutter, surely Henry can get away with Fubble as a portmanteau word for flutter and rumble?

An anti-fubble device is essentially simple. Anything electronically impelled can be electrically controlled. So we receive the output from a non-linear source, process it, use the result to control that source and the output should be linear within the acceptance time of the detecting system.

The principle is applied to gramophone and tape deck motors. In these cases, current consumed by the d.c. motor depends partly on any mechanical resistance. Torque varies—current varies. The variation is sampled, controlling a transistorised circuit which effectively damps the supply line. So the motor attempts to turn always at the same speed.

A walk around the block.

I say "attempts" for in practice the device has fairly narrow limits. When the retarding force causes the drive mechanism to vary beyond those limits, the effect can be wild, man, wild. Not all servo systems are as effective as the Sony 3000 turntable, whose control circuit is more comprehensive than the average gramophone amplifier, and whose "black box" (well, silver, actually) is larger than the motor it controls. But when one has a turntable so finely engineered that one has to take a walk around the block after fitting the turntable, to allow the air bearing to settle, who is arguing about a few extra refinements? Not this green-eyed critic.

Logically, in audio engineering, the next step is to control whatever is outside the feedback loops. Perfectionists tell us that the ultimate is a signal injected directly into the brain. But I do not fancy calling in the surgeon every time I want the slope filter adjusted. We shall have to settle for a perfectly controlled system feeding some sort of transducer. Which, with loudspeaker output, is what we have.

There are various methods of damping an amplifier-loudspeaker combination to reduce resonances, maintain a constant drive, keep some sort of equilibrium. But the mechanics of the system always add some kind of coloration. As long as we are aware of the cone former puffing in and out of that gap, we shall feel uneasy.

For those who say the electrostatic speaker is the answer, I can only point mutely to the little woman, who refuses to take any more furniture out of the lounge. The room is not big enough for the siting of a stereo pair at least four feet from *any* wall. Henry wants to *sit* and listen, not prop himself in the doorway.

So let's be inventive and defeat fubble with a method of including the loudspeaker in the feedback loop.

We shall float a transducer at the focal point of the loudspeaker cone, read off pressure variations, convert them to an electrical signal and combine it with the audio output. Brilliant! Why didn't someone think of that before?

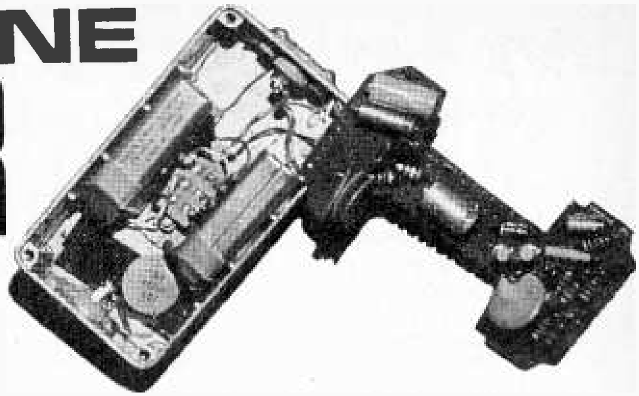
The little woman who refuses.

Trouble is, someone has. Cutting right across Henry's bows, Messrs. Philips describe what they call motional feedback with loudspeakers in *Technical Review* Vol. 29, 1968, No. 5. The paper is by J. A. Klaasen and S. H. de Koning and is far too long and detailed for my exposition here. Briefly, however . . .

An acceleration transducer consisting of a piezo-electric device is fixed to the moving coil. At low audio frequencies it produces a feedback signal which is integrated and added to the main feedback, giving a flat amplitude characteristic, to below the mechanical resonant frequency of the loudspeaker. Substantial improvement in bass is reported. They have beaten fubble—or have they simply made it possible to hear it with greater clarity?

Ah well, back to the drawing-board.

MICROPHONE PREAMPLIFIER



J. A. JEBB

A HIGH-GAIN RUGGED UNIT FOR BOOSTING LOW-LEVEL AUDIO SIGNALS

THIS unit was designed to meet the needs of general amateur tape-recording systems, both indoor and outdoor, for insertion in a signal line carrying insufficient signal for the purpose for which it is intended. Such a unit must have a very high gain, high stability, be small in size, and have good frequency response. Several two-transistor designs were tried, and it was found that these had low noise levels, but rather insufficient gain. Moreover, loading of the output resulted in alteration of the a.c. negative feedback level in one case, and this produced severe distortion.

A three-transistor circuit was then tried, and it was found that an increase in gain resulted. This circuit was originally designed by A. R. Bailey and described in *Wireless World*, Dec. 1966, and the author claims no credit for the exact details. The characteristics of this circuit were found to fit the needs of the unit, having an input impedance of about 200kΩ with an output impedance of 200Ω and that the feedback point was at low impedance, so no loading effects caused by any feedback network used were apparent.

Silicon transistors are used throughout, giving a gain of 30dB. The type of transistor is not of critical importance, but if others than the types specified are used, then care must be taken to ensure that the d.c. operating point of the amplifier is satisfactory. The voltage supply is quite high (18V), this is to ensure that the amplifier does not easily bottom and square off the wave-form. This high voltage presents difficulties as far as size of battery is concerned, but this can be overcome by careful layout. The current drawn is between 2·1 and 2·5mA.

Frequency response will be the least of the constructor's problems; the unit has been used by the author at 200kc/s while still providing useful gain. The lower limit is about 20c/s.

Circuit description

Tr1 is a simple amplifier operating in common emitter mode, coupled by an R.C. parallel network to the d.c. connected pair, Tr2 and Tr3. This network allows the d.c. operating point to be stabilised over the whole amplifier, rather than independently over Tr1 then over Tr2 and Tr3. The output is at low impedance, being of the emitter-follower configuration as the connection of long leads could load a high impedance output to an intolerable level. Feedback is applied between Tr1 emitter and Tr3 emitter at both d.c. and a.c. It is possible to modify the response curve of the unit by alteration of the a.c. part of the feedback loop, as will be explained later.

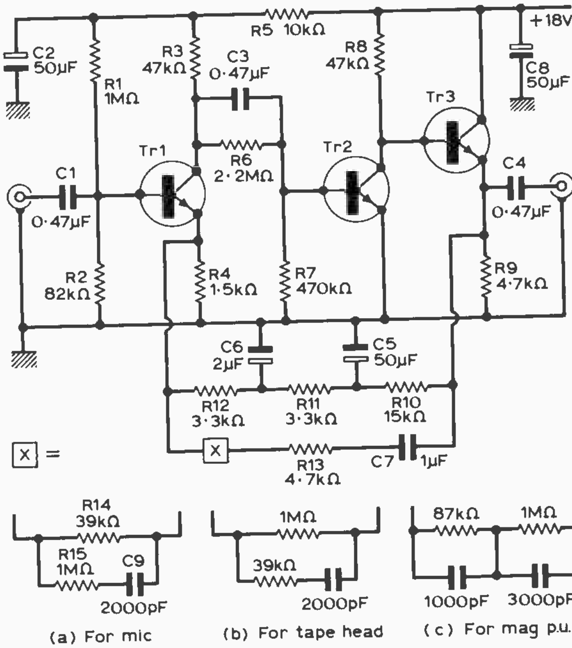


Fig. 1: The circuit of the preamp. Networks a, b and c are inserted at x for correct equalisation.

Construction

The unit was built in an Eddystone die-cast steel box, type 896. These boxes are a little expensive, but are ideal for this purpose as the close-fitting lid and the rigid construction are necessary features.

Veroboard was used, the components being arranged on the circuit-board corresponding to their relative positions in the circuit as far as possible. The input capacitor and several of the inter-circuit capacitors were ceramic types of only 10V working, for reasons of size limitation. It is therefore essential that the input does not contain any d.c. component.

The input and output plugs were of the flush-

mounted Belling-Lee type, these are quite strong, and the plugs will not pull out very easily. The base-bias resistors of Tr1 are very important, as they determine the current that flows through the system. Consequently, resistors of good thermal and long-term stability are essential here, though the others in the circuit are not critical.

Because of the low impedances used in the circuit, no problems with feedback oscillations should occur, but a low-impedance earth path is essential as the circuit may oscillate under certain conditions, e.g. input shorted. The components used are all available from *Radiospares*, with the exception of the die-cast box and transistors, which the author obtained from *Electroniques, (STC) Ltd.* and *Mullard Ltd.* respectively.

Operation

Care must be taken when switching-on for the first time, for if a mistake has been made, transistors may start to illuminate the workbench! A multimeter and a few resistors or a resistance box are of great assistance here, since then the battery voltage may be increased gradually, and watch be kept on the total current, which should be around 2mA. The circuit will not operate at about 12V, so do not be discouraged if nothing happens below this level. With the input open-circuit, the noise may seem excessive, but on connection of a 50KΩ or less input load, the noise should disappear.

The unit should find use among tape enthusiasts, as it is suitable for use with a microphone at the distant end of a long coax cable, thus feeding the cable at volt rather than millivolt level, and also alleviating the treble-loss due to cable capacitance by reduction of the impedance of the signal.

The author's own unit has proved reliable over a period of about 18 months, and has withstood several hard landings on various floors, and even immersion in water. ■

★ components list

Resistors:

R1	1MΩ†	R9	4·7kΩ
R2	82kΩ†	R10	15kΩ
R3	47kΩ	R11	3·3kΩ
R4	1·5kΩ	R12	3·3kΩ
R5	10kΩ	R13	4·7kΩ
R6	2·2MΩ†	R14	39kΩ
R7	470kΩ	R15	1MΩ
R8	47kΩ		

All ¼ watt miniature; all 10% except, †, Carbon film 5%

Capacitors:

C1	0·47μF 10V	C6	2μF 15V
C2	50μF 40V	C7	1μF (2 x 0·47) 10V
C3	0·47μF 10V	C8	50μF 25V
C4	0·47μF 10V	C9	2000pF
C5	50μF 16V		

Semiconductors:

BC 107/108/109 or BC 167/168/169
2N 2926
2N705—may need 500kΩ at R1 instead of 1MΩ.

Miscellaneous:

Eddystone die-cast box type 896, Veroboard, two PP9 batteries, connectors, on/off switch, etc.

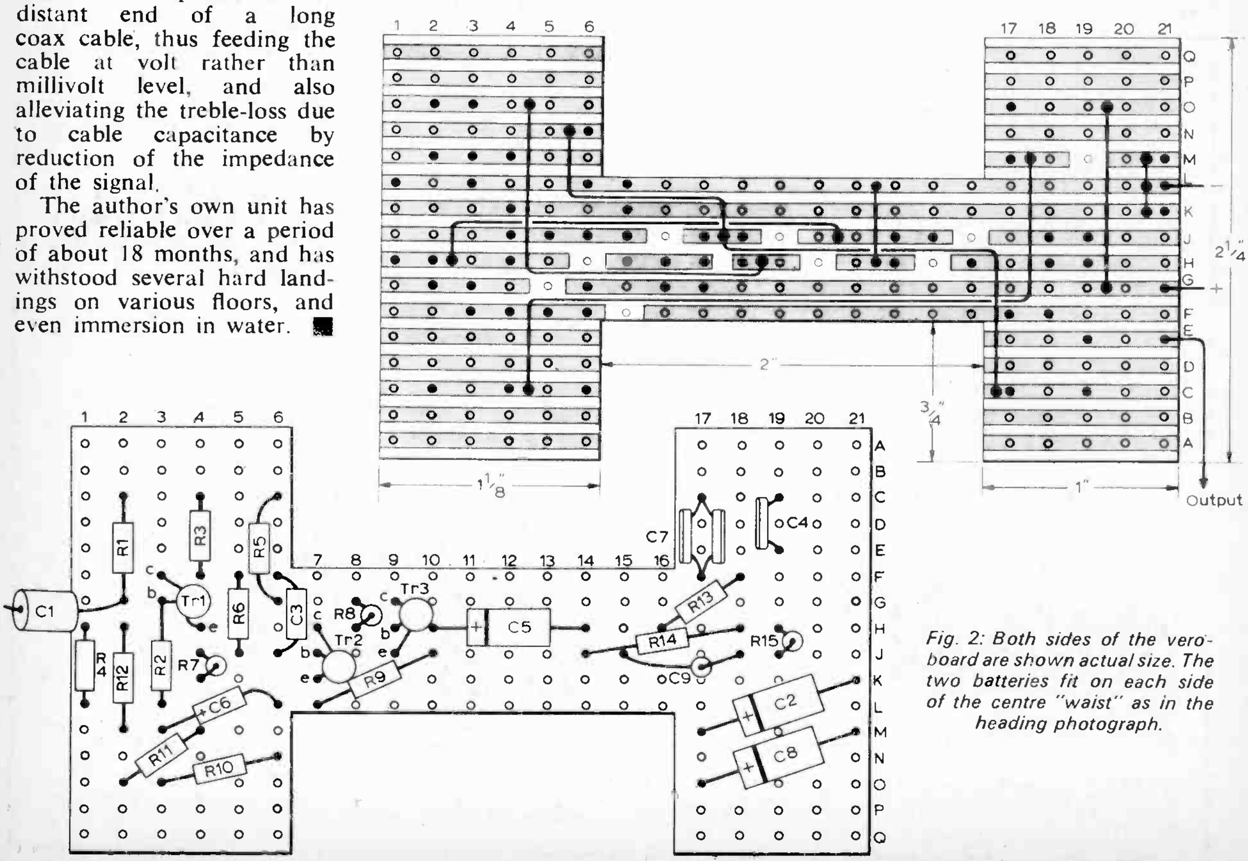


Fig. 2: Both sides of the veroboard are shown actual size. The two batteries fit on each side of the centre "waist" as in the heading photograph.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

What an un-holy business

I was delighted to note in Mr. Sinclair's article on Transistors, (Part one, January 1968), that "hole" theory is a fiction. Working in semi-isolation as I do, with contact mainly with students, I was under the impression that I was quite alone in believing this was so.

When I was called upon to take an RAE Course for the first time some years ago, transistor theory was a hole in my knowledge which needed filling.

I found it quite impossible to believe what I read in various text-books, many of which varied in their statements anyway, and I was forced to think for myself. I found it extremely simple to explain p-n-p by electron flow only and developed a theory to explain all the observable facts.

No text-book that I have seen "explains" in any other way than by "holes" so I sent my effort to a National Radio Society which is supposed to encourage the work of its amateur members with a view to publication and consequent controversy. What other scientific process is there in the constant search for truth?

The "acknowledged experts"—their description of themselves, not mine—seemed to shy away in horror for they sent it back with neither reason nor counter-argument. A subsequent challenge from me to meet either of them in a public debate brought no reply at all. But as I told them later, anyone who actually believes—and publishes diagrams to make that belief very plain—that current in a high vacuum valve flows in at the anode and screen grid and out through the cathode, can hardly expect to be taken seriously as experts on anything.

One could laugh at their behaviour if it wasn't for the harm they do. Every batch of students I get each year confess that they have become stuck on this very point. I tell them to ignore it and ask themselves always "What are the electrons doing?"

People seek to justify "hole theory" as an aid to understanding the transistor. Such people cannot be teachers, for nothing is further from the truth. My own belief is that comparatively few people actually make any real effort to understand them. They follow the circuit directions and, since they usually work, that's all they bother about. This, in my experience, is because they find "hole" theory incomprehensible. I would also say here in this connection that young people becoming interested in radio for the first time invariably turn to PRACTICAL WIRELESS.

Unlike people who just write text-books, I have to stand and justify every statement I make, not only to mature students, but also to myself. Twenty-five years ago I had to write about another fiction in order to obtain my City & Guilds Certificates in "Radio Communication". This fiction was called AETHER. I've hardly heard of it for the past quarter of a century.

Now, so that my students can satisfy City & Guilds examiners in RAE, I have to teach them another fiction—"hole" theory.

Does any "expert" deny that large quantities of electrons enter a p-n-p transistor at the COLLECTOR terminal and leave at the EMITTER? If they do not deny this, how do these electrons get through?

As far as I am aware, I am the only person who has gone to the trouble to try to explain this and I have yet to discover anyone who can "shoot it down". You will certainly not find any mention of electron flow in p-n-p in any text-book or periodical. For one great moment I thought Mr. Francis (The Semiconductor Diode, P.W. May 1968), was on his way to it but it was not to be.

So, sir, if you are interested, may I say that I do not believe in "holes" which carry a positive charge—nothings which are current carriers. I regard "hole" theory as a disease. May I suggest the name HIATITIS PUNGENS for this distressing clinical condition?—**B. R. Meredith, G2CYV** (*London, S.W.*16).

Switch off and make room

I note in the December issue that letters are still appearing as a result of Mr. Meachim's comments last September.

I agree and would go even further:

Why have an RAE which requires such a high standard of radio knowledge, when many of the successful candidates immediately purchase commercially built equipment (including aerial systems) sit down at their rigs and rabbit on for hours about their warts etc?

Admittedly a certain amount of humour is to be welcomed but to say that a radio amateur can advance his knowledge very little, and that it is a hobby not to be taken too seriously, amazes me!

Amateurs who have this outlook will quickly lose interest and we will soon see their gear offered for sale in these columns.

To those genuinely interested, radio is a wonderful and rewarding pastime, one learns something new every day, and can never learn enough.

To the chatterboxes I say, "Switch off and make room!"—**D. M. Seager** (*Wales*).

I'm for it too

I think a lot of people's views on the Beginners' Licence are completely wrong, as I and I am sure many others, would love to have the chance to become licensed to transmit. As there is not a s.w.l. club in the district, all I can do is go on listening and hoping too that I can become licensed.—**A. Bradley** (*Huddersfield*).

★ ★ ★

The RAE is not beyond anyone who is really keen and the sort of examination the "aspiring GW3" suggests is such a short step from the present RAE that it will make little difference in the amount of study required.

I also fail to see how a Beginner's Licence would raise the standard of the RAE and I too would like to know when Mr. Williams would possibly find time to transmit (I say nothing of even building his rig) if he did have a Beginners' Licence since he is so tied up with "O" level studies.

I am studying for "A" levels and still find time to prepare for the RAE. I therefore believe that people *are* only trying to find an easy way out in seeking a Beginners' Licence.

Do we really want to transmit with "L plates"? I think not.—**J. Kojminihi** (*Bournemouth*).

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U11	30	PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U12	12	Silicon Rectifiers EPOXY BY126/127	10/-
U13	30	PNP-NPN Sil. Transistors OC200 & 2S104	10/-
U14	150	Mixed Silicon and Germanium Diodes	10/-
U15	30	NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U16	10	3-Amp Silicon Rectifiers Stud Type up to 1000 PIV	10/-
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U18	8	6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U19	30	Silicon NPN Transistors like BC108	10/-
U20	12	1.5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	10/-
U21	30	A.F. Germanium alloy Transistors 2G300 Series & OC71	10/-
U22	10	1-Amp Glass Min. Silicon Rectifiers High Volts	10/-
U23	30	Madt's like MAT Series PNP Transistors	10/-
U24	20	Germanium 1-Amp Rectifiers GJM up to 300 PIV	10/-
U25	25	300 Mc/s NPN Silicon Transistors 2N708, BSY27	10/-
U26	30	Fast Switching Silicon Diodes like IN914 Micro-min	10/-
U28		Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc. 8 Assorted Pieces	20/-
U29	10	1 Amp SCR's TO-5 can up to 600 PIV CRSI/25-600	20/-
U30	15	Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U31	20	Sil. Planar NPN trans. low noise 2N3707	10/-
U32	25	Zener diodes 400mW DO-7 case mixed Vlts. 3-18	10/-
U33	15	Plastic case 1 Amp silicon rectifiers W4000 series	10/-

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked

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AC107	3/6
AC126-7-8	2/6
AF116-117	3/6
AF139	10/-
AL102	15/-
BC107-8-9	5/-
BFY50-51-52	7/6
BSY26-7	3/6
BSY28-9	4/6
BSY95-95A	4/6
OC22-25	5/-
OC26-35	5/-
OC28-29	7/6
OC44-45	1/9
OC71-81	1/6
OC72-75	2/6
OC81D-82D	2/3
OC82	2/6
OC140	5/-
OC170	2/6
OC171	3/6
OC201	7/6
ORP12-60	8/6
OCP71	8/6
OA5-10	1/9
OA47	2/-
OA70	1/3
OA79	1/9
OA81-85	1/6
OA91	1/3
OA95	1/9
OA200	3/-
OA202	3/6
2N696-7	5/-
2N706	3/6
2N708	5/-
2N2160	15/-
2N2646	15/-
2N2712	5/6
2N2926	2/6
MAT100-101	3/-
MAT120-121	3/6
ST140	3/-
ST141	4/-

SIL. RECTS TESTED

PIV	750mA	3A	10A	30A
50	1/-	2/9	4/3	9/6
100	1/3	3/3	4/6	15/-
200	1/9	4/-	4/9	20/-
300	2/3	4/6	6/6	22/-
400	2/6	5/6	7/6	25/-
500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
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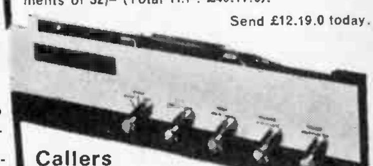

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

No excuses please!

Recently several correspondents, particularly some of the younger enthusiasts, have written to you advocating a Beginners' Licence so that they can operate a transmitter without having to sit for the Radio Amateurs' Examination. There seems to be a general complaint that forthcoming "O" levels, or other commitments, leave no time to study for the RAE.

One can appreciate the difficulty in this respect, but I would like to put just one question—if these poor unfortunates have no time to study for the RAE, how could they find time to operate the transmitters they have such a burning desire to put on the air?—**W. E. Thompson, G3MQT** *(Sussex)*.

* * *

I am becoming apalled by young readers who are sending in correspondence in greater and greater amounts, all grumbling and bemoaning either the terrible "work" for GCE and other exams, or the absence of easy or beginners' transmitting licences. (As if Amateur Radio has not survived for quite a long time without.) I want to assume that J. Waters and C. Williams are not using the reasons given as excuses for not aiming at the requirements (international I might add) for a full transmitting licence. I want to concentrate on the signs of inhibition and strait-jacketing that is the only other answer to their attitude.

I have had a great deal of experience with youth Amateur Radio schemes, and radio/electronic club work, as some of your readers might know. Always, those boys with fears, and excuses, and cramming tendencies about exams and school work make by far the worst club members. So often they are inhibited by this pressure; coming, I'm afraid, from unenlightened parents, and from a competitive school situation. Teachers too, use this pressure as an offshoot of the Authoritarian system we still have in the schools. I have waged war against this kind of thing as a teacher inside the system, and will continue to do so outside it. The social development and creativity of youths with the attitude I have mentioned, particularly suffers. To see a conflict between Amateur Radio/Electronic hobbies for boys and this pressure for "progress" is, well frankly, very depressing, and all of us who know how releasing and worthwhile our activities are should attack the creeping paralysis of the freedom and fun and personal exploration which is a right for youth. I have even had a case where a Headmaster more or less demanded that a boy leave his Scout Troop, for the sake of some school requirement. There was a case of school trying this kind of thing on with a member of the Roding Boy's Society, and we were ready for a real battle . . . a few well-aimed mental kicks up the appropriate region of these pompous teachers, but they climbed down.

What is the usual excuse given? "You won't get a good job", or "The school must keep up its record", or perhaps "What will the neighbours think, if he isn't *suffering* with his work; good heavens he shouldn't *enjoy* it!" For an answer, read the first few paragraphs of *A Career in Physics* published by the Institute of Physics. (About boys building amplifiers, and its preferability to academic swots.) Also, I have known young possessors of an Amateur Licence gain great advantage in employment with industry. Personnel officers being quite impressed, at the least RAE being equal to a GCE (Although all this is not the reason for the RAE!) And finally, I assure you, the attitude of many a college department head, or professor is, "Yes, yes, OK on the GCEs, you have a few, I'm not interested in them; now what projects have you carried out, what clubs have you been in? Can you take responsibility—have you been an officer in a club or society?" I think Amateur Radio with its social-scientific experience, its national, no international, friendship forming powers and other advantages, is uniquely placed regarding this. So let's not have this inhibited grumbling from young people who should have the opposite view.—**Ken Smith, G3JIX** *(Kent)*.

I disagree

I disagree with C. Williams (January issue) on having a beginners' licence. I too have "O" levels coming up this year, but I foresaw the amount of studying coming up and so took the RAE last year.

If C. Williams is really keen he will be able to wait until next December and anyway, if he cannot find the time to study, how is he going to find the time to go on the air? I'll be removing my PA bottle!—**J. O. Parkinson, G3XJB** *(Manchester 23)*.

Not telegraph ops

It would appear that Mr. Dixon ("P.W." January 1969) would like to see the G.P.O. issue an Amateur licence to cover all bands with a special licence for the morse key. He implies that Amateurs only use morse because it is a skill they have been forced to acquire in the process of obtaining a licence. He goes on to say that if the morse test is abolished, Amateur morse will be killed and radio Amateurs will be struck down with some sort of malady leaving them unable to send morse at more than two words per minute.

I fear I cannot agree with Mr. Dixon's views. I still feel that the morse test is unnecessary. If it were abolished I don't think that morse would disappear or that the standard would be lowered. Amateurs realise that if they are to work DX under difficult conditions then obviously A1 is the best form of emission. If they want to operate under bad conditions then they will learn morse. If they are motivated in this way they will learn the code very quickly and enjoy doing so.

At present a radio Amateur has the option of using either phone or c.w. Under the new system where there is no longer a morse test, there would be the same choice of modes of operation. Mr. Dixon feels that only phone would be used under the new system. I hold that if the morse test were abolished morse would still continue to be used as the most effective mode under difficult conditions. R.T.T.Y. operators are not required to obtain an 80 w.p.m. certificate before they are allowed on the air. Why then should radio Amateurs be required to obtain a certificate in morse? We must continue to bear in mind that radio Amateurs are supposed to be experimenters and not telegraph operators.—**T. Wright** *(Northern Ireland)*.

PART 2

MAGNETIC SOUND RECORDING

W.S.FOWLER

THE chief difficulty with the type of tape recorder described last month lies in the fact that the tape speed is constantly varying, because the spool drive diameter gradually increases during the recording process, thus pulling the tape off the supply spool at a gradually increasing rate. A typical machine of the type described may commence recording at a speed of about 3 i.p.s., and towards the end of the spool the speed may have increased to over 7 i.p.s. This is wasteful of tape and furthermore as the quality of the recording is dependent upon the speed of the tape travel, the recording will be uneven in quality.

Furthermore, as this simple "spool drive" system does not employ any kind of governor or regulator to stabilise the actual motor speed, any variations or irregularities in the load will produce variations in tape speed which give rise to "wobbles" in reproduction known as *wow* and *flutter*. For this reason such machines are not suitable for the recording and reproduction of music, etc.

For serious recording work, especially of music, it is necessary to use a drive system which will allow the tape to traverse past the record/play head at a constant speed (usually $3\frac{3}{4}$ i.p.s., with alternatives of $7\frac{1}{2}$in. for high quality work and $1\frac{7}{8}$in. for speech etc.) This constant speed is achieved by the use of a small capstan in conjunction with a pinch wheel, revolving at a constant speed (see Fig. 9).

As with the spool-driven recorder, the tape is fed from the left hand tape spool, which usually "freewheels" for this function. (With quality decks, a slight reverse pull is applied in order to maintain an even tape tension). The tape leaves the feed spool and passes around the left hand guide pillar and along to the erase head, followed by the record/play head. Before continuing to the take-up spool via the right hand tape guide it is pressed against the constantly revolving capstan (see diagram) by the pinch wheel.

This arrangement ensures that, regardless of the increasing size of the take-up spool as the tape "builds up" on it during recording, the actual speed of tape traverse past the heads remains constant. It follows that some kind of "clutch" system of power drive to the take-up spool is necessary, in order to avoid a constantly increasing tension, since the take-up spool is increasingly working against the constant drive of the capstan.

THREE MOTOR DECKS

Some commercial decks employ three separate electric motors for the tape drive system; motor 1 is connected directly to the left hand feed spool and is used to provide rapid rewinding of the tape before replay, see Fig. 9. It may also be used in conjunction with a dropper resistance to provide a slight "reverse drag" during normal operation.

Motor 2 drives the capstan at a constant speed, to produce tape speeds of $1\frac{7}{8}$; $3\frac{3}{4}$; or $7\frac{1}{2}$ i.p.s. The drive from the motor spindle is generally via a stepped pulley and a rubber idler wheel which drives against the flywheel rim of the capstan itself. The manner of construction closely resembles that of the motor drive of a gramophone turntable providing for various speeds.

The drive motor is usually mounted on rubber bushes to minimise vibration etc., and on high quality tape decks the flywheel is dynamically and statically balanced, as is the motor armature, in order to minimise the irregularities which produce wow and flutter, noticeable as a "whine" on playback, especially with piano music. The wow and flutter specification for a satisfactory tape recorder for music use should not be in excess of 0.15% at a tape speed of $7\frac{1}{2}$ i.p.s., and 0·2% at a tape speed of $3\frac{3}{4}$ i.p.s.

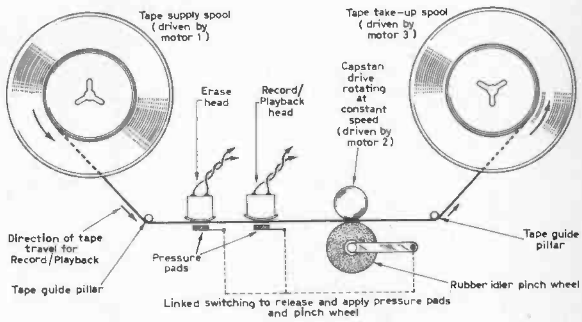

Fig. 9: The arrangement of the feed and takeup spools, the heads and the pinch wheel on a three motor tape deck.

Motor 3 is the "take-up" motor which spools the tape after it has passed the capstan. The motor spindle is usually directly coupled to the spool platform. This motor is also brought into function to provide a "fast forward" facility when it is desired to reach a certain point which may be, for example, half-way through the tape length.

Many satisfactory tape recorders, while using the capstan principle, have dispensed with the "three motor" principle described. The alternative system uses a single motor which drives the capstan by means of a rubber pulley. On its return journey the pulley is taken back to the motor via a flanged wheel; this wheel is coupled to the take-up spool by means of a felt clutch, which allows for the varying

speed of take-up during the recording and playback processes. In order to provide a "fast rewind" facility, a second pulley (or rubber idler wheel) is brought into action to connect to the rewind spool.

SPOOL SIZES

The smallest size of spool in common use is the "message" size of 3in. diameter. $5\frac{3}{4}$in. is a size often used on popular tape recorders, while the 7in. spool is the standard for serious recording work. Semi-professional tape recorders will usually accommodate reels up to $10\frac{1}{2}$in. in diameter. The size of the spool of course determines the length of play which can be achieved at one "run" of the machine. Another factor affecting total playing time is the number of "tracks" used by the recorder.

Professional machines usually employ full-width heads but the standard for domestic use has become half-track. Here the tape heads cover a little less than half the available tape width (see Fig. 10). When the recorder is being used for normal monaural work, it can therefore be reversed at the end of the run, so that the previously blank half of the tape is brought into use. The same *side* of the tape (the dull, coated side) must of course always be in contact with the record/play head.

For *sterophonic* use both tracks are used simultaneously, and a stereo record/play head is necessary. This type of head consists of an "upper" track and a "lower" track head stacked vertically and connected to the left and right channels of the input signal. It is of course possible to use a stereo recorder for "mono" work and if desired, music can be recorded on the upper track and speech on the lower track. On replay, the two channels can be mixed, to give the effect of a commentary with background music.

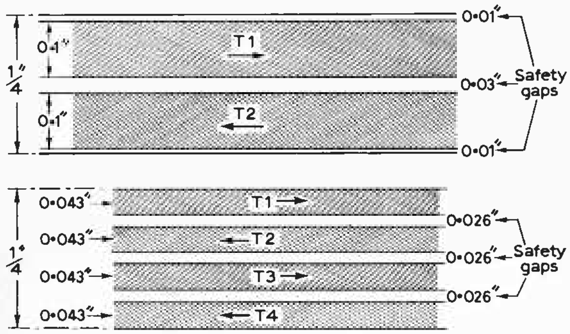

Fig. 10: The recorded track widths showing directions and safety gaps for both two and four track standards.

A further development of the normal "two track" system has been the division of each of the two tracks into two further tracks, making a total of four tracks in all (see Fig. 10). The disadvantages of the four track system are (a) the signal to noise ratio is poorer; (b) there is more likelihood of cross-interference between channels; (c) extra care is necessary over tape quality and condition because the recording area comes to the edges of the tape; (d) editing of recordings is more difficult because, wherever a cut is made, four separate recordings will be involved.

RECORDING TAPE

As has already been remarked, the standard tape width is $\frac{1}{4}$in., and the magnetic oxide is generally backed on to clear plastic. In the earlier days of tape recording, paper tape was commonly used, and this was referred to as "craft based" tape; this had a low breaking point, and also a high noise factor due to the comparatively brittle nature of the backing. It is interesting to note that the very earliest experiments in magnetic recording employed, among other media, waxed paper impregnated with iron filings!

The cheaper variety of tape on sale today may be *acetate* based, and although this is generally satisfactory, the breaking point is again fairly low, and it tends to become brittle, especially in cold weather. Better quality tape has a plastic backing known as *polyester*, and high quality tape will also have been pre-stretched before spooling; this is known as *tensilised polyester* tape. Different varieties of tape also have their own characteristic and can vary considerably in background noise and in high frequency response. An interesting experiment is to splice together several short pieces of different brands of tape and use it to make a sample recording. The most acceptable tape can usually be spotted upon replay as the quality and sound level vary between each joined piece.

An important factor in assessing the playing time of a spool of tape is the actual tape *thickness*. A 7in. spool will hold 1,200ft. of standard thickness tape giving about half an hour of playing time at $7\frac{1}{2}$ i.p.s. (a further half-hour is obtained when the tape is reversed). With the introduction of thinner tape backings, "long play" tape is now common, giving 45 minutes playing time. Double play tape is also available, giving one hour's playing time at the same speed, and triple and even *quadruple* play tapes are now on the market.

A SOLID STATE RECORDER

From what has already been discussed, it will be obvious that the drive and capstan mechanism constitute a piece of precision engineering which is out of the range of most constructors. Battery tape decks using capstan drive are available for around £4 however, and as the amplifier etc., can be taken from the previously mentioned spool driven machine, this constitutes virtually the only expense.

Apart from the battery connection, the only other connections which have to be made between amplifier and the tape deck consist of two leads from the record/play head on the tape deck. These are connected to the piano key switches, and in the record position the signal take-off lead (from C6) should be connected to the head via the record switch.

On replay, the record/play leads go via the play piano key to the input section of the transistor amplifier. This will have a microphone jack socket in circuit, M1, and the flying lead from the piano key is connected to the jack socket so that it connects the base circuit of TR1 via C1 when the microphone jack is removed. If it is desired to leave the microphone in the jack socket during replay, then the contacts on the play and dictate keys should be used to provide the requisite "switchover" from microphone input (on record) to head input (on replay). Erasure is automatically achieved by permanent magnet when the dictate key is depressed, and d.c. bias is provided on record via R13.

TO BE CONTINUED

P.W. GUIDE TO COMPONENTS

PART 4

M. K. TITMAN, B.Sc.(Eng)

Microphone transformers have special requirements due to the high sensitivity and impedance associated with the circuit. Great care is taken in design, and very large high inductance windings are used. The coil is usually resin potted in a cylindrical aluminium or in a quality transformer mumetal can. Lead-out wires usually protrude as flying leads. The transformers are thus fully screened both magnetically and electrically from surrounding fields. Prices are relatively high, from 15s. to £10.

Pulse and inverter transformers often use iron cored coils and for these types special methods are required. In general, thin laminations and low resistivity windings are used. Occasionally air gaps are deliberately introduced to prevent saturation, and thus extend the limits of usefulness, although this reduces the inductance.

As coils of a given power requirement reduce drastically in size as the frequency is increased, high frequency transistor inverters are used increasingly in miniature circuits. Often the inverter transformer is designed to saturate and provide the transistor switching action.

Swinging chokes are also used increasingly to cut down circuit size. These inductors decrease in inductance as the standing d.c. current through them increases. This effect is achieved by using two different core materials one of which saturates at low current, or by using an air gap in part of the core. The inductance is therefore high until saturation at which point it reduces to the portion of material which has not saturated.

Former Wound Coils

These coils are extremely common and find their greatest use in radio circuitry. The formers are made of various plastic materials such as polystyrene and generally have provision for a dust core to be inserted. The core material is of fairly low relative permeability, from 2 to 100, and therefore the inductance is low, from $0{\cdot}1\mu$H to 10mH. Figure 1 shows a typical former wound coil with an iron dust core. Both iron dust and ferrite cores are used and because of the inherent air gaps they are non-saturable. The winding terminations are soldered to the pins on the base of the former, which usually provides the screw mounting holes.

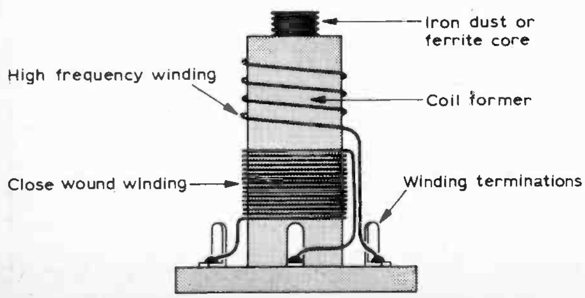

Fig. 1: Former wound coil.

These inductors and transformers are used for radio frequency chokes, aerial tuning coils and transmitter tank circuits, and are often wound by the home constructor. Because of the rather hit-and-miss methods of winding that are employed many newcomers are dismayed by coil winding. This is further aggravated by the lack of information displayed on circuit diagrams. Much information is published on coil winding and various charts and abacs can be used. One useful formula for an air-cored coil is due to J. H. Reyner:

$$L=\frac{0{\cdot}2\,N^2\,d^2}{3{\cdot}5d+8l}\times\left(\frac{d-2{\cdot}25\,D}{d}\right)\mu\text{H} \qquad (1)$$

where L is the inductance, N the number of turns, d the external diameter in inches, l the winding length and D the depth of winding.

For a single layer coil the bracketed term is unity. As a very rough guide however 20–36 s.w.g. can be used from 100kc/s to 10Mc/s and 16–20 s.w.g. for coils up to 100Mc/s.

On a ½in. diameter former approximately 4 turns of 18 s.w.g. will give tuning with a 100pF capacitor at 30Mc/s whilst 10 turns gives 15Mc/s, 20 turns 8Mc/s and 40 turns of 30 s.w.g. gives 4Mc/s. Hence trial and error and common sense readily result in the desired coil. Cores and formers cost from 6d. to 2s. 6d.

Ranges of r.f. and oscillator coils are available from 4s. to 10s., and many people prefer to purchase coils ready wound. I.F. transformers are also wound on formers, and can be purchased between 10s. and £2 in matched pairs. These particularly require careful design since a very important factor is the Q or quality of the coils. I.F. transformers require a high Q to give good rejection of unwanted signals and to define the bandwidth. The value of Q depends on the formula:

$$Q=\frac{2\pi fL}{R} \qquad (2)$$

where f is the frequency in c/s, L the coil inductance in henrys and R the dynamic (r.f.+d.c.) resistance in ohms.

The formula shows that to obtain high Q factors the ratio of inductive reactance to resistance must be high, and coils with Q factors of 100–1,000 are readily available. I.F. coils are usually screened with aluminium alloy cases and have ferrite or iron dust cores to give tuning adjustment.

The resistive portion of the formula for Q consists of both the d.c. and r.f. resistances and this is due to the skin effect. At radio frequencies the current path is

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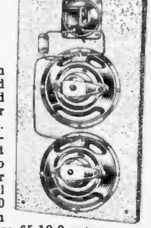

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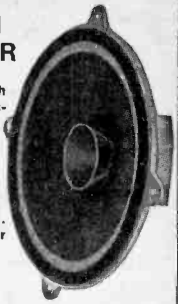

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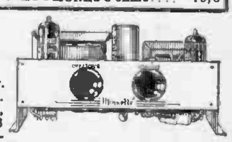

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confined to the surface layers of the conductor and hence the resistance tends to increase. In order to limit this effect in high Q circuits the conductor is often silver plated, or with multi-turn coils Litz wire is used. Litz wire consists of a number of thin conductors bundled together. This has the result of increasing the surface area and thus giving lower r.f. resistance values.

Many radio circuit coils are now made in ultra miniature form for mounting directly on printed circuits. As these versions are only slightly larger than the average transistor they have great application in miniature receivers. They are available in sets consisting of r.f., oscillator and two i.f. coils from 15s. to £3.

Self-supporting Coils

Commonly v.h.f. and transmitter power coils are self-supporting. As the frequencies are high the number of turns is small, and in order to reduce skin effect large diameter conductors of 12–18 s.w.g. are used. The better quality coils are silver plated to further reduce the r.f. resistance.

The home constructor usually winds these coils around a tube and experiments to obtain the correct inductance. Most f.m. circuits give details of any coils to be wound. Lack of information should not deter the novice, for experiment is simple and 20 turns of 16 s.w.g. wound on a pencil and then chopped gradually to give the required inductance is usually successful.

For transmitter coils $\frac{1}{8}$in. copper tubing is often used, and many varieties are available on the market. Variable types with sliding contacts are available and silver plating is common. These coils are fairly large, 6 × 2in. in diameter or more, and reasonably expensive, from £1 to £10. When building these coils it is as well to remember that porcelain supporting members should be used as sparingly as possible since high r.f. power results in great stress in the material.

Ferrite Pot Cores

A very wide range of core types and mountings is produced. An average form of core is shown in Fig. 2. The coils are wound on a small plastic bobbin, and end wires left protruding 5–6 inches out of the bobbin. This is slipped over the centre spindle of the half-core and the other core located on the top. The end connections are located in grooves in the cores. The core is rigidly held by a metal clamping assembly which usually incorporates the terminals for end connections. The coils are mounted on the circuit by one or more bolt connections.

Ferrite cores are designed for use in the general range 1kc/s to 15Mc/s for both inductors or transformers and the number of turns for 1mH inductance varies from 20 to 250. As the permeability varies from 20 to 400 they are not as effective as iron cores at low frequencies but due to the inherent air gaps in the material they tend to be non-saturating. They have no eddy current losses whilst hysteresis losses are kept to a minimum.

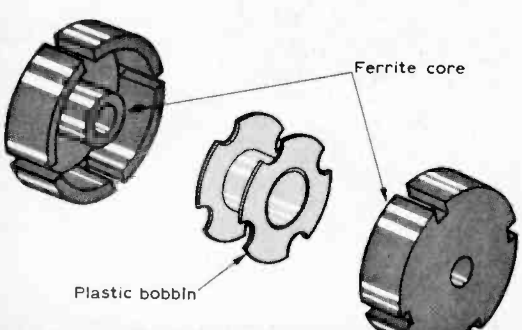

Fig. 2: Ferrite pot core.

Ferrite core inductors and transformers are used from audio frequencies to r.f. as low power transformers, filtering inductors, tuned loads, oscillator transformers, thyristor trigger transformers, etc. Most circuits give details of the winding of transformers and the type of core to be used. However, the design is readily modified to suit existing cores by adjusting the winding to give the correct frequency, inductance and turns ratio. The costs vary from 10s. to £4, depending on the fittings used.

Ferrite Rods

Ferrite rod cores are used extensively in modern transistor receivers as the aerial coil circuit up to 20Mc/s. They consist of ferrite material in rod form of approximately $\frac{3}{8}$in. diameter and from 4 to 10in. long. The rods are available at 1s. to 5s. each. In common with the alternative former wound coils the number of turns is dependent on the frequency range (waveband) to be covered. The rods have a permeability of between 10 and 25, which increases with length up to approximately 10in.; the resulting Q factors are from 100 to 500. Figure 3 shows the construction of a ferrite rod aerial with coils wound for medium and long waves.

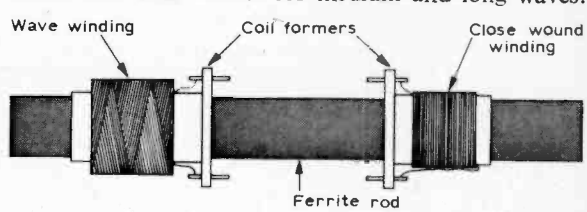

Fig. 3: Ferrite rod aerial.

Table 1: Ferrite Rod Aerial Windings

Waveband	*Frequency*	*Turns*	*Wire type*	*Winding form*
Long	250kc/s	175	Litz 9-strand	Wave
Medium	1Mc/s	54	Litz 22-strand	Close
Short	10Mc/s	6	22 s.w.g.	1in.
Short	20Mc/s	$4\frac{1}{2}$	22 s.w.g.	1in.

The coils are wound on card formers with terminals for the coil termination. Using a tuning capacitor of 500pF the winding details are as given in Table 1. The long wave coil is wave wound in which the turns cover the entire length of the coil many times. Close wound coils are wound with each turn in close proximity to the last. Short wave windings are open, and cover the full 1in. with $4\frac{1}{2}$ to 6 turns.

When the coils are wound the receiver is lined up and tuned by adjusting the coil positions relative to the ends of the rod. The card formers are then fixed in position with drops of wax.

Toroids

Ferrites, iron dust and iron cores are available in toroidal form. The advantage of this construction is that stray magnetic fields are held to a minimum.

Mechanical winding of toroids is more difficult than bobbin coils and therefore they tend to be slightly more expensive.

Toroids are used for filters, magnetic stores, magnetic amplifiers, saturating inverter coils, pulse transformers, etc. A typical toroid is shown in Fig. 4.

Ferrite and iron dust cores are usually pre-moulded and ceramic covered whilst iron cores are made of iron alloy tape wound in a reel and surrounded by a plastic cover to protect the windings. Windings are usually of enamel covered wire covered with tape. The coils are either mounted directly with the coil terminations as flying leads, or the whole is resin encapsulated in a metal container and connections made to terminals or printed circuit pins projecting through the casing.

Ferrite and dust toroidal cores can be obtained readily at 1s. to 5s. each, and inductance information is usually supplied. They are very suitable for differentiating and trigger transformers for switching thyristors and power circuits. Trial and error will produce the required transformer, whilst the inductance required can be calculated from the pulse width, voltage and current using the formula:

$$V = -L \times \frac{di}{dt}$$

$$\text{or } L = -\frac{V\tau}{\Delta I} \qquad (3)$$

where L is the coil inductance, V the voltage across the winding (volts), τ the pulse width (secs) and ΔI the change of current (A).

Recapitulation and Future Trends

We have seen that the range of coils manufactured is wide and the construction and materials are dictated largely by circuit requirements. Standard coils are

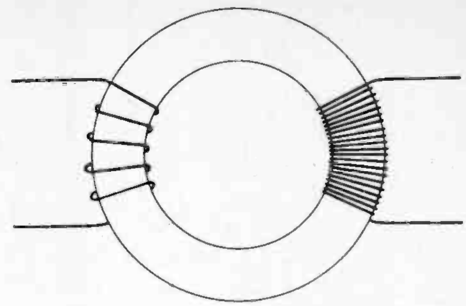

Fig. 4: Toroidal transformer

available for most applications but are difficult to obtain for unorthodox or new requirements. Prototype coils are built as a service by most manufacturers but these are expensive and take between 2 and 6 months to make. Therefore the only solution for the home constructor is to wind and build his own coils using available materials.

In general, satisfactory coils can be reconstructed with a very limited knowledge of coil design. The main requirement is common sense and trial and error. The novice to coil design, once he takes the plunge, is often surprised at the simplicity of obtaining the desired results. They may not always be ideal in design but will fill the bill, which is all that matters.

Future trends will be towards even greater diversity of coil type, especially in the field of switching, inverter and pulse circuits. Power supplies, which at present are limited in size by the large mains transformer, will reduce in size as high frequency switching supplies take over. Most coils will reduce in size as better materials become available.

TO BE CONTINUED

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80µF	6·4 volt
100µF	6 volt
125µF	4 volt
At 1/- each	
16µF	250 volt
50µF	10 volt
100µF	12 volt
320µF	10 volt

Also 8µF 350V **1/2**, 25µF 25V **1/3** and 50µF 50V **1/9**. Other electrolytics in current list. Postage, Packing and Insurance all above **7d.** up to 3; **1/-** from 4–11; 12 and over paid.

2 GANG VAR. CONDENSER: Mod., small, air-spaced, ·0005 ea. sec. **5/-** (1/-).

TRANSFORMERS: Sub-min Output (3Ω for OC72 etc.) and Driver **2/6** each (6d.).

MULTIMETER: 20,000 Ω/v. D.C., 10 000 Ω/v. A.C. 0–5/25/50/250/500/1K volts D.C. ● 0–10/50/100/500/1K volts A.C. ● 0–50µA/2·5mA/250mA D.C. ● 0–6KΩ/6 megΩ ● 10µµF–·001mfd/1mfd. ● —20 to +22dB. ● In leather carry case. Complete with test leads and instructions. ● Over-load protected 1969 model with every refinement. **£4.7.6** (2/6). **JUNIOR MODEL at 35/- (1/6)** 1000Ω/v. described in free list.

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(PW16)

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TRS

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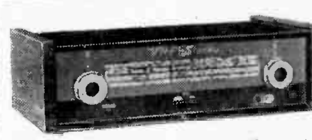

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This advanced design commutable Hi Fi mono/stereo FM tuner comes in easy-to-assemble prefabricated units engineered to the highest standards of efficiency and performance. Valuable refinements include switchable A.F.C., automatic noise suppression, flywheel tuning, stereo indication light, excellent audio response. Sensitivity better than 5 microvolts. Stereo can be added later if so requested. Inclusion of a world famous Gorler I.F. amplifier ensures superb performance. Excellent chassis design made specially to fit the standard TRS Simplex cabinet system. Styled to match the TRS Stereo 4·4.

S.A.E. brings full details.

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Kit to make MONO tuner inc. chassis and tuning assembly (p.p. 3/6)	**15 gns.**
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INTEGRATED AMPLIFIER

A T.R.S. design based on newly developed Mullard 4 watt modules with BC108 pre-amp. Suitable for speakers from 3 to 15 ohms. Bass and treble cut/boost. Response—60 to 14kHz ±3dB. This excellently engineered layout requires only wiring between controls and modules. Complete with metal chassis and T.R.S. simplex teak-ended cabinet for instant assembly. Stereo/Mono and Radio/PU switches.

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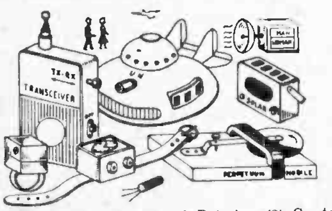

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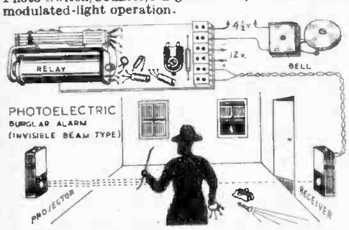

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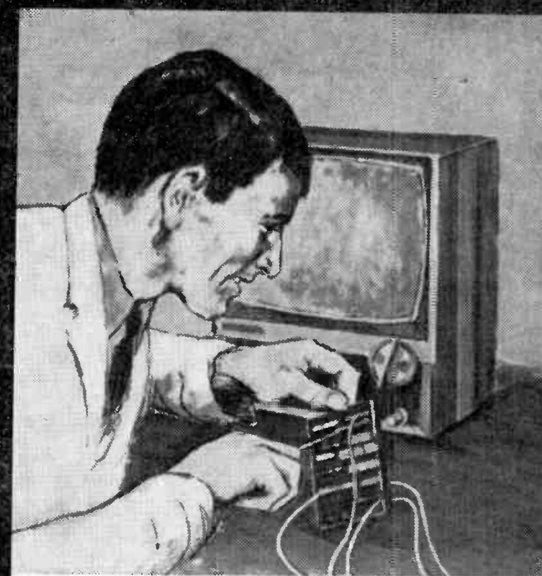

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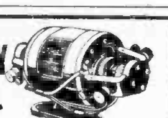

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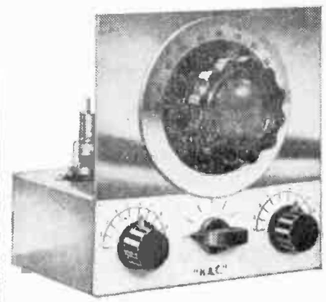

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PRACTICAL WIRELESS, MARCH 1969

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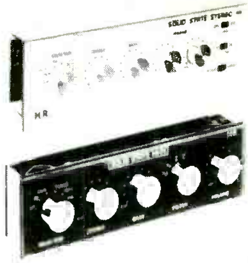

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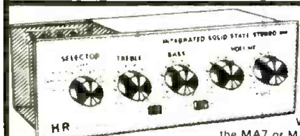

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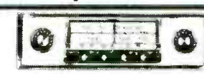

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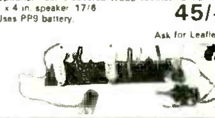

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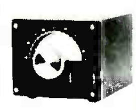

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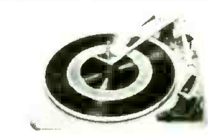

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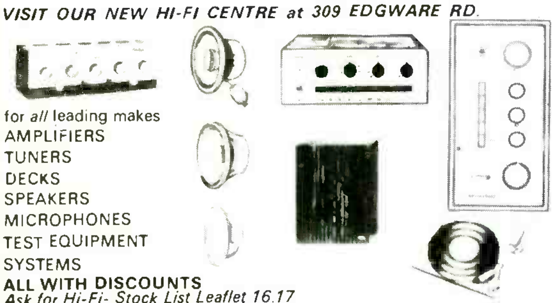

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