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AUGUST 1968

2/6

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1 WATT I.C. AMPLIFIER

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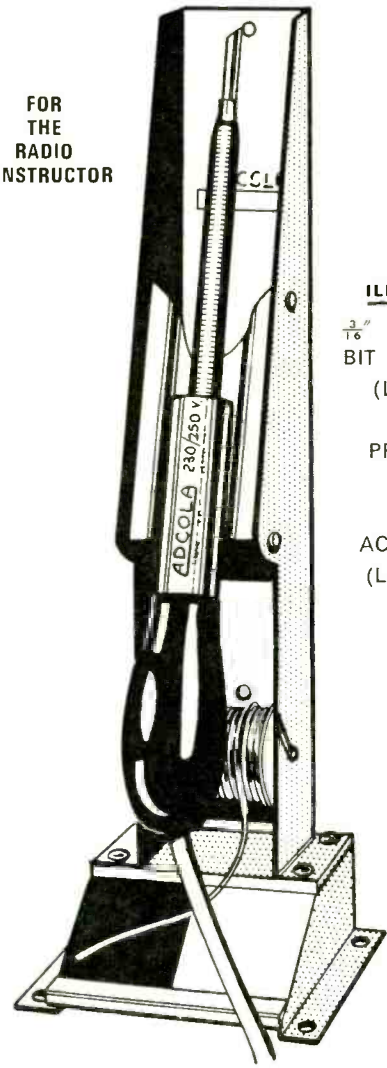

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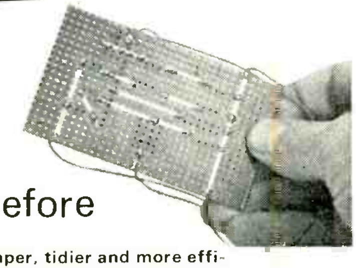

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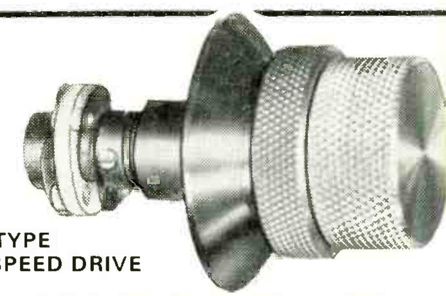

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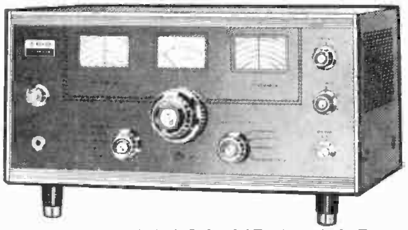
Lasky's Radio

COMMUNICATION RECEIVERS

TRIO



MODEL 9R-59DE

Brief spec.: 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. Special features: SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. band spread dial ● IF frequency 455 Kc/s ● Audio output 1·5 W ● Variable RF and AF gain controls. For use on 115/250 V A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size 7 × 15 × 10in. Weight 19 lbs. Fully guaranteed, complete with instruction manual and service data.

Lasky's Price £36.15.0 Carriage and Packing 12/6

MODEL JR-500SE

Brief spec.: Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. Special features: Crystal controlled oscillator ● Variable BFO ● VFO ● AVC ● ANL ● S meter ● SSB-CW ● Stand-by switch ● Special double gear dial drive with direct reading down to 1 kHz ● Remote control socket for connection to a transmitter. Audio output 1 watt. For use on 115/250 V A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 × 13 × 10in. Weight 18 lbs. Fully guaranteed, complete with instruction manual and service data.

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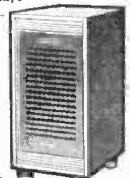
JUST ARRIVED

TRIO SP-5D "SPEAKER MATE"



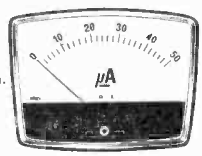
Communications speaker unit—matching both the above receivers in both style and size. Contains 5 × 3in. elliptical 8Ω speaker specially designed to give extremely crisp reproduction of voice frequencies. Dark grey metal cabinet—size 7 × 3½ × 5½ in.

Lasky's Price 82/- Post 3/6

MORE TRIO *NEWS*

Send large S.A.E. for full details of this new great TRIO system NOW AVAILABLE—comprising: The outstanding TS-500 200 W SSB Transceiver £165; PS-500AC Power supply and speaker unit £38; VFO-5 Variable Frequency Oscillator £28. These three units form a complete system superbly matched in performance and appearance.

LASKY'S CLEAR PLASTIC PANEL METERS



Precision made in Japan by HIOKI. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Add 1/6 Post on each. Quotes for quantities.

Type KR-52 3 × 2½in. (illustrated)

1mA	38/6	50μA	56/-
5mA	38/6	1mA S meter	39/6
100mA	38/6	100μA	52/6
300 V	35/-	500μA	45/-

Type MK-38A 1⅝in. square		Type MK-45A 2in. square	
1mA	29/6	1mA	29/6
5mA	27/6	5mA	28/6
100mA	27/6	100mA	28/6
300 V	27/6	300 V	28/6
50μA	37/6	50μA	49/6
1mA S meter	29/6	1mA S meter	32/6
100μA	37/6	100μA	42/6
500μA	29/6	500μA	35/-

Type MK-65A 3in. square		Type KR-65 3½ × 3in.	
1mA	38/6	1mA	38/6
5mA	36/-	5mA	37/6
100mA	38/6	100mA	38/6
300 V	36/-	300 V	36/-
50μA	59/6	50μA	59/6
1mA S meter	38/6	1mA S meter	42/-
100μA	52/6	100μA	56/-
500μA	42/-	500μA	46/-

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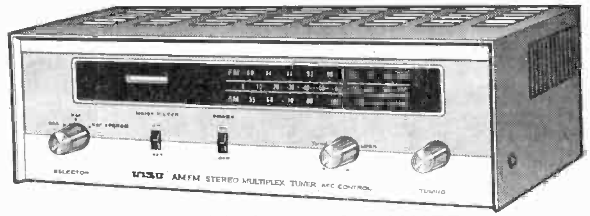


AFX-3U AM/FM STEREO TUNER

Superbly engineered by world famous manufacturer, the Model AFX-3U is an ultra sensitive AM/FM stereo multiplex tuner using 14 valves and 9 diodes. The extra wide bandwidth of the tuner and unique multiplex circuitry ensures the finest possible FM reception with optimum stereo separation of over 38dB. Stereo signal beacon with special circuitry unaffected by external noise, simplifies FM stereo broadcast selection. 3 gang variable condenser provides highly sensitive reception on both bands. The multiplex circuit is completely free from subcarrier leakage and permits direct tape recording without any beat noise interference. An MPX noise filter is also fitted. **Brief specification:** 14 valves, 2 Germanium diodes and 2 Silicon diodes. Frequency range: FM—80–108 Mc/s, AM—535–1605 Kc/s. Sensitivity: FM—1·9μV/98 Mc/s, AM—2μV/100 Kc/s. Output FM/FM Stereo 2 V, AM—3 V. Frequency response: FM—20–20,000 c/s. Distortion less than 1%. Special Circuits: FM Stereo indicator, AFC. Noise filter. Output for direct tape recording. Hammer enamel and brushed alloy finish. Cabinet size 14½ × 5 × 9¼in. For 220/240 V. AC Mains (50 or 60 c/s) operation. Complete with operating manual. List Price 55 Gns.

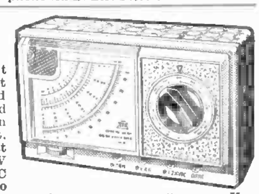
Lasky's Price 26 Gns. Carriage and Packing 7/6

FOSTER HF-204 COMBINED MICROPHONE/HEADSET

High quality moving coil headphones and sensitive dynamic microphone combined in one light weight unit. For use with tape recorders (provides constant monitoring), communications equipment, PA (crowd or traffic control), stage direction, language labs, etc. Extremely comfortable to wear for long periods—adjustable foam padded ear cushions, vinyl covered headband. Headphone imp. 8Ω, max. input 100mW. Microphone imp. 25Ω. Weight 8.8 ozs. Single cable contains both headphone and microphone leads. List Price 7 Gns.

Lasky's Price 59/6 Post 2/6

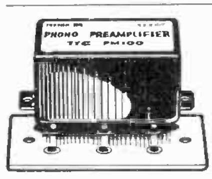
METER BARGAIN Model C-1051



A completely new design 20,000 O.P.V. pocket multimeter with built in thermal protection circuit and mirror scale. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment. Range spec. AC volts: 0–6–30–300–1200 V at 10K/ohms/V. DC volts: 0–3–15–150–300–1·2KV at 20K/ohms/V. Resistance: 0–60K–6megs. DC current: 0–63μA–300mA. Decibels: —20dB to +17dB. Hand calibration gives extremely high standard of accuracy on all ranges. Uses one 1½ V penlight battery. Strong impact resistant plastic cabinet—size only 4⅞ × 3⅞ × 1⅛in. Two colour buff/green finish. Complete with test leads and battery. Original list price £5.5.

Lasky's Price 75/- Post 2/6

LASKY'S INCAPSULATED SOLID STATE MODULES



7 completely new special function circuit modules now with unique plug in base enabling the module to be plugged in or out of circuit as required. Size of each module only 2¼ × 1¼ × ¾in. Ready for immediate use—just connect to power source (usually 9 V batt.), input and output. Incapsulated modules are shock proof and almost indestructible. Comp. with full ins. Post 1/6 ea.

E-1311 Phono Pre-amp Module—max. output 3 V. RMS, input 50mV, input imp. 100kΩ, gain 28dB, RIAA compensation. **PRICE 29/9**

E-1312 Tape Head Pre-amp Module—max. output 3 V RMS, input 50mV, input imp. 100kΩ, gain 25dB, NARTB compensation. **PRICE 29/6**

E-1313 Microphone Pre-amp Module—max. output 4 V. RMS, input 50mV, input imp. 100kΩ, gain 28dB, response 10–50kc/s. **PRICE 29/6**

E-1314 Power Amplifier Module—max. output 300mW, input imp. 1kΩ, gain 20dB, response 50–10kc/s, distortion 3% at 200mW. **PRICE 29/6**

E-1315 Electronic Organ (tone oscillator) Module—frequency 200–1000 c/s, output 80mW. For use with keyboard, variable resistors and 8Ω speaker. **PRICE 25/-**

E-1316 Morse Code Practice Oscillator Module—frequency 400 c/s, output 80mW. For use with morse key and speaker. **PRICE 25/-**

E-1317 Modulated Wireless Signal Transmitter for use in test bench fault finding—frequency 400 c/s–30 Mc/s, tone freq. 400 c/s. For use with any AM receiver. **PRICE 25/-**

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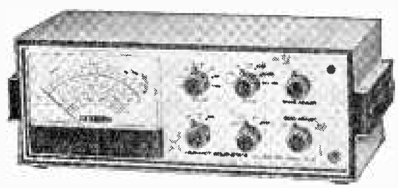
Kit IM-25 **£48.10.0** **Ready to use** **£59** P.P. 7/6

New Solid-State, High-Impedance Volt-Ohm-Milliammeter . . . IM-25

● 9 AC and 9 DC voltage ranges from 150 millivolts to 1500 volts full scale ● 7 resistance ranges, 10 ohms centre scale with multipliers x1, x10, x100, x1k, x10k, x100k, and x1 meg . . . measures from one ohm to 1000 megohms ● 11 current ranges from 15 μA full scale to 1·5 A full scale ● 11 megohm input impedance on DC ● 10 megohm input impedance on AC ● AC response to 100 kHz ● 6in. 200 μA meter with zero-centre scales for positive and negative voltage measurements without switching ● Internal battery power or 120/240 VAC, 50 Hz ● Circuit board construction for extra-rugged durability.



Kit IM-16 **£28.8.0** **Ready to use** **£35.8.0** P.P. 6/-

New Solid-State Volt-Ohm-Meter . . . IM-16

● 8 AC and 8 DC ranges from 0·5 volts to 1500 volts full scale ● 7 ohm-meter ranges with 10 ohms at centre scale and multipliers of x1, x10, x100, x1k, x10k, x100k, and x1 megohm ● 11 megohm input on DC ranges, 1 megohm on AC ranges ● Operates on either built-in battery power or 120/240 VAC, 50 Hz ● Circuit-board construction.

Kit IP-17 **£37.4.0** **Ready to use** **£46** P.P. 10/6

IP-27 not illustrated, but similar in styling.

New Variable Control Regulated High Voltage Power Supply . . . IP-17

● Furnishes 0 to 400 volts DC at 100 mA maximum with better than 1% regulation for 0 to full load and ± 10 volt line variaton ● Furnishes 6 VAC at 4 amperes and 12 VAC at 2 amperes for tube filaments ● Provides 0 to —100 volts DC bias at 1 milliampere maximum ● Features separate panel meters for continuous monitor for output current and voltage ● Terminals are isolated from chassis for safety ● High voltage and bias may be switched "off" while filament voltage is "on" ● Modern circuit board and wiring harness construction ● 120/240 VAC, 50 Hz operation.

New Improved Version of the Famous Heathkit Solid-State, Voltage-Regulated, Current-Limited Power Supply . . . IP-27

● New zener reference ● New improved circuitry is virtually immune to overload due to exotic transients ● 0·5 to 50 volts DC with better than ± 15 millivolts regulation ● Four current ranges 50 mA, 150 mA, 500 mA and 1·5 amperes ● Adjustable current limiter: 30 to 100% on all ranges ● Panel meter shows output voltage or current ● "Pin-ball" lights indicate "voltage" or "current" meter reading ● Up-to-date construction ● Unequalled performance in a laboratory power supply.

Kit IP-27 £46.12.0. Ready to use £55. P.P. 9/-.

FULL SPECIFICATION ON ANY MODEL AVAILABLE ON REQUEST

New Solid-State Volt-Ohm-Meter, IM-17

● Just right for the home owner, boater, model builder, hams, sophisticated enough for even radio and TV servicing ● Solid-state circuit ● FET input ● 4 silicon transistors, 1 diode circuit ● 4 AC voltage ranges ● 4 DC voltage ranges 4 ohm ranges, 11 megohm input DC, 1 megohm input AC, 4½in. 200 μA Meter ● Self powered ● Rugged polypropylene case with self cover and handle. Storage space for own flex leads. PCB construction.

Kit £12.12.0. Ready to use £17.10 0. P.P. 4/6.

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Consisting of (1) Garrard Mk II SP25 4-speed Turntable with Pick-up. Heavy 12in. turntable, hydraulic lowering device and many other features inc. Plug in P.U. head. Fitted CS90 P.U. Cartridge. Ready wired on plinth (baseboard). Fitted plugs for instant use. (2) Super 30 Amplifier fully wired and fitted in cabinet (3) Pair of Stanton Loudspeaker Units. Extremely attractive cabinets finished Satin Teak Veneer. Tinted Perspex 'hinged' lid. Performance comparable with equipment at twice the cost. Substantial saving on package deal.
Special inclusive price **72 Gns.**
Terms: Dep. £21.12.6 and 12 mthly pymts of £5. Total £81.12.6 Send S.A.E. for leaflet. Also 'Plan 3' with Goldring Transcription Unit and Shure P.U. Cartridge. 82 Gns.

Inc. Garrard SP25 MkII Player Unit (with heavy cast turntable) on B/board, ready wired, with plugs and fitted Goldring CS90 high compliance ceramic cartridge with diamond stylus. Assembled TA12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. Total for above saving £9. Special Price **47 Gns.** Carr. 35/-
Perspex cover 59/9 extra.
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Heavy cast construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range. Impedance 3 or 15 ohms. Please state choice. Response 40–18,000 c.p.s. Exceptional performance at low cost.

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HF120	12" 15W	69/9	HF126D	12" 15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets of latest styling Satin Teak or Walnut acoustically lined (and ported where appropriate). Credit terms available on all units.

DORSET Size 16 x 11 x 9in. Response 45–18,000 c.p.s. Rating 8–10 watts. Fitted Audiotrine HF800D speaker. Impedance 3 or 15 ohms. **£7.10.0** Inc. Carr.

STANTON IIIS Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815 speaker with roll rubber surround and 15,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet Response 30–20,000 c.p.s. Impdnce 3 or 15 ohms. Gives smooth realistic sound output. **16 Gns.**

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

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on Credit Sales settled in 3 months.

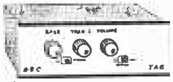
EXTENSION LOUDSPEAKERS 29/9

Cabinet size 12 x 8 x 5in. Attractive Grey Lizard Skin finish. Fitted high flux 4–5 watt. 6½in. 3 ohm speaker.

E.M.I. MAINS R/PLAYER TURNTABLES

4 Speed, with P.U., T/O Cartridge. Limited number. Mail Order only. Mono 79/9. Stereo 89/9.

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. 9½ x 2½ x 5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6
Or factory built with 12 months guarantee. Post Paid 8 Gns. **6 Gns.**

RECORD PLAYING 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, plinth and cover. Normally approx. £26. Inc. Carr. **22 Gns.**
RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Normally approx. 32 gns. Inc. Carr. ONLY **27½ Gns.**

AUDIOTRINE PLINTHS

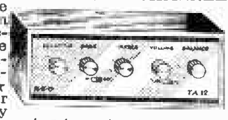
for Record Playing units. Teak finish cut for Garrard 1000. 2000. 3000. AT6. AT60. SP25 or Goldring GL68. Available with clear Perspex cover as ill. Inc. Carr. **£5.15.0** **59/9**
Pespex cover sold separately at 59/9 Limited number slightly damaged but repaired by Manufacturer. 39/9 to clear.

PHONE AMPLIFIERS

Speak and listen with both hands free. Battery operated. **59/9**

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 and instructions. Factory built with 12 mth gntee 15 GNS. Or Deposit £4.16.0 and 9 mthly pymts. 29/- (Total 17 GNS.). **11** GNS. Carr. 7/9
Teak finish cabinet as above 73/6 or as in stereo system 4 Gns.

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
FR3b 3-Speaker System inc. HF 122L 12in. 20 watt Bass speaker with roll rubber cone surround for very low fundamental resonance. 5in. 10,000 line middle range speaker, high flux cone type tweeter, appropriate choke/capacitor cross-overs. Imped. 15 ohms. Frequency response 20–20,000 c.p.s. Provides superb reproduction. Circuit and recommended cabinet size supplied. **11 Gns.**

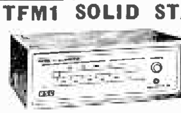
HI-FI 'SPEAKER ENCLOSURES

Teak veneer finish

Modern design. Accoustically lined and ported.
JE8 Size 16 x 11 x 9in. Gives pleasing results with any 8in. Hi-Fi 'speaker. Inc. Carr **£3/19/9**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Inc. Carr. **£4/19/9**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24 x 15 x 10in. **5 Gns.**
SE12 For excellent performance with 12in Hi-Fi 'spkr and Tweeter. Size 25 x 16 x 10½in. **6 Gns.**

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

Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ 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.



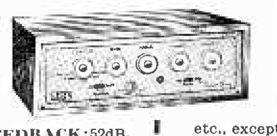
★High-sensitivity ★200-250v. A.C. Mains operation. ★Sharp A.M. Rejection. ★Drift-free reception. ★Output ample for any amplifier (approx. 500 m.v.). ★Simple alignment instructions. ★Output available for feeding tuning meter. ★Output for feeding Stereo Multiplexer. ★Tuner head using silicone Planar Transistors. ★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 first grade transistors and components used. A quality product at half the cost of comparable units. Stereo version, all parts 18 gns. Assembled 22½ gns. Carr. 10/-.

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

SOLID STATE CONSTRUCTION

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.
LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
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. 0·1%
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 3½ Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST



R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance 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/- **19 Gns.**
Unit factory built 27 Gns. or deposit £6.2.0 and 9 monthly payments 56/3. (Total £31.8.3). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £6.2.6 and 9 monthly paymts 64/- (Total £34.18.6). *Send S.A.E. for leaflet.*

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
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GLASGOW 326 Argyle St. (No half-day) Tel. CITy 4158; 403 Sauchiehall St. (Opp. Locarno) 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.

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AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST Please send S.A.E. for leaflet.
CAN BE ASSEMBLED IN AN HOUR
ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.

Incorporating latest Magnavox Tapedeck. High quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leathercloth. Size 14¾ x 17 x 8½in. and circuit. Items purchased separately total approx. £36. Performance equal to units in the £60–£70 class. **Deposit 4 gns.** and 9 monthly payments 59/6 (Total 29¾ gns.). 4 Track Model 3 gns. extra. Limited number now available at pre budget price. Carr. 19/6 **26½ GNS.**

R.S.C. STEREO/20 HI-FI AMPLIFIER

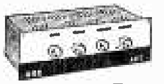
PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 20 millivolts max. **Harmonic Distortion:** 0·2% ★**Four-position tone compensation and Input Selector Switch.** ★**Stereo/Mono switch.** ★**Neon panel indicator.** ★**Handsome Perspex Frontplate.** ★**Separate Bass and Treble controls.** Output transformers are high quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 mths' gntee 19gns. Or Dep. £4.10.0 and 9 monthly payments £2 (Total £22.10.0). *Send S.A.E. for leaflet.*

14 Gns. Carr. 12/6

R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All first grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that **any kind of Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram, Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **13 Gns.** Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months' guarantee for 16 gns. **TERMS: Deposit £5.14.0** and 9 monthly payments of 28/9 (Total £18.12.9). Send S.A.E. for leaflet.

R.S.C. A11T 15 WATT HIGH FIDELITY AMPLIFIER



DUAL PURPOSE P.A. or HI-FI. SOLID STATE CIRCUITRY. ★3 input sockets. ★2 vol. controls for mixing purposes. ★Input Selector. ★Output for speakers between 3 and 15 ohms. ★Separate Bass and Treble Controls. Suitable for Gram, Radio, Tape, Microphone, or Guitar P.U. For Vocal and Instrumental groups. Frequency Response 20-40,000 c.p.s. —3dB. Hum level —80dB. Harmonic Distortion 0·2% at 10 watts R.M.S. Operation on 200-250v. A.C. mains. Size 9¾ x 2¾ x 5¼in. Complete Kit of parts with comprehensive wiring diagrams and instructions. **9 Gns.** Carr. 9/6
Or Factory built with 12 mths. guarantee 13 gns. Carr. 9/6. Terms: Deposit £4 and 9 monthly payments 25/6 (Total £15.9.6).

R.S.C. BASS-REGENT 50 WATT AMPLIFIER

An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes" plus Bass and Treble controls.
49½ Gns. Carr. 30/- or dep. £7.17.6 and 9 monthly payments of £5.10.10. (Total 55 gns.). Send S.A.E. for leaflet.
Also B20 Bass inc. 15in. 25w.Spkr. 29¾ gns. G15 inc 12in. 20w. Spkr. 19¾ gns.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1 An all-dry battery eliminator. Size 5½x4½x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or assembled 59/11.

SELENIUM RECTIFIERS | F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9.

R.S.C. MAINS TRANSFORMERS

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

MIDGET CLAMPED TYPE 2½ x 2¾ x 2¼in.

250v., 60mA, 6·3v. 2a.	14/11
250-0-250v., 60mA, 6·3v. 2a.	15/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	19/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	33/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	33/9
300-0-300v. 130mA, 6·3v. 4a., c.t., 6·3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	33/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	42/9
425-0-425v. 200mA, 6·3v. 4a. c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6·3v. 4a, 6·3v. 4a., 5v. 3a.	69/9
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	79/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a.	19/9
250-0-250v. 100mA, 6·3v. 3·5a.	21/9
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a.	22/9
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	23/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	32/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	32/9
300-0-300v. 130mA, 6·3v. 4a., 0-5-6·3v. 1a. Suitable for Mullard 510 Amplifier	39/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	32/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	39/11

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 6/9; 6·3v. 2a. 7/9; 6·3v. 3a. 9/9; 6·3v. 6a. 19/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1·5a. 19/9; 0-9-18v. 1½a. 15/9; 0-12-25-42v. 2a. 27/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 13/11; 2½a. 16/11; 3a. 18/11; 6a. 25/11; 8a. 31/11

AUTO (Step UP/Step DOWN) TRANSFORMERS

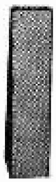
0-110/120v.-200-230-250v. ......50-80 watts	14/9
150 watts, 29/11; 250 watts 49/9; 500 watts	99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000Ω or 7,000Ω to 3Ω	7/9
Push-Pull 8 watts EL84 to 3Ω or 15Ω	11/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15Ω	21/9
Push-Pull EL84 to 3 or 15Ω 10-12 watts	19/9
Push-Pull Ultra Linear for Mullard 510, etc.	35/9
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15Ω	29/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15Ω	55/9

SMOOTHING CHOKES
150mA, 7-10H, 250Ω 12/9; 100mA, 10H, 200Ω 9/11; 80mA, 10H, 350Ω 7/9; 60 mA, 10H, 400Ω 4/11.

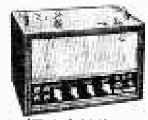
R.S.C. COLUMN SPEAKERS



Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 25-30 watts.** Fitted four 8in. high flux 7watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **15 Gns.**
Type C412, 40 watts. Fitted four 12in. 12,000 line 10watt speakers. Overall size 56 x 14 x 9in. approx Carr. 15/- **22 Gns.** Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

R·S·C HI-FI CENTRES LTD.

30 WATT HI-FI AMPLIFIER



for Guitar, Vocal or Instrumental Group
A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Peak rating 60 watts. Latest valves. 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 monthly payments of 39/8 (Total £21).

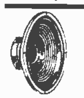
12in. HIGH QUALITY LOUDSPEAKERS

In Teak veneered or Rexine covered Cabinets
18 Watt 12,000 lines 3 or 15 ohms **5 Gns.** 20 Watt 12,000 lines 3 or 15 ohms **8 Gns.**

LOUDSPEAKERS

Limited number of heavy duty units at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available over £8.

12in. 10 watt HIGH FLUX	12in. 20 watt DUAL CONE	12in. 30 watt DUAL CONE	15in. 30 watt DUAL CONE
59/11	£5.15.0	Normally appr. £13 **£6.19.9**	Normally appr. £15 **9 gns.**



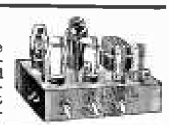
FANE 'POP' 100 LOUDSPEAKER

18" 100 Watt POST FREE
Fantastic power handling. Guaranteed 2 years. **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 26/11. Or assembled 39/11. **22/11**

R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER



A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and most "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feed-back 15dB. For A.C. mains 200-250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions **£4.17.9**

HIGH QUALITY 8" x 3" LOUDSPEAKERS 10000 Gauss 3 ohm only **12/9**

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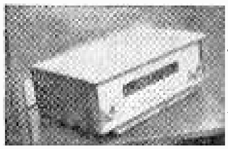
BRITISH NATIONAL RADIO SCHOOL

TRANSISTOR POWER OUTPUT STAGE on P.C. Board (with diagram). 5½in. x 2in. x 1½in. high. Tested and working. OC71, OC81D and 2 x OC81 and Heat Sinks. With O.P. Trans. for 35 ohm speaker. Requires 5K Pot, Speaker and 9v. supply. Price 27/6. Post paid. 5K Log Pot + Switch 4/-. 8in. x 2½in. 35 ohm. Speaker 16/6.

NEW RANGE GARRARD AUTOCHANGERS. All Carr. Pd. and without cartridge except type 3000 (stereo) and BSR UA25 (mono). 1025—£10.2.6; 2025—£10.10.0; 3500—£11.17.6; SL55—£13.10.0; 3000—£13.5.0; SP25 Mk. II—£15; AT60 Mk. II—£16.15.0; 50 Mk. II—£12.10.0; SRP22—£6.10.0; BSR UA25—£7.10.0.

60 MIXED CERAMIC CONDENSERS. 1 pf to ·1 mf 10/-. 150 for £1. Post paid.

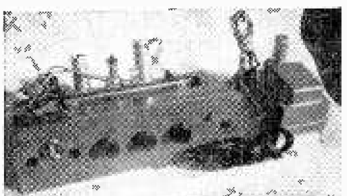
1½W MAINS GRAMOPHONE AMPL. EZ80, ECL82, O.P. Transformer (3 ohm) Vol./On-off and Tone Control. Double wound mains transformer. 2½ x 2½in. x 2½in. separate but wired to chassis, 4in. x 2½in. x 4½in. over valves, 65/- post paid including 6½in. Speaker. (52/6 less speaker.)



NEW F.M. TUNER. Range 87 to 107 MHz. Attractively finished metal container with cast front escutcheon. Case size 13in. x 7in. x 3½in. high. Mains transformer. Metal Rectifier and Valves ECC85, EF89, EF80, ECC82 as cathode follower, EM84 tuning indicator, 2 x AF117 and 2 diodes. A really fantastic performer. Price £15.15.0 tax paid and carr. paid or with Stereo, Decoder £22.10.0.

2 x 4 WATT STEREO AMPLIFIER. Printed circuit. Separate power pack. Metal rectifier. ECC83 and 2—EL84. Negative feedback. Vol., bass, treble each channel Muting switch and on/off. £5.10.0 (7/6 P. & P.).

TAPE AMPLIFIER FOR MAGNAVOX TAPE DECKS — 2 or 4 TRACK



Chassis 12½ x 5½ x 4½in. high. Front panel "gold" finish—12½ x 4½in. 200—250 A.C. Record/Playback amp. switch Off/On-Tone; Vol./Mic.; Vol./Gram; Mic. Input; Gram. Input; Monitor; Speaker Socket Valves 6BR7; 12AX7; EM84; EL84; 6X4 Separate power pack 2 Track £8.19.6; 4 Track £10.4.6 (6/- post each) Rexine covered cabinet (tan) 15½ x 17 x 9½in. high with sloping front for amp; complete with two tweeter speakers, and special adapting brackets for Magnavox Deck 85/- (8/- carr) 3 speed Magnavox 4 track tape deck Type 363 £16.10.0 carr paid.

8+8W. TRANSISTOR STEREO AMPLIFIER by Dulci. Fully built and attractively presented. Write illus. and details. Only £19.19.0 post paid.

TRANSISTOR RADIO "BASICS". (1) Variable 2-gang. (2) 6½in. aerial with M.W. and L.W. coils. (3) 5K control and switch. (4) Driver and O.P. trans for OC81s into 3-ohm. (5) 6 x 4in. speaker. (6) 2-tone dial and 2½in. perspex tuner; at 40/- the lot, post paid, plus 10/- for Osc. and 3 I.F.ts. (17mm circ.).

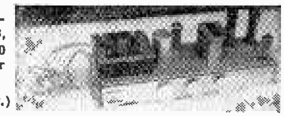
"SUPER SIX" L.W. and M.W. TRANSISTOR RADIO KIT, Mark 2. Complete set parts £4.2.5 (5/- post), PP6 batt. 2/9 extra. Instructions and list 2/- (free with kit). Superhet; ferrite rod; wooden cab. 9½ x 7½ x 3in. Celestion 4½in. speaker, 6 transistors, diode, etc.

SPEAKERS IN CABINETS. 20 x 15 x 6½in. Finished Vynair and Rexine, various colours. With E.M.I. 13 x 8in. 3 or 15 ohm speaker 90/-; with 12in. Elac 15-ohm 15W speaker. £8.10.0 (post 10/- on either).

½W. SKELETON POTENTIOMETERS. OHMS. 300, 1·5K, 2·7K, 5K, 10K, 15K, 20K, 25K, 50K, 220K, 1M, 2M. 1/-ea. postage 4d, any quantity, or 25 for £1, post paid.

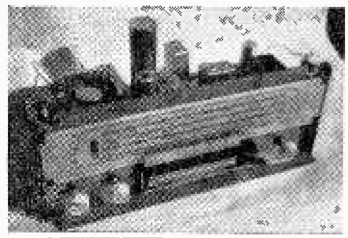
100 MIXED UNMARKED TRANSISTORS, 50/-, post paid.

8 WATT. PUSH-PULL OUTPUT AMPLIFIER, 200-250 Volts A.C. EZ80, ECC83, 2—EL84, Bass, treble, vol/on-off. £5.15.0 (7/6 P. & P.). Size 12 x 3½ x 5in. high. For Record Player, Radio Tuner, etc.



Available as a Kit at £5 (7/6 P. & P.)

5 PUSH-BUTTON STEREOGRAM CHASSIS



M.W.; S.W 1; S.W.2; V.H F.; Gram: Stereo Gram. Two separate channels for Stereo gram with balance control. Also operates with two speakers on Radio. Chassis size: 15 x 7 x 6½in. high. Dial silver and black 15 x 3in. 190-550M; 18-51M; 60-187M; VHF 86-100 Mc/s. Valves: ECC85, ECH81, EF89, 2x ECL86, EM84 and Rect. Price £19.19.0, carr paid or £6.13.0 deposit and 5 monthly payments of 56/6. Total H.P. price £20.15.6. Cream moulded escutcheon included.

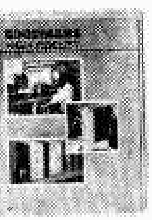
GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, Hants.

(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240
CLOSED WEDNESDAY AFTERNOON. CATALOGUE 6d.

ALL ITEMS FULLY BUILT UNLESS OTHERWISE STATED

GOODMANS HIGH FIDELITY MANUAL



A Guide to full listening enjoyment

The Manual is much more than a catalogue of Goodmans High Fidelity Loudspeakers—it contains informative articles, including advice on stereo, special beginners page, and full cabinet drawings. You'll find it interesting as well as informative.

The Perfect Combination

MAXAMP 30

TRANSISTORISED STEREOPHONIC HIGH FIDELITY AMPLIFIER 15 + 15 watts · Silicon solid state · Integrated pre-amplifier · Negligible distortion · £54.

STEREOMAX

MATCHING AM/FM STEREOPHONIC FM TUNER

Transistorised · Outstanding specification · Stereo de-coder (optional) £65.5.0 + £15.14.0 P.T.

Both MAXAMP 30 and STEREOMAX have polished wood cases (10½" x 5½" x 7¼" deep) in Teak or Walnut to order.

Full specifications of the Maxamp 30 and Stereomax are given in the High Fidelity Manual—send the coupon for your FREE copy—or pay an early visit to your Goodmans dealer.

FREE Please send Hi-Fi Manual together with name and address of my nearest Goodmans dealer.

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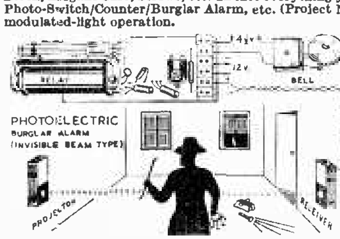
PHOTOELECTRIC KIT

CONTENTS: 2 P.C. Chassis Boards, Chemicals, Etching Manual, Infra-Red Phototransistor, Latching Relay, 2 Transistors, Condenser, Resistors, Gain Control, Terminal Block, Elegant Case, Screws, etc. In fact everything you need to build a Steady-Light Photo-Switch/Counter/Burglar Alarm, etc. (Project No. 1) which can be modified for modulated-light operation.



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12 PHOTOELECTRIC PROJECTS. (1) Steady-Light Photo-Switch/Alarm. (2) Modulated-Light Alarm. (3) Long-Range Stray-Light Alarm. (4) Relay-less Alarm. (5) Warbling-Tone Alarm. (6) Closed-Loop Alarm. (7) Projector Lamp Stabiliser. (8) Electronic Projector Modulator. (9) Mains Power Supply. (10) Car Parking Lamp Switch. (11) Automatic Headlamp Dipper. (12) Super-Sensitive Alarm.

INVISIBLE BEAM OPTICAL KIT

Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, Infra-red filter, projector lamp holder, building plans, performance data, etc. Price 19/6. Postage and Pack. 1/6 (UK). Commonwealth: Surface Mail 2/-; Air Mail 8/-

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Versatile Invisible-beam, Relay-less, Steady-light Photo-Switch, Burglar Alarm, Door Opener, Counter, etc., for the Experimenter.
CONTENTS: Infra-Red Sensitive Phototransistor, 3 Transistors, Chassis, Plastic Case, Resistors, Screws, etc. Full Size Plans, Instructions, Data Sheet "10 Advanced Photoelectric Designs".
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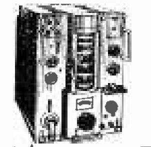
YORK ELECTRICS, 333 York Road, London, S.W.11

Send a S.A.E. for full details, a brief description and Photographs of all Kits and all 52 Radio, Electronic and Photoelectric Projects Assembled.



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, bandpass 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 x 13½ x 16in. Weight 114 lbs. Offered in good working condition. **£22.10.0.** Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s., **£17.10.0.** Carr. 30/-.

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing, ¼in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1000/1500/2500 or 5000 ohms, **14/6.** P. & P. 1/6.
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100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms, **27/6.** P. & P. 1/6.

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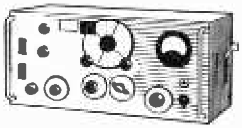
High quality 97 range instrument which measures A.C. and D.C. Voltage, Current, Resistance and Power Output. Ranges D.C. volts 250mV–10,000V. (10 megΩ–110 megΩ input). D.C. current 10µA–25 amps. Ohms: 0–1,000 megΩ. A.C. volt 100 mV–250V. (with R.F. measuring head up to 250 Mc/s). A.C. current 10µA–25 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/-.

MARCONI TEST EQUIPMENT



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

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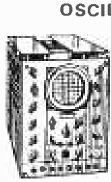
Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM/CW/FM Incorporates precision dial, level meter, precision attenuator 1 µV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A C Size 12 × 8½ × 9in. Supplied in brand new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

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

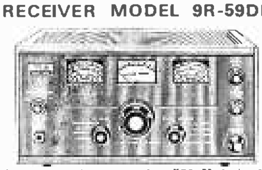


An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. **£22.10.0.** Or complete with all accessories, probe, leads, lid, etc. **£25.** Carriage 30/-.

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid.
High quality construction. Input 230 V. 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.

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. 115/250 V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. **£37.10.0.** Carriage 12/6.

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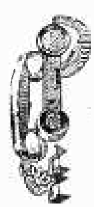
Each headphone contains a 2½in. woofer and a ⅞in. tweeter. Built in individual level controls 25–18,000 c.p.s. 8Ω imp. with cable and stereo plug.
£5.19.6. P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

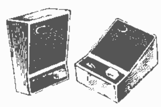


Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets.
£6.19.6. P. & P. 3/6.

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.
500 W. **£3.10.0.** P. & P. 6/6.
1,000 W. **£5.10.0.** P. & P. 7/6.
1,500 W. **£6.10.0.** P. & P. 8/6.
3,000 W. **£7.10.0.** P. & P. 12/6.
7,500 W. **£15.10.0.** P. & P. 20/-.

INTERCOM/BABY SITTER



Transistorised Intercoms, ideal for home / office / workshop etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions, 2 station **59/6.** P. & P. 2/6. 4 station **£6.12.6.** P. & P. 5/-.

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An extremely high quality oscilloscope with time base of 10Q/sec. to 20 m/sec. Internal Y amplifier. Separate mains power supply 200/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. **£8.19.6.** Carriage 30/-.

SINCLAIR EQUIPMENT

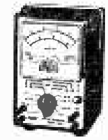
Z12 12 watt amplifier, **89/6.** PZ4 Power Supply Unit, **99/6.** Stereo 25 Preamp., **£9.19.6.** Q14 Speakers, **£7.19.6.** Micromatic Radio Kit, **49/6.** Built, **59/6.** Micro FM Radio Kit, **£5.19.6.** All Post Paid.

SPECIAL OFFER
2 Z12 Amps., PZ4 Power Supply, Stereo 25 Preamplifier. **£22**
Or with two Q14 Speakers **£37.**

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

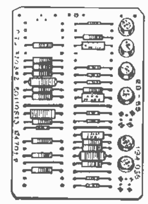
2 pF–2,000 mfd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V A.C. Brand New **£17.10.** Carr. 7/6.

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



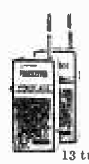
10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4 cps.–1·2Mc/s. Decibels —40 to +50 dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. **£17.10.0.** Carr. 5/-.

PRINTED CIRCUITS



Five assorted printed circuit boards with transistors, diodes, resistors, condensers, etc. Guaranteed minimum 20 transistors. Ideal for experimenters. 5 boards for **10/-.** P. & P. 2/-.

2-WAY RADIOS



Super quality. Brand new and guaranteed.

3 transistor	£6.15.0 pr.
4 transistor	£6.19.6 pr.
5 transistor	£7.19.6 pr.
6 transistor	£8.12.6 pr.
6 transistor De Luxe	£12.10.0 pr.
10 transistor	£22.10.0 pr.
13 transistor 500 MW	£31.10.0 pr.

Post extra.
These cannot be operated in U.K.

NOMBREX TRANSISTORISED TEST EQUIPMENT

All Post Paid with Battery

Model 22. Power Supply 0–15V DC	£14.10.0
Model 30. Audio Generator.	£19.10.0
Model 31. R.F. Signal Generator.	£12.10.0
Model 32. C.R. Bridge.	£10.10.0
Model 33. Inductance Bridge.	£20.0.0
Model 66. Inductance Bridge.	£18.0.0
Model 61. Power Supply.	£6.10.0

COSSOR DOUBLE BEAM OSCILLOSCOPES

Type 1035. General purpose. A.C. Coupled. Type 1049. L.F. D.C. Coupled. **£35** each. Carr. 30/-.

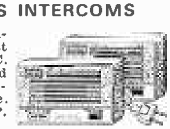
LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

0–20 Kc/s. Output 5 K or 500 ohms. 200/250 V. A.C. offered in excellent condition. **£12.10.0.** Carriage 10/-.

R.C.A. AR88 SPEAKERS

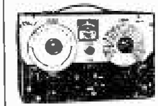
8in. 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available brand new and boxed with leads. **59/6.** Carr. 7/6.

MAINS INTERCOMS



No wires, no installation, just plug into A.C. power point and operate. Extremely sensitive. **£8.12.6.** P. & P. 3/-.

ARF-100 COMBINED AF-RF SIGNAL GENERATOR



AF. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P HIGH IMP. 21V P/P600Ω 3·8V P/P. TF 100Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V A.C. **£27.10.0.** Carr. 7/6.

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 instructions. **£15.0.0.** P. & P. 7/6. S.A.E. for details.

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, **£15.** Carr. 7/6.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.
Model 47A **£9.19.6.**
Model 7 **£13.10.0.**
Model 8 **£18.**
P. & P. 7/6 each.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.

3in. 225ft. L.P. acetate	3/6
3¼in. 600ft. T.P. mylar	10/-
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1,200ft. D.P. mylar	15/-
5in. 1,800ft. T.P. mylar	32/6
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/-
5¾in. 1,800ft. D.P. mylar	22/6
5¾in. 2,400ft. T.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

TAPE CASSETTES

C60—60 minutes	12/6
C90—90 minutes	17/6

Over £2 post paid.

EVERSHED VIGNOLES SERIES II 500 VOLT MEGGERS. Perfect condition **£21.** P. & P. 10/-.
CT.53 SIGNAL GENERATORS. 8·9–15·5 and 20–300 Mc/s. Output 1µV–100 mV. Mains operated. Perfect condition less charts. **£12.10.0.** Carr. 15/-.

WS.88 TRANS/RECEIVERS. A and B sets available. Complete with valves. **39/6** each. P. & P. 4/6. Accessories available.

No. 10 MICROPHONE AND HEADSET. Moving coil Accessory for 19 set. Unused. **15/-.** P. & P. 4/-.

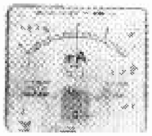
DUBILIER NITROGEL CONDENSERS. Brand new. 8 mfd. 800V. **8/6.** P. & P. 2/-; 2 mfd. 5,000 V., **42/6.** P. & P. 5/-.

LUCAS 20/0/20 AMMETERS. Brand new boxed. Suitable car/motorcycle. **12/6.** P. & P. 2/-.

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

SEW PANEL METERS

Send S.A.E. for full lists. Other ranges available. Please include postage.
Special quotations for quantities.



CLEAR PLASTIC METERS

Type MR.38P. 1 21/32in. square fronts.

50µA	37/6	750mA	25/-
50-0-50µA	35/-	1 amp	25/-
100µA	35/-	2 amp	25/-
100-0-100µA	32/6	5 amp	25/-
200µA	32/6	3V. D.C.	25/-
500µA	37/6	10V. D.C.	25/-
500-0-500µA	25/-	20V. D.C.	25/-
1mA	25/-	50V. D.C.	25/-
1-0-1mA	25/-	100V. D.C.	25/-
2mA	25/-	150V. D.C.	25/-
5mA	25/-	300V. D.C.	25/-
10mA	25/-	500V. D.C.	25/-
20mA	25/-	750V. D.C.	25/-
50mA	25/-	15V. A.C.	25/-
100mA	25/-	50V. A.C.	25/-
150mA	25/-	150V. A.C.	25/-
200mA	25/-	300V. A.C.	25/-
300mA	25/-	500V. A.C.	25/-
500mA	25/-	8 meter 1mA	29/6
		VU meter	39/6

Type MR.45P. 2in. square fronts.

50µA	42/6	10V. D.C.	27/6
50-0-50µA	39/6	20V. D.C.	27/6
100µA	39/6	50V. D.C.	27/6
100-0-100µA	35/-	300V. D.C.	27/6
500µA	29/6	15V. A.C.	27/6
1mA	27/6	300V. A.C.	27/6
5mA	27/6	8 meter 1mA	35/-
10mA	27/6	VU meter	42/6
50mA	27/6	1 amp. A C.*	27/6
100mA	27/6	5 amp. A C.*	27/6
500mA	27/6	10 amp. A.C.*	27/6
1 amp.	27/6	20 amp. A.C.*	27/6
5 amp.	27/6	30 amp. A.C.*	27/6

Type MR.52P. 2⅞in. square fronts.

50µA	59/6	100-0-100µA	45/-
50-0-50µA	49/6	500µA	42/6
100µA	49/6	1mA	37/6
5mA	37/6	300V. D.C.	37/6
10mA	37/6	15V. A.C.	37/6
50mA	37/6	300V. A.C.	37/6
100mA	37/6	8 Meter 1mA	39/6
500mA	37/6	VU Meter	59/6
1 amp.	37/6	1 amp. A.C.*	37/6
5 amp.	37/6	5 amp. A.C.*	37/6
10V. D.C.	37/6	10 amp. A.C.*	37/6
20V. D.C.	37/6	20 amp. A.C.*	37/6
50V. D.C.	37/6	30 amp. A.C.*	37/6

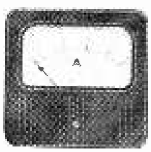
Type MR.85P. 4¼in. × 4⅞in. fronts.

50µA	69/6	15 amp.	49/6
50-0-50µA	59/6	30 amp.	49/6
100µA	59/6	20V. D.C.	49/6
100-0-100µA	59/6	50V. D.C.	49/6
200µA	55/-	150V. D.C.	49/6
500µA	52/6	300V. D.C.	49/6
500-0-500µA	49/6	15V. A.C.	49/6
1mA	49/6	300V. A.C.	49/6
1-0-1mA	49/6	8 meter 1mA	55/-
5mA	49/6	VU meter	69/6
10mA	49/6	1 amp. A.C.*	49/6
50mA	49/6	5 amp. A.C.*	49/6
100mA	49/6	10 amp. A.C.*	49/6
500mA	49/5	20 amp. A.C.*	49/6
1 amp.	49/6	30 amp. A.C.*	49/6
5 amp.	49/6		

Type MR.65P. 3½in. × 3¼in. fronts.

50µA	65/-	50V. D.C.	39/6
50-0-50µA	52/6	150V. D.C.	39/6
100µA	52/6	300V. D.C.	39/6
100-0-100µA	49/6	15V. A.C.	39/6
500µA	45/-	50V. A.C.	39/6
1mA	39/6	150V. A.C.	39/6
5mA	39/6	300V. A.C.	39/6
10mA	39/6	500 V. A.C.	39/6
50mA	39/6	8 meter 1mA	45/-
100mA	39/6	VU meter	65/-
500mA	39/6	50mA A.C.*	39/6
1 amp.	39 6	100mA A.C.*	39/6
5 amp.	39/6	200mA A.C.*	39/6
10 amp.	39/6	500mA A.C.*	39/6
15 amp.	39/6	1 amp. A.C.*	39/6
20 amp.	39/6	5 amp. A.C.*	39/6
30 amp.	39/6	10 amp. A.C.*	39/6
50 amp.	39/6	20 amp. A.C.*	39/6
10V. D.C.	39/6	30 amp. A.C.*	39/6
20V. D.C.	39/6		

BAKELITE PANEL METERS

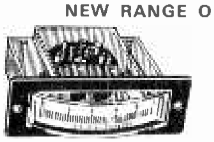


Type MR.65. 3½in. square fronts.

25µA	67/6	500mA	32/6	30V. A.C.*	32/6
50µA	45/-	1 amp.	32/6	50V. A.C.*	32/6
50-0-50µA	42/6	5 amp.	32/6	150V. A.C.*	32,6
100µA	42/6	15 amp.	32/6	300V. A.C.*	32/6
100-0-100µA	42/6	30 amp.	32/6	1 amp. A.C.*	32/6
500µA	39/6	50 amp.	32/6	5 amp. A.C.*	32/6
1mA	32/6	5V. D.C.	32/6	10 amp. A.C.*	32/6
1-0-1mA	32/6	10V. D.C.	32/6	20 amp. A.C.*	32/6
5mA	32/6	20V. D.C.	32/6	30 amp. A.C.*	32/6
10mA	32/6	50V. D.C.	32/6	50 amp. A.C.*	32/6
50mA	32/6	150V. D.C.	32/6	VU meter	59/6
100mA	32/6	300V. D.C.	32/6		

*Moving iron, all other moving coil.

NEW RANGE OF "SEW" EDGEWISE METERS



MODEL PE70. Dimensions 3 17/32 × 1 11/32 × 2⅞in deep overall. Available as follows:

50 microamp	57/6	500 microamp	49/6
50–0–50 microamp	55/-	1 milliamp	45/-
100 microamp	55/-	300 volt A.C.	45/-
100-0-100 microamp	52/6	VU meter	62/2
200 microamp	52/6		

Post extra.

★ TRANSISTORISED FM TUNER ★

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108 Mc/s. Ready built ready for use. Fantastic value for money. **£6.7.6.** P. & P. 2/6. Stereo multiflex adaptors **5 gns.**

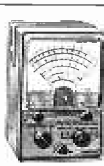
GARRARD DECKS

Brand New and Guaranteed 1025 with cartridge **£7.10.0** A70 Mk II less cart. **£12.12.0.** LAB 80 Mk II less cart. **£23.10.** LAB 80 Mk. II with base, **£27.10.0.** 401 Transcription less cart. **£27.6.0.** Carr. 7/6. **WOODEN PLINTH** for Garrard Series 1000, 2000, 3000 etc. with perspex cover **£4.10.0.** P. & P. 4/6.

MODEL ZQM TRANSISTOR CHECKER

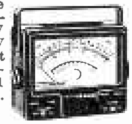
It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec: A: 0·7–0·9967. B: 5–200. Ico: 0–50 microamps 0–5mA. Resistance for diode 200Ω–1MΩ. Supplied complete with instructions, battery and leads. **£5.19.6.** P.P. 2/6.

TE-65 VALVE VOLTMETER

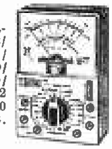


High quality instrument with 28 ranges. D.C. volts 1·5–1,500v. A.C. volts 1·5–1,500v. Resistance up to 1,000 megohms. 220/240v. A.C. operation. Complete with probe and instructions **£17.10.0.** P. & P. 6/-. Additional Probes available: R.F. **35/-.** H.V. **42/6.**

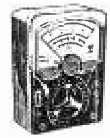
MULTIMETERS *for EVERY purpose!*



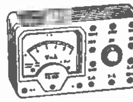
LAFAYETTE 57 Range Super 50kΩ/volt Multimeter. D.C. volts 125mV–1000V. A.C. volts 1·5V–1000V. D.C. current 25µA–10 amp. Ohms 0–10megΩ. dB—20 to +81 dB. Overload protection. **£12.10.0.** Carr. 3/6.



MODEL AF-105. 50kΩ Volt. Mirror scale, built-in meter protection. 0/·3/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600/1,200v. A.C. 0/30µA/6/60/300mA/12 Amp. 0/10K/1M/10M/100 MΩ. —20 to +17 dB. **£8.10.0.** P. & P. 3/6.

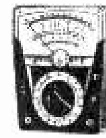


NEW MODEL 500 30,000 O.P.V. with overload protection, mirror scale. 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60K/6 meg/60 megΩ **£8.17.6.** Post paid.

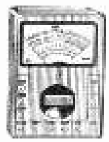


MODEL PT-34 1,000 O.P.V. 0/10/50/250/500/1,000v. A.C. & D.C. 0/1/100/500mA D.C. 0/100KΩ **39/6.** P. & P. 1/6.

TE-51. NEW 20,000Ω/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. **85/-.** P. & P. 2/6.

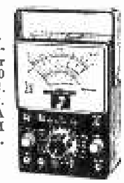


MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30µA/3/30/300 mA. 0/16K/160K/1·6M/16 MegΩ. **£5.10.0.** P. & P. 3/-.



MODEL 250J. 2,000 O.P.V. 0/10/50/500/2,500 v. D.C. 0/10/50/500/2,500 v. A.C. 0/2 Meg. Ω. 0/250 mA —20 to +36 dB. **49/6.** P. & P. 2/6.

MODEL TE-10A. 200kΩ/Volt 5/25/50/250/500/2,500 v. 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, 100 mFd. 0·100-0·1 mFd. **69/6.** P. & P. 2/6.



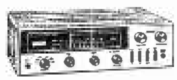
MODEL AS-100D. 100KΩ/VOLT 5in., mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200 v. D.C. 0/6/30/120/300/600 v. A.C. 0/10µA/6/60/300mA/12 Amp. 0/2K/200K/2M/200MΩ. —20 to +17dB. **£12.10.0.** P. & P. 3/6.

TE-900 20,000Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000 v. A.C. 0/25/12·5/10/50/250/1,000/5,000 v. D.C. 0/50µA/110/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. **£15.** P. & P. 5/-.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes, IHF music power, 30W at 8Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16Ω. 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. **£25.** Carr. 7/6.

LAFAYETTE LR-500T

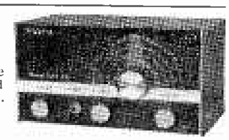


60 Watt Solid State AM/FM Stereo Multiplex Tuner Amplifier. The latest most advanced stereo receiver in the world. Incorporates 4 integrated Circuits, 2 Fet's, 30 Transistors, 17 Diodes, 60 Watts IHF Power. Complete flexibility of operation plus full range of stereo inputs. Distinctively styled metal cabinet with simulated walnut wood grain case. Operation 115/230V. A.C. **£75.**

LAFAYETTE LA-85T

85 watt. Solid State Amplifier. Latest 1968 model. 4 Stereo Inputs. Speaker outputs for 4, 8 or 16 ohms plus convenient output for direct stereo taping. 9 versatile controls. Response 22–22,000 cps ± 1dB. H.D. less than 1%. Brushed aluminium, gold anodised extruded front panel. Simulated walnut wood grain case. 115/230V. A.C. operation. **£47.10.0.** Carr. 10/-.

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 MODEL HA-700 AM/CW/SSB AMATEUR COMMUNICATION RECEIVER

8 Valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150–400 Kc/s, 550/1,600 Kc/s, 1·6–4·0 Mc/s, 4·8–14·5 Mc/s, 10·5–30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, B.F.O. product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2kΩ or speaker 4 or 8Ω. Operation 220/240V A.C. Size 7¾ × 15 × 10in. Supplied brand new and guaranteed with handbook. **36 gns.** Carr. 10/-. S.A.E. for leaflet.

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SUPERIOR AMPLIFIER. Built and tested. Better sound! Isolated AC Mains Transformer 3 watt. ECL82 triode pentode valve. Volume and tone controls with knobs. Quality Loudspeaker. **89/6**

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EMI Junior	£3.19.6	Garrard 1000	£7.19.6
Garrard SRP22	£6.19.6	BSR Transcription UA70	
Garrard SP25	£13.19.6	Stereo/Mono	£12.19.6
Philips AG1016	£11.19.6	Garrard Stereo/Mono	
Garrard LAB80	£24.19.6	Model 3000	£12.19.6
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GARRARD TEAKWOOD BASE W.B.1. Ready cut out for mounting 1000, 2000, 3000, SP25, AT60. **65/-**
GARRARD PERSPEX COVER SPC.1 for WB.1 65/-

SANGAMO 3 inch SCALE METER 45/- ea.

Various calibrations and movements. 100 Microamp; 1 Milliamp; 50-0-50 Microamp, etc. S.A.E. for list.

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strongly built wooden cabinet covered in Blue and Grey leathercloth. Size 15 × 17 × 8in. Motor Board 14½ × 12½in. ready cut out for B.S.R. Monarch UA12/14/15/16/25 decks. Amplifier space size 14 × 7 × 3in. The baffle is cut out for a 6½in. dia. speaker. Post 5/6

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32/450 v. ..	3/9	8+16/450 v.	3/9	50+50/350 v.	7/-
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WAVE-CHANGE SWITCHES WITH LONG SPINDLES.
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Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. 1 wafer 12/-, 2 wafer 17/-, 3 wafer 22/-
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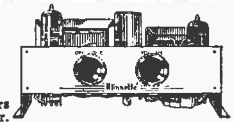
15/6 EACH TYPE

MINETTE AMPLIFIER



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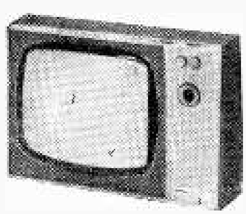

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Ex. MAINTENANCE TESTED TUBES
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Polished walnut veneer with elegant glass fronted cocktail compartment, padded. Position for two 10in. elliptical speakers. Record storage space. Height 35½in., width 52½in., depth 14½in. Legs 1 gn. extra.

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3S4	5/9	25U4GT	11/6	DL96	7/-	EL90	5/-	PL84	6/3	UL41	9/6
3V4	5/9	30C1	7/-	DY86	5/9	EL95	5/-	PL500	13/-	UL44	20/-
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5Z4G	7/6	30F5	12/-	EB91	2/3	EM87	7/6	PY33	10/-	VP4B	10/6
6/30L2	12/6	30FL1	12/6	EBC33	7/6	EY51	7/-	PY80	5/3	VP1321	21/-
6AL5	2/3	30FL14	12/6	EBC41	8/-	EY86	6/3	PY81	5/3	Z77	3/6
6AM6	3/6	30L1	6/-	EBF80	6/-	EZ40	7/6	PY82	5/-	Transistors	
6AQ5	4/9	30L15	14/-	EBF89	6/3	EZ41	7/6	PY83	5/9	AC107	3/6
6AT6	4/-	30L17	13/-	EC90	2/9	EZ80	4/6	PY88	7/3	AC127	2/-
6AU6	5/6	30P4	12/-	ECC81	3/9	EZ81	4/9	PY800	6/9	AD140	7/6
6BA6	4/6	30P12	11/-	ECC82	4/9	KT61	8/9	PY801	6/9	AF102	18/-
6BE6	4/3	30P19	12/-	ECC83	7/-	KT81	15/-	R19	6/6	AF115	3/-
6BG6G	15/-	30PL1	12/6	ECC84	5/6	N78	14/9	R20	12/9	AF116	3/-
6BJ6	6/9	30PL13	14/6	ECC85	4/9	PC86	9/6	TH21C	9/9	AF117	3/3
6F13	3/6	30PL14	14/6	ECC804	12/6	PC88	9/6	U25	13/-	AF118	3/-
6F14	9/-	35L6GT	8/-	ECF80	7/-	PC97	8/6	U26	11/6	AF124	7/6
6F23	12/6	35W4	4/6	ECF82	6/9	PC900	8/3	U47	13/6	AF125	3/6
6K7G	2/6	35Z4GT	5/-	ECF86	9/-	PCC84	6/-	U49	13/6	AF126	7/-
6K8G	4/3	85A2	7/3	ECH35	6/-	PCC89	10/6	U52	4/6	AF127	3/6
6L18	6/-	6063	12/6	ECH42	10/6	PCC189	9/9	U78	3/6	OC22	5/-
6V6G	3/6	AZ31	9/-	ECH81	5/9	PCF80	7/-	U191	11/-	OC26	5/-
6V6GT	6/6	B36	4/9	ECH84	7/3	PCF82	6/-	U301	13/6	OC44	2/3
6X4	3/6	B729	12/6	ECL80	6/9	PCF86	9/9	U801	18/9	OC45	2/3
6X5GT	5/9	CCH35	10/-	ECL82	6/9	PCF800	11/6	UABC80	6/3	OC71	2/6
7B6	10/9	DAC32	7/3	ECL83	9/-	PCF801	7/3	UAF42	9/6	OC72	2/6
7B7	7/-	DAF91	4/3	ECL86	8/3	PCF802	9/6	UB41	6/6	OC75	2/-
7C5	15/-	DAF96	6/-	EF39	3/9	PCF805	9/-	UBC41	7/9	OC81	2/3
7C6	6/9	DCC90	8/6	EF41	9/6	PCF806	11/6	UBF80	6/-	OC81D	2/3
7H7	5/6	DF33	7/9	EF80	4/9	PCF808	12/6	UBF89	6/9	OC82	2/3
7Y4	6/6	DF91	2/9	EF85	5/6	PCL82	7/3	UBL21	9/-	OC82D	2/6
10F1	15/-	DF96	6/-	EF86	6/3	PCL83	9/-	UC92	5/-	OC170	2/6

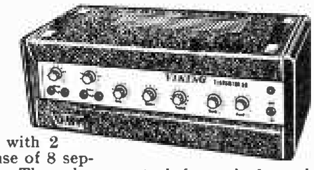
READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

VIKING AMPLIFIER

50 WATT AMPLIFIER



An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS
4 electronically mixed channels, with 2 inputs per channel, enables the use of 8 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets.

SENSITIVITIES AND INPUT IMPEDANCES

Channel 1	4mV	at 470K	These 2 channels (4 inputs) are suitable for microphone or guitars.
Channel 2	4mV	at 470K	
Channel 3	200mV	at 1m	Suitable for most high output instruments (gram, tuner, organ etc.).
Channel 4	200mV	at 1m	

Input sensitivity relative to 10w output.

TONE CONTROLS ARE COMMON TO ALL INPUTS
Bass Boost +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s.
Treble Boost +11dB at 15 KHz/s. **Treble Cut** −12dB at 15 KHz/s.
With bass and treble controls central −3dB points are 30 Hz/s and 20 KHz/s.

POWER OUTPUT
For speech and music 50 watts rms. 100 watts peak.
For sustained music 45 watts rms. 90 watts peak.
For sine wave 38·5 watts rms. Nearly 80 watts peak.
Total distortion at rated output 3·2% } at 1KHz/s
Total distortion at 20 watts 0·15% }
Output to match into 8 or 15 ohms speaker system.

***Price* 27 gns P & P 20/-**

NEGATIVE FEED BACK 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES** Adjustable from 200–250v A.C. 50–60 Hz/s. A protective fuse is located at the rear of unit.
VALVE LINE UP Double purpose ECC83 x 3, EL34 x 2 and GZ34.

FOUR *PLUS* FOUR *Stereo Amplifier*

A superb high quality, yet inexpensive stereo amplifier. Due to the great demand we are now able to offer this precision made instrument at a fantastically low price. The high quality, reliability and styling has been maintained in spite of its low price.

SPECIFICATIONS
Elegant styled cabinet (sizes 16″ wide 5″ high 8½″ deep) in black rexine and woodgrained sides. Brushed aluminium front panel with contrasting black / silver knobs.

CONTROLS
Stereo/Mono switch. Gram/Aux switch. Volume left. Volume right. Treble (cut and lift). Bass (cut and lift). Separate on/off switch. Neon pilot indicator.

INPUTS AND OUTPUTS (per channel)
Gram, aux, tape out and speaker out. A switched mains socket is also provided at the rear of unit. Employs Mullard valves throughout. ECC83 and 2 x ECL86 with a metal bridge rectification.

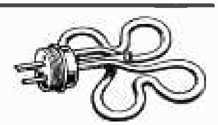
TECHNICAL SPECIFICATIONS
Gram sensitivity 40mV at 1 KHz. Aux sensitivity 50mV at 1 KHz. (Sensitivities are given for rated output). 4 watts r.m.s. in (8 watts r.m.s. in monaural position). Output matches into standard 3 ohms speaker system. Suitable 10″ x 6″ speakers are available at **29/6** each, plus 5/- p. & p. Bass control at 100 Hz lift + 9dB cut − 10dB. Treble control at 10 KHz lift + 8dB cut − 13dB. Total harmonic distortion 0·35% at 3 watts and 2% for rated output at 1 KHz. Negative feedback 13dB at 1 KHz. Mains supply 220–250V A.C. 50–60 Hz.

Price* 13 gns *P & P 15/-

SPEEDEX the SPEED CONTROLLER for ELECTRIC POWER DRILL

infinitely variable electronic speed controller for your electric power drill. Varies the speed of all power tools (up to 600W) between 12 r.p.m. and maximum r.p.m.
Instantly adjustable with simple single control overriding switch for instant maximum speed. Simply connected into lead of power tool. Only **25/-** plus 3/6 P. & P.

GEC KETTLE ELEMENT

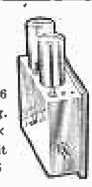


3,000W WITH AUTOMATIC EJECTION
200/240v. Size of hole required 1 $\frac{1}{16}$″
List Price 32/-. Our PRICE 15/-. P. & P. 1/6.

POCKET MULTI-METER

Size 3¾ x 2½ x 1⅜in Meter size 2½ x 1⅜in Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods, battery and full instructions, **42/6.** P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter.

CYLDON U.H.F. TUNER



Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4¼ × 5¼ × 1⅛in. Complete with circuit diagram. 35/- p. & p. 3/6

THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13½ x 8 $^{1}/_{16}$ x 4¼ inches. By famous manufacturer. List Price £7. Our price **69/6** plus 3/6 P. & P.

600 mW FOUR TRANSISTOR AMPLIFIER

Features N.P.N. and P.N.P. complementary symmetrical output stage, 2¼″ x ⅞″ x ⅞″ Speaker. Output impedance 12 ohms frequency response 3dB points 90 c/s and 12 Kc/s. Price **19/6** plus 1/- P. & P. 7 x 4″ Speaker to suit, **13/6** plus 2/- P. & P.

2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7″ x 4¼″ x 1¾″. Frequency response 100 c/s—10 Kc/s Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0** plus P. & P. 3/6. Suitable 8″ x 5″ 10,000 line high flux speaker, **18/6** plus 2/- P. & P.

NEW TRANSISTORISED SIGNAL GENERATOR

Size 5¼ x 3½ x 1⅛in. For IF and RF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. P. & P. 3/6. **49/6**

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5¾″	Std.	850ft.	9/-	5″	L.P.	850ft.	10/6
7″	Std.	1200ft.	11/6	3″	T.P.	600ft.	10/6
3″	L.P.	240ft.	4/-	5″	T.P.	1800ft.	25/6
5¾″	L.P.	1200ft.	11/6	5¾″	T.P.	2400ft.	32/6
7″	L.P.	1800ft.	18/6	7″	T.P.	3600ft.	42/6
5¾″	D.P.	1800ft.	18/6	4″	T.P.	900ft.	15/-

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

THE RELIANT 10W SOLID-STATE HIGH QUALITY AMPLIFIER

SPECIFICATIONS
Output—10 watts RMS Sine-wave
13 watts RMS Music-power
Output Impedance—3 to 4 ohms
Inputs—1. -xtal mic 10mV
2. -gram/radio 250mV
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.

LESLIE TREMOLO SPEAKER UNIT

Model 10C3. Made in U.S.A. by Electro Music Corp., Pasadena, Calif. Complete with 8″ 6 ohm Heavy Duty Loud Speaker. (Larger Speaker may be fitted without major structural change). Dimensions: baffle size 18¼″ × 19″. Rotor size 15″. A.C. mains 110-220-240 50 c/s. suitable for organs.
PRICE £30 plus £2 P. & P.

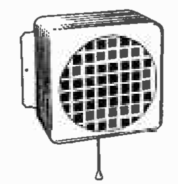
50 WATT POWER AMPLIFIER

Manufactured by Livingstone Labs. at a cost price of £90. In two units, Amplifier size 15¼″ × 9″ × 7″. Heat sink size 14¼″ × 9″ × 4″. Output into 15 ohm Speaker. Transistors —eight OC28s. Two 2G374. Sensitivity 1V. RMS at 6K input impedance. Power Response 5H2–15KHZ (50 watts). Ideal for Tannoy Systems or organs where constant use is essential.
PRICE 28gns. plus £2 P. & P.

ANTI-THIEF CAR BURGLAR ALARM

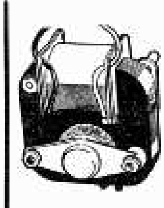
The Melguard Safermatic consists of an electrical device housed in small metal box 4″ × 2″ × 1½″, which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches, and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12V operation. List price 79/6, our price **29/6** plus 2/6 P. & P. Full easy-to-follow instructions supplied.

EXTRACTOR FAN



AC Mains 230/250 v. complete with pull switch. Size 6″ x 6″ x 4″. Price **27/6** plus 5/- P. & P.

AC MAINS MOTOR



1400 R.P.M.
230/250v
PRICE 9/6
P. & P. 3/-

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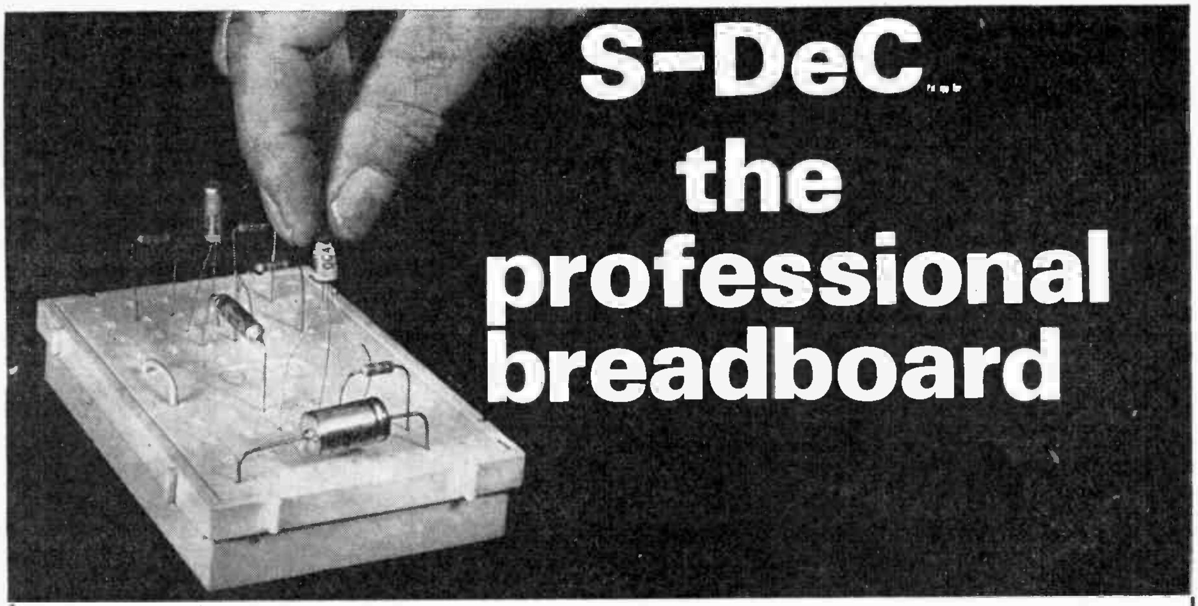
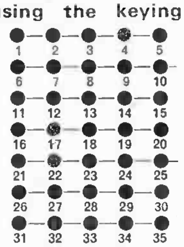


S-DeCs are a professional breadboard which are used in their thousands in industrial and Government research laboratories and being used increasingly in educational establishments from degree level electronics courses to the teaching of electricity to primary school children. This breadboard is sold world wide, and over 50% of current production is exported.

The diagram shows the layout of the contacts on S-DeC. Each S-DeC contains two of these panels, permitting most electronic building blocks to be accommodated. DeCs may be joined using the keying method provided to form a stable area of any size. The connection points are on a ⅜in. matrix. Components are simply pushed into the contacts and may be withdrawn at will.

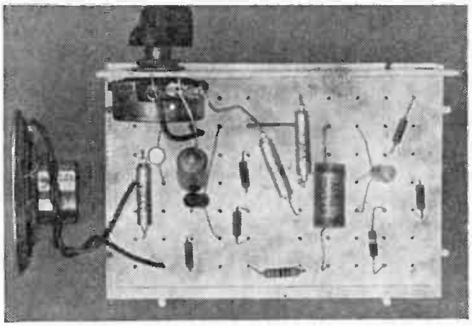


Experiment and Project Guides: S.D.C. Products provide a series of experiment and project guides for educational users. These are available to the enthusiast and full details can be supplied, either from 'Electroniques' (Edinburgh Way, Harlow, Essex) or the manufacturers, S.D.C. Products (Electronics) Ltd.

Accessory Kits: With every S-DeC kit purchased there are included accessories. A control panel is supplied for mounting such things as potentiometers, and this panel simply slots into the S-DeC base. Other accessories include small compression springs for making solderless connections to controls and clips for mounting such things as ferrite rods on the panel. Also included with each kit is an instruction leaflet and booklet of projects.

Projects on S-DeC: In every kit a booklet of circuits is supplied with full instructions for assembly of the circuits on DeCs. The circuits include a three transistor reflex radio with diode detection, morse practice oscillator, electronic flasher, a monostable multivibrator, a three stage audio amplifier, (picture of amplifier mounted on a DeC below) and circuits for a number of oscillators.

Insertion/Withdrawal Force .... 90 gm.wt.
Capacitance between adjacent rows of contacts .... 3pF.
Resistance between adjacent contacts 10m Ω
Resistance between adjacent rows of contacts .... 10^{10} Ω



Single DeCs: One S-DeC with Control Panel, Jig and Accessories for solderless connections to controls, etc., with booklet 'Projects on S-DeC' giving construction details for a variety of circuits. **29/6d.** retail.

4-DeC Kit: Four S-DeCs with two Control Panels, Jigs and Accessories and the booklet 'Projects on S-DeC' all contained in a strong attractive plastic case. Ideal for the professional user, **£5.17.6d.** retail.

Available from leading suppliers and 'Electroniques' dealers

In case of difficulty DeCs may be purchased direct from the manufacturers. Include 6d. (in the case of single DeCs) and 2/6d. (in the case of 4-DeCs) to cover postage and packing.

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PRACTICAL WIRELESS

VOL 44 No 4

issue 738

AUGUST 1968

TOPIC OF THE MONTH

Impressed but unperturbed

THE recent Electronics and Automation Exhibition at Olympia has been called "the greatest technical show on earth", and with justification. Let us sprout a few figures . . .

It attracted more than 112,000 visitors, including 9,000 from 80 different countries. Equipment worth more than £50M was displayed by the near-1,000 exhibitors from 15 countries in the 12 acres of floor space. The industries supporting the exhibition had a turnover of £2,420M last year, of which £430M came from exports (averaging no less than £1·75M exports every day). There are 900,000 people employed in the industry, meaning that at least 2·5M people rely on the electrical, electronics and allied trades to live.

These are cold, hard facts—impressive but impersonal. Yet they spotlight the way in which the industry is now in many ways affecting, controlling and fashioning our lives and environment; making its impact industrially, economically and socially.

Without electronic aids to support production and commercial activities, our industrialists would face a bleak future in this competitive world, for without modern scientific methods they are doomed. On the domestic and industrial front, TV and radio communications continue to progress. Techniques developed in space research are finding industrial and domestic applications; techniques devised for industry are being adapted for medicine and surgery. So it goes on—a great interplay and flexibility.

It is remarkable how the garden-shed set-ups of the early days of wireless have ballooned into one of our greatest growth industries, and one which will exert an ever-increasing influence in many spheres as the years go by. Yet one fringe activity seems to have been content to maintain a dignified aloofness to this headlong acceleration.

In the "cottage industry" days, enthusiasts were building their own radio sets. And today, even amidst all the technical magnificence of modern electronics, enthusiasts are *still* building their own radio sets. Which goes to show, if it shows anything at all, that it's a splendid hobby!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

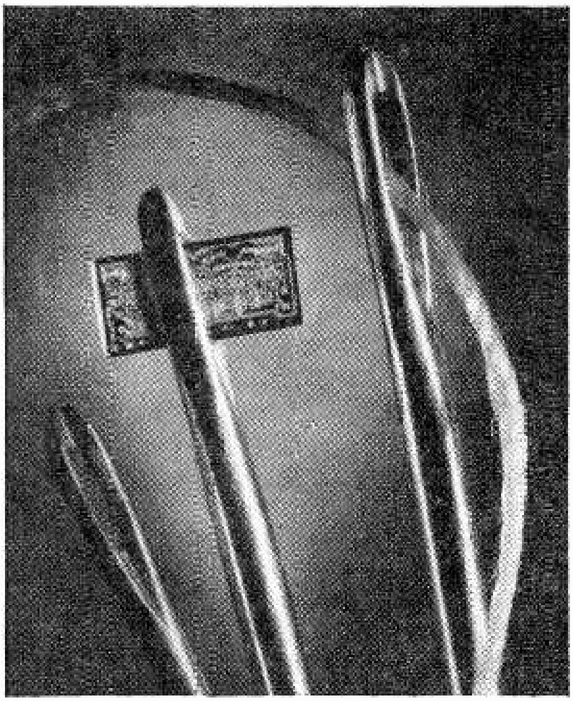
CONSTRUCTIONAL

OTHER FEATURES

SEPTEMBER ISSUE WILL BE PUBLISHED ON AUGUST 9th

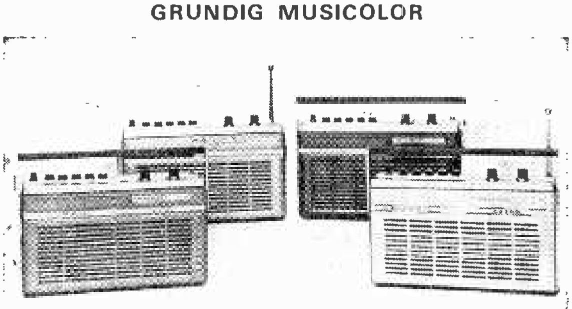
NEWS AND COMMENT...

. . . AND SO *AD INFINITUM!*



The vanishing species? Will they get so small in the end that they'll disappear altogether? Nobody knows, but they're certainly having a jolly good try. The "they" are the integrated circuits. You can see (just about) one in the photograph being poked through the proverbial eye of a needle. This one is a Mullard unencapsulated TTL decade counter performing its special trick of jumping through the eye of a number 5 sewing needle: the circuit contains over 120 components, and the "rope" is 40 gauge sewing cotton.

GRUNDIG MUSICOLOR



The Music Boy de luxe is now available in leather-styled padded finish and a choice of four colours. This portable receiver covers long, medium, short and v.h.f. wavebands, and runs from a PP9 battery from which 150 hours' life is expected. It contains 15 semiconductors, has telescopic aerial for v.h.f. and s.w., and a ferrite aerial for the other wave bands. Price is 29½ gns.

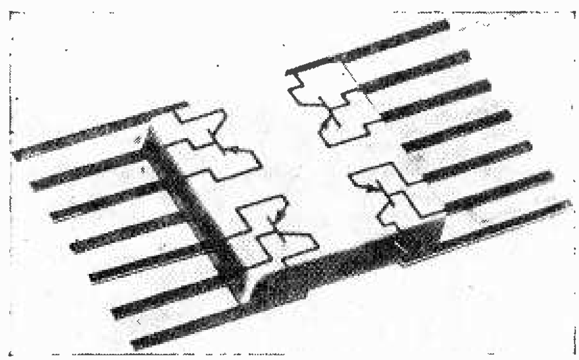
TON-UP TAPPERS

sometimes appears to deceive the ear, too. That is, if we correctly understand the latest piece of petty niggling by the GPO.

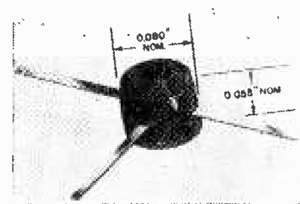
The Radio Services Department of that august body has lately been mailing letters of complaint to licensed amateurs who are sending their callsigns faster than the specified 12 w.p.m. (it used to be 20 w.p.m.). Why it should suddenly become necessary to throw the book at operators is beyond understanding, unless the GPO monitors have so declined that they can only copy dead slow morse. It comes to something when the professionals ask the amateurs to slow down!

We did it—or did we? Either way it does seem a coincidence that no sooner does our Leader raise an eyebrow at the GPO's attitude to c.w. speeds on the amateur bands (page 817, March 1968) than that very same government body announce that the speed restriction is raised to 20 w.p.m. Whoever it was who used super red tape solvent to get this one through—your very good health Sir, and to all you amateurs—whip those weights off the bug keys lads, we're having a c.w. ball.

VANISHING SPECIES



Things in the electronic world are getting smaller and smaller. With integrated circuits coming in one wonders whether the days of the common transistor are numbered. But even transistors themselves are shrinking.



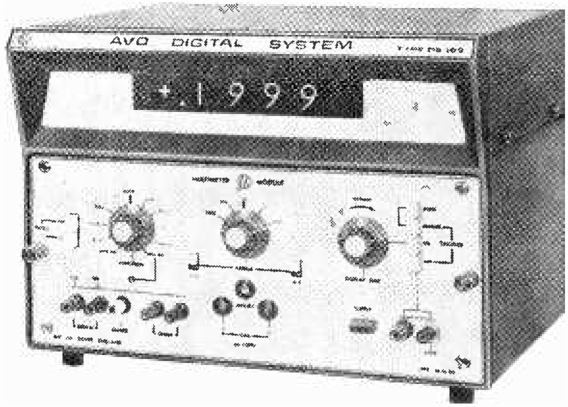
The larger photograph shows the Motorola Quad transistor 2N5146 which houses four transistors in a 14 pin TO-86 flat package measuring $0{\cdot}25 \times 0{\cdot}25 \times 0{\cdot}07$in. exclusive of leads. Typical electrical characteristics for each of the four transistors are: h_{FE} 40 at I_C=1A d.c.; V_{CE}(sat) 0·7V d.c. at 1A d.c.; f_T 250Mc/s at I_C=50mA d.c.

A low-level, high-speed switch and an r.f. amplifier have been added to Motorola's new Micro-T transistor line. These are only $0{\cdot}08 \times 0{\cdot}058$in. as the small photograph indicates. This is about one-tenth the size of a TO-18 can. For a v.h.f./u.h.f. amplifier mixer, or oscillator application, the MMT918 offers a high current gain-bandwidth product of 600Mc/s min. measured at 100Mc/s; output capacitance of 1·7pF (0·1—1Mc/s), and a collector-emitter breakdown voltage of 15V d.c. min.

Further details of both these units from Motorola Semiconductors Ltd., York House, Empire Way, Wembley.

NEWS AND COMMENT...

FACE-LIFT FOR AVO



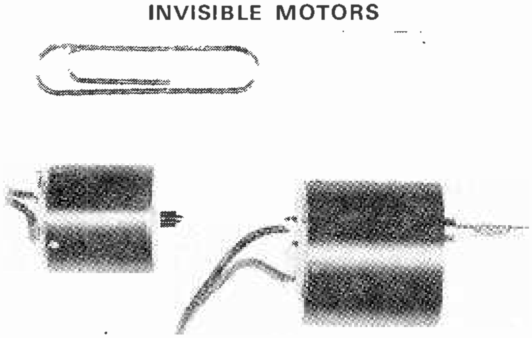
The AVO Digital System is completely new. It comprises a main display unit which is designed to accept a number of plug-in modules. The measured value is automatically presented in digital form by four in-line neon indicators having a numeral height of 14mm. The polarity and over-range indication is also presented automatically and the decimal point is automatic with range switching.

A built-in Weston reference cell provides a reference voltage which enables the calibration of the lower ranges to be corrected to the initial accuracy. The stability of the cell is 0·01% per year and the temperature co-efficient over the range 10°C to 40°C is less than $\pm$ 5μV/°C ($\pm$ 0·0005%/°C).

The specifications are impressive: d.c. voltage from 0·1999 to 1,999V $\pm$ 0·05% of indication $\pm$ 0·05% of full range at 20°C. The input impedance on the higher ranges is 10MΩ and greater than 1,000MΩ on the two lower ones. D.C. current from 0·1999 to 1,999mA; resistance from 0·1999 to 1,999kΩ with similar coverage for the a.c. voltage and current ranges.

The unit has other ranges and applications. Further details may be obtained from the makers.

INVISIBLE MOTORS



Well, not quite but darned near. High output efficiency and low weight combined with extreme miniaturisation are the features of two new groups of d.c. electric motors in the revised and expanded Micromotors range from B & R Relays Ltd. There are three models in each group—designated 050 and 030—but all have a common configuration. These really are small, for instance, those in the 050 range have a diameter of 15mm and a casing length of 16mm. By employing skew-winding with three rectangular coils and an ironless bell-shaped armature, the starting time can be speeded and the spindle diameter can be very small. This helps reduce friction losses at the commutator and gives low contact resistance between the precisely matched gold alloy bushes and the 95% silver alloy collector. The 050/0055 motor has a no-load running speed of 19,100 r.p.m. which can be reduced by slip-on gear-boxes in the ratios 3·45:1, 11·8:1, 141:1, and 5,750:1. With an armature resistance of 5Ω and a measuring voltage of 3V, the 030/010 motor develops a specific torque of 16·90 cmp/A.

RADIONETTE MULTICORDER

This tape recorder is claimed to be the first in the world to use only one single reel. It has two speeds and gives up to 12 hours' playing time—enough for 18 big L.P. records. It will also accept pre-recorded tapes and tapes recorded on conventional tape recorders, with tracks in the opposite direction.

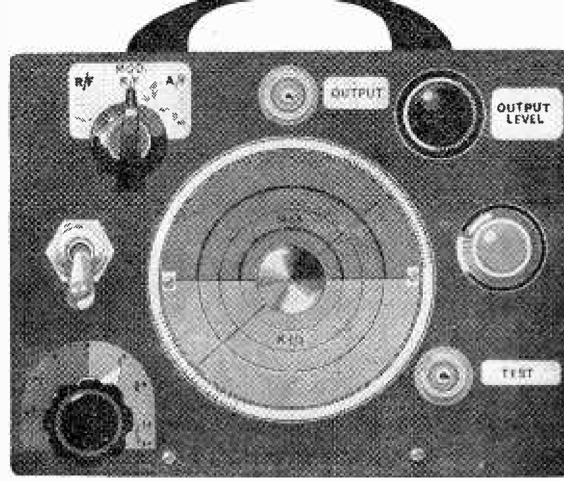
The Multicorder is fully portable and transistorised, and a companion battery eliminator is available too. Another accessory is the vinyl carrying case which also accommodates the microphone. The mike is a dynamic type, and can be used as a "pillow phone".

Outlets are provided for extension speaker, earphone and radio. It has an output/recording/battery meter and a tape-position indicator. There are four tracks, any one of which is instantly selectable by the track selector control thus obviating the need to turn the reel over.

Power required is 9V obtained from six U2 cells. Current consumption is 80–100mA at low volume rising to 200-250mA at 1 watt output. Circuitry uses seven transistors and two diodes; wow and flutter less than 0·2%; tape speeds $1\frac{7}{8}$ and $3\frac{3}{4}$ i.p.s.; reel size 5in.; microphone input 700Ω with a sensitivity of 1-2mV; radio input is 470Ω with a sensitivity of 20mV; amplifier outlet 20kΩ, 50-100mV. Price with mike is 49gns, case to suit costs an extra 5gns.

A SIMPLE SIGNAL GENERATOR

James Hossack



THE signal generator described here uses a conventional twin-triode oscillator circuit for both the r.f. and a.f. sections, and has a frequency coverage of 120kc/s to 50Mc/s, thus enabling tests to be carried out on most domestic radio and television apparatus (with the exception of u.h.f. receivers), harmonics being used to cover up to 200Mc/s. The method of construction is somewhat unusual in that it employs the "Cir-kit" technique, enabling an extremely satisfactory printed circuit board to be made without the use of chemicals or other etching medium.

CIRCUITRY

The theoretical circuit is shown in Fig. 1, and apart from resistor and capacitor values, both halves of the signal generator are identical. Briefly, damped oscillations set up in the grid inductance of the left-hand triode of each valve are maintained by feedback of the correct phase supplied from the right-hand anode via the appropriate coupling capacitor. In the case of the a.f. section, a tightly-coupled coil, actually the primary of the a.f. transformer T1, whose secondary comprises the audio oscillator coil, picks up the oscillation and employs it to modulate the anode of the r.f. section when a modulated output is required. Final calibration of the generator is simplified if a second, calibrated, generator can be borrowed, although an alternative, but less accurate, procedure is described later.

THE CASE

Although a suitable die-cast metal box can be purchased for a reasonable cost, it was decided to press into service a discarded metal container measuring 8 × $6\frac{1}{2}$ × $4\frac{1}{2}$in., replacing the ebonite base with an aluminium sheet $8\frac{1}{2}$ × $6\frac{1}{2}$in. which then becomes the front panel. Drilling details for the latter are shown in Fig. 2.

A small metal sub-frame 6 × 4in. constructed of angle aluminium and bolted to this panel at XX carries the printed circuit board, the coils being bolted directly to the lower part of the front panel, or else supported on a small strip of Bakelite, as in Fig. 3. Coil-winding details are given in Table 1. Figure 3 also indicates a convenient method for mounting the coils. The three lowest-frequency coils are supported on a length of $\frac{3}{8}$in. ferrite rod bolted to the front panel, while coils 4 and 5 can be wound on a suitable short-wave coil former from which the core has been removed. The coil for the highest range, which is self-supporting, is best inserted after

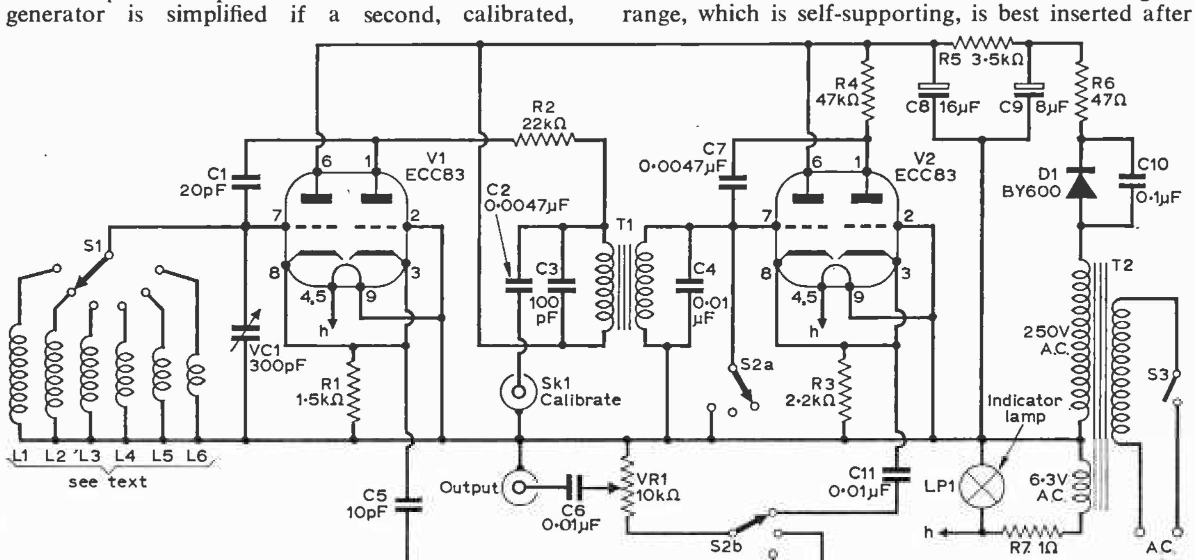


Fig. 1: Circuit diagram of the simple signal generator.

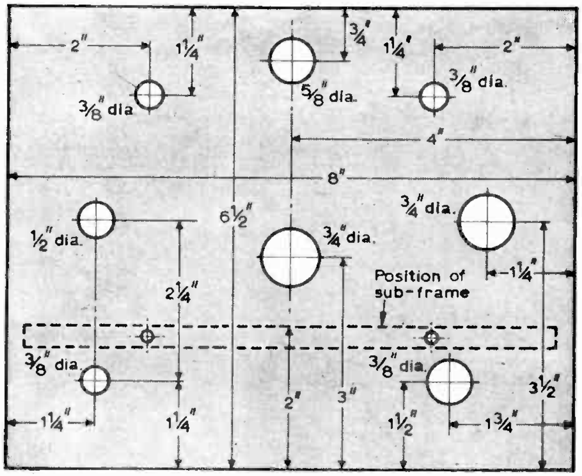
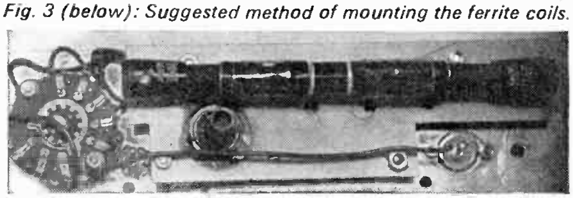


Fig. 2 (above): Drilling details of the front panel.

Fig. 3 (below): Suggested method of mounting the ferrite coils.



the generator has been set up and calibrated on the lower ranges as in this way it can be checked that the coverage is complete without excessive overlap. Since two-terminal coils are used, coverages for all coils may in any case be altered fairly easily, after construction has been completed, owing to the "open" nature of the printed circuit layout. For example, if a more conventional type of mounting is desired for the l.f. coils in preference to the ferrite rod method, the turns for coils 1-3 should be increased by about 30%, and adjusted finally, by removal of turns, to give the desired coverage.

After mounting coils, range switch, and output terminals, the remaining front panel components, consisting of on/off and modulation switches, output control, and indicator lamp, are bolted in position. The lamp, though not essential, is a desirable addition, since it has been found, in practice, that test equipment may be inadvertently left switched on for long periods, with possible overheating. As a further precaution in this respect, due to the poor ventilation consequent upon nearly complete screening, it was considered desirable to include the 1Ω dropping resistor, R7, which reduces the heater voltage to a safe 5·8V.

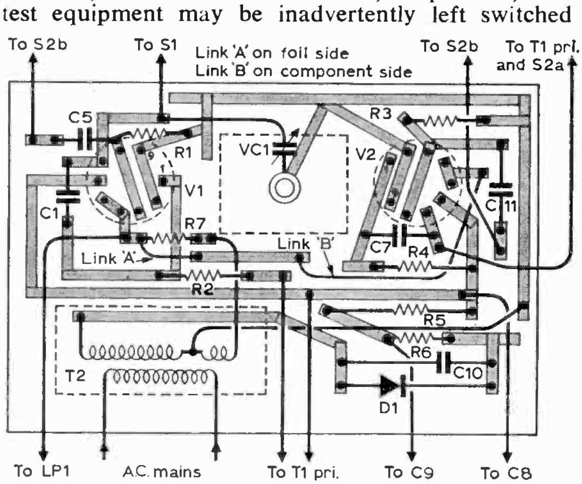


Fig. 4: Wiring diagram of the underside of the "chassis" using Cir-kit copper strip.

CONSTRUCTION

The next step is to cut and drill the paxolin "Cir-kit" board to take valve holders (B9G, printed circuit type), tuning capacitor, mains transformer, and all fixed capacitors and resistors, including the silicon diode, D1, but excluding C8 and C9, which are mounted on the back of the sub-chassis. C3 and C4 are soldered respectively across the primary and secondary of the modulation transformer, which is also bolted directly to this chassis. Make sure that the tuning capacitor is efficiently earthed with a piece of heavy gauge wire—do not rely on the "Cir-kit" strip for this purpose, since oscillation may be impaired on the highest-frequency range.

Now, lay the copper strip on the underside of the board, following the layout of Fig. 4, and taking care to leave sufficient overlap at corners to facilitate subsequent soldering. Finally, the "Cir-kit" strips are pierced with a pin where they underlie the component holes, and all resistors, capacitors, etc. can be threaded through and soldered into position. R5 and the silicon rectifier should be spaced about $\frac{1}{2}$in. above the paxolin board to assist heat dissipation. At the same time, solder the valve-holder pins to the appropriate strips, insert and solder the mains transformer leads, and place a spot of solder at each strip junction, as previously mentioned.

Range	Coverage	No. of turns	Wire gauge s.w.g.	Former
1	120-300kc/s	250	32	$\frac{3}{8}$in. ferrite rod
2	300-650kc/s	120	32	
3	600-2000kc/s	64	32	
4	1·9-6·0Mc/s	50	32	pile wound on $\frac{1}{4}$in. former
5	5·1-22Mc/s	14	28	
6	20-50Mc/s	4	16	self-supporting

Table 1: Winding details for the coils.

The flying leads connecting the p.c. board to the under chassis components (coil, range switch, modulation transformer, and smoothing capacitors) and to those above chassis (modulation switch, indicator lamp, and other controls), can also be soldered on at this stage, leaving sufficient lengths to reach the appropriate connections on the front panel (compare Fig. 4).

ASSEMBLY

The completed circuit board is now screwed on to the sub-chassis frame, the latter bolted to the front panel, and all flying leads soldered into position. Figure 5 is a top view of the completed assembly. Unless a separate signal source is available and it is desired to use the heterodyne method of calibration, with headphones, it will probably be better to leave the generator out of its cabinet meantime, since this will enable sufficient output to be picked up on a nearby receiver without the necessity for a coupling lead or dummy aerial.

Initial calibration is best carried out with the modulation off. Switch to the lowest frequency range (range 1), and tune the generator for zero beat with the long-wave light programme on the adjacent receiver. This enables the 200kc/s point to be accurately marked. Leaving the generator set to this point, tune in the harmonics of 200kc/s on the receiver at 600, 800, and 1,000kc/s. Leaving the receiver set to the latter frequency, switch on the internal modulation, and tune the generator, on range 3, for maximum response from the receiver

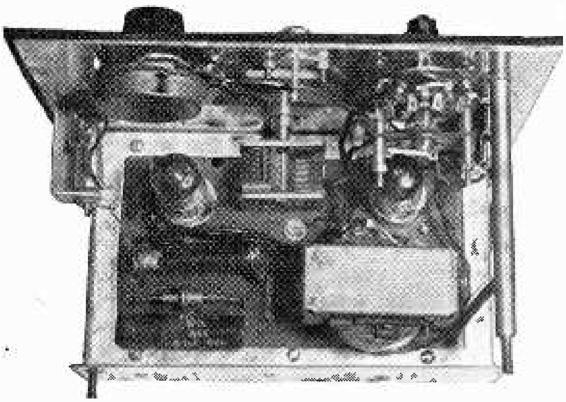


Fig. 5: Top view of the completed unit.

at this new frequency. Mark this point 1Mc/s. Harmonics will now be available at 2, 3, 4 etc. Mc/s, and the receiver can be tuned to detect any or all of these frequencies, depending on its short-wave coverage. After each setting has been found on the receiver, leave the latter untouched, and retune the generator for maximum response on the receiver, this representing the fundamental of the frequency to which the receiver is tuned.

Although this procedure will not produce accuracy comparable with the use of a second (calibrated) generator, nevertheless, it should be sufficiently accurate for general testing purposes. A useful check can be made by graphing frequency against dial reading for each range, and this will also ensure that spurious responses—particularly troublesome when the receiver used is a small transistor type—are not confused with the fundamentals or main harmonics. ■

★ components list

Resistors:

R1	1·5kΩ ½ watt	R5	3·5kΩ 5 watt
R2	22kΩ 1 watt	R6	45Ω 1 watt
R3	2·2kΩ ½ watt	R7	1Ω 1 watt
R4	47kΩ 1 watt	VR1	10kΩ pot.

Capacitors:

C1	20pF	C7	0·0047pF
C2	0·0047μF	C8	16μF 350V electrolytic
C3	100pF	C9	8μF 350V electrolytic
C4	0·01μF	C10	0·1μF 650V
C5	10pF	C11	0·01μF
C6	0·01μF	VC1	300pF variable

Valves:

V1	ECC83	V2	ECC83

Inductors:

L1–L6 see table
T1 3:1 or 5:1 intervalve transformer
T2 0–250V at 25mA, 6·3V at 1·2A

Switches:

S1 1 pole 6 way
S2 2 pole 3 way
S3 SPST mains toggle

Miscellaneous:

Silicon rectifier type BY600; dial bulb and holder; coil formers and wire for coils; two B9A valve holders; two co-ax sockets; Cir-kit copper strip; materials for chassis and case; nuts and bolts; solder etc.

new books

AMATEUR RADIO CIRCUITS BOOK
Compiled by G. R. Jessop, G6JP. Published by Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. 119 pages. Size 8½ x 5½in. Price 10s 6d.

THIS second edition is packed with circuits for the Ham. It does not give full details of how to build each project, but supplies the circuit and sufficient information for most amateurs to construct the units described. Just about every aspect of amateur radio is catered for and circuits are given for a.t.u.'s; front ends; speech amplifiers; oscillators; transistor transmitters; test gear etc. A large number of the circuits are transistorised and one depicts a 70 and 144Mc/s converter using field effect transistors.

This edition is a decided improvement on its predecessor in that it appears to contain even more detailed information. For the amateur enthusiast or ham who likes all those useful circuits in one place this is a good ten-and-sixpence worth, and can be confidently recommended.—*DLG*.

WORLD AT THEIR FINGERTIPS
By John Claricoats, G6CL. Published by Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. 307 pages. Size 8½ x 5½in. Price 12s 6d. (De-luxe—45s.)

DEFINITELY a must for the Historians, the curious and for those radio enthusiasts who like to read an interesting book which is devoid of maths and other such features which makes some works rather heavy going. This book is the story of Amateur Radio in the United Kingdom and a history of the Radio Society of Great Britain. John Claricoats is certainly to be congratulated on producing some interesting and informative reading, coupled with a huge number of facts many of which are quite an eye-opener.

Scene 1 commences with the very first meeting of a group of enthusiasts with their "coherer"—". . . a ½-inch diameter glass tube, 1 inch long, filled with iron filings. Corks were pressed into the ends of the tube and copper wires were passed through into the iron filings so that they did not quite meet". Finally, after chapters of interesting facts and photographs, the book arrives at the present-day.

One is often surprised by the odd snippits of information which come out, for instance the various people who have held membership in the Society—Sir Oliver Lodge, Senatore Guglielmo Marconi to name just two.

Just who were the first amateurs and what did they get up to. Well, there was . . . no, you buy the book and read for yourself.—*DLG*.

I.E.A. EXHIBITION 1968

THE Seventh International Instruments, Electronics and Automation Exhibition held at Olympia, London, from May 13 to 18 was one of the greatest technical exhibitions of its kind ever staged. A thousand companies from 15 different countries occupied the 695 stands spread over 250,000 square feet (around 12 acres!).

The equipment shown ranged from homely connectors to highly complex factory automation systems and much of it was on show to the public for the first time, some having only arrived from the development departments just in time for the exhibition.

Obviously it is impossible to deal with this exhibition in detail in the space available but we have selected some of the more interesting items touching on aspects of appeal to readers of PRACTICAL WIRELESS.

FREQUENCY CONTROL

An interesting frequency-controlled oscillator was shown by Pedoka Ltd., consisting of a small encapsulated unit, capable of printed circuit mounting, housing a miniature tuning fork to which piezoelectric elements are strapped. The crystals are energised at a low voltage, transferring energy to the fork which vibrates at its natural frequency. The oscillations are then passed on to built-in amplifying circuits. Frequency accuracy, in the range 300 to 3,000c/s, is normally better than 0·1 of a cycle. They can be built as oscillators or filters.

PRECISION MEASUREMENT

A displacement transducer and digital display giving reading accurate to one part per million was featured by Automatic Systems Laboratories.

The firm also showed a number of displacement transducers possessing a resolution of 0·25 micron and an accuracy of 0·5 micron. These are digitised sequentially, the measurements printed out on tape.

CHEQUE CHECK

Verification of cheques which need to be examined at more than one location in banks is speeded up by the Epsylon Telecheque system, operating with closed circuit television. The unit is so designed that the camera not only views the surface of the cheque but also sees through it to give warning of attempts to forge either signature or the amount payable. When the authorising officer at the remote station has approved the cheque, he presses a button which activates electromagnetic equipment at the bank counter to emboss the cheque with a mark indicating that it is approved.

LONG LIFE RELAY

Astralux Dynamics Ltd. featured their Reedac reed relay which can switch up to 15A at 250V a.c. with a life expectancy of 500 million operations (approx. 16 years of once-a-second operation). It is controlled by 6—24V d.c. and the control circuit requires a power of only 125mW.

FLAMEPROOF FLASH

An electronic flash unit which is flameproof and allows conventional photography to be carried out in explosive atmospheres (mines, oil refineries, etc.) was exhibited by Ernest Turner Ltd.

TAPE WOUND CORES

Ross & Catherall Ltd. showed for the first time cut tape wound transformer cores, epoxy resin covered but not impregnated to preserve the electrical properties. The new process is claimed to give an improved core with no increase in cost.

VIBRATING C

The type XL7900 shown by Mullard Ltd. is a vibrating capacitor with which extremely small voltages can be measured. Electrometers using this capacitor have measured currents as small as 8×10^{-17} Amp., the equivalent of the flow of 500 electrons per second.

It contains four metal plates in parallel, the outer ones fixed, the inner ones mechanically linked to preserve constant spacing but able to vibrate as a pair with respect to the fixed plates. A.C. is applied between one vibratory and one fixed plate. The voltage to be measured is applied to the other two plates.

ELECTRONICS FOR CARS

A. B. Electronic Components Ltd. showed microcircuits for use in the electric systems of cars, designed as part of the Lucas alternator equipment which will ultimately replace the conventional d.c. generator. Thick film resistive and conductive elements are fired to a refractory base and then Lucas "hybridise" the circuit by fitting semiconductors of their own manufacture.

LONG LIFE BITS

Harrison Clark Ltd. showed a new type of soldering bit with a 500 micron electrolytic coating within the diameter and a protective nickel coating over the top. Cost is high but it is estimated that their life is 75 times that of a standard copper bit. One specimen has been in use for six months and completed 600,000 joints and is still operating. The claim is for up to 4,000,000 joints without undue wear.

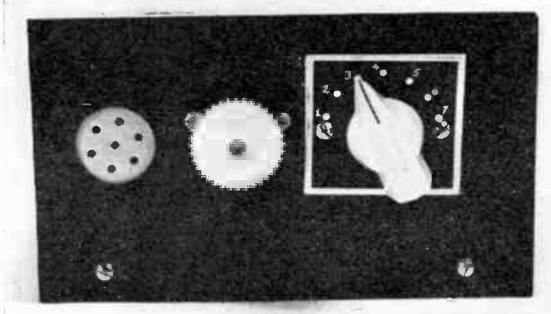
MINI COMPUTERS

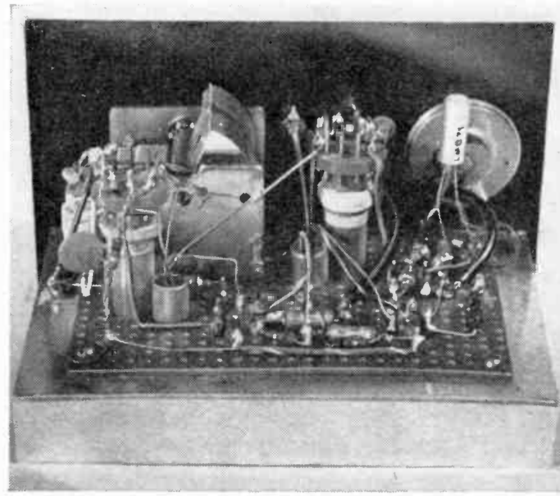
Muldivo Ltd. displayed a range of desk-top computers. The most sophisticated was the IME86S featuring seven registers all with check-back factors after calculation. Cost, £740. The most compact weighed only 28·5lb. and had an average speed of calculation of 0·2 seconds, or 2·5mS for an elementary addition.

MINIATURE MAINS SWITCH

A. F. Bulgin & Co. Ltd. exhibited a mains switch needing only a 1/32in. x 0·512in. panel cut out and projects only 0·2in. It weighs 17gm. and carries an illuminated legend with a brilliant-glow neon lamp. ■

THREE TRANSISTOR





3 SIMPLE RECEIVERS FOR Beginners

by T. Simon

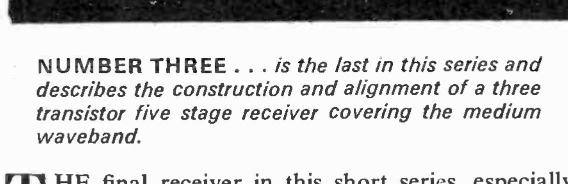
NUMBER THREE . . . *is the last in this series and describes the construction and alignment of a three transistor five stage receiver covering the medium waveband.*

THE final receiver in this short series, especially for the beginner, differs from the other two. The previous designs have been t.r.f. receivers standing for tuned radio frequency—whereas this receiver is called a super heterodyne or superhet.

The T.R.F

What is the difference between the two types? Well, let us look at Fig. 1. The radio frequency signal (r.f.) comes into the set via the aerial to the r.f. amplifier stage. Here it is amplified and passed to the detector where it is converted to audio frequency (a.f.) and from here passes to the a.f. amplifier for further amplification.

If we drew a similar block diagram of the first receiver in the series it would look like Fig. 2. The first stage amplifies the signal at r.f., passes it to the detector stage which converts it to a.f., and it is then fed back to the first stage again for further amplification. Note that the first time it passed through the first stage it was amplified at r.f. and the second time at a.f. We say that the stage is reflexed or that it is a reflex stage. Figures 1 and 2 depict t.r.f. receivers since the signal is amplified at the frequency it is received at, i.e. it is not changed or converted to a different r.f. frequency.



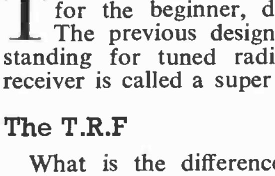


Fig. 1: Block diagram of a t.r.f. receiver.

Fig. 2: A reflexed t.r.f., note the signal passes through the first stage twice.

The Superhet

Now look at Fig. 3. This is a block diagram of a superhet receiver. Note that the last two blocks marked DET and AF are the same as the last two in Fig. 1. But what about the first three marked MIX, IF and OSC? This is the difference between the simple t.r.f. and the superhet.

The signal is again received via the aerial and fed to the mixer—which might be thought of as an ordinary r.f. amplifier stage, just like the first box in Fig. 1. Let us suppose that the signal received is at a frequency of 2,000kc/s. The box marked OSC is an oscillator—a tiny transmitter which emits a signal—and this also is fed with the aerial signal to the mixer. Just as its name implies, the mixer mixes the two signals together and at the output of the mixer there will be two main signals, the sum and the difference of the two signals fed in.

Let's take an example to clarify matters. We are receiving a signal from the aerial at 2,000kc/s (say) and our oscillator is tuned to give a signal of 2,460kc/s. Therefore, at its output, there will be two signals, 2,000kc/s plus 2,460kc/s = 4,460kc/s, and 2,460 minus 2,000kc/s=460kc/s. If we put a tuned circuit in the output and tune it to 460kc/s it will pass the 460kc/s signal and reject the 2,460kc/s signal.

Suppose that we couple the tuning of our aerial circuits and those of our oscillator so that the oscillator is always tuned to a frequency 460kc/s above the frequency to which the aerial circuit is tuned to. Then, no matter where we tune in the band, there will always be a signal of 460kc/s at the output of the mixer. This is just exactly what happens in the superhet.

The i.f. stage is nothing more than an r.f. amplifier tuned to amplify at the i.f. (intermediate frequency) which in this case is 460kc/s. From here the signal is detected and the resultant audio is amplified by the a.f. amplifier just as it was in the t.r.f.

Reflex Circuit

Figure 4 shows a block diagram of the receiver described here. The first transistor is arranged to function as both mixer and oscillator. The second stage is reflexed, and the i.f. signal at 460kc/s is first amplified at this frequency and then passes to the detector where it is converted to a.f. The a.f. signal is now passed back again to the i.f. stage which this time amplifies a signal at audio frequencies and passes it to the a.f. audio output stage to feed the speaker or headphones.

The Receiver

The complete circuit for the receiver is shown in Fig. 5. The signal is fed to the small coupling coil between pins 8 and 9 on L1. The tuned circuit VC1/L1 tunes in the station and this is then coupled to the base of Tr1 by the second coupling coil, pins 5 and 7. Coil L2 also has three windings. The two sets between pins 8 and 9, and 5 and 7 cause the circuit to oscillate by feeding back some of the r.f. energy, while the tuned circuit VC2/L2 governs the exact frequency at which the stage will oscillate. We arrange this oscillator frequency to be 460kc/s above the incoming signal frequency, and since VC1 and VC2 are ganged together, they will alter the tuned

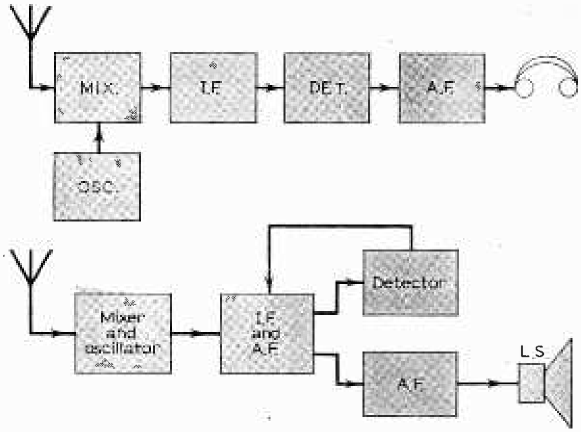


Fig. 3 (above): Block diagram of a simple superhet.
Fig. 4 (below): Superhet with a reflexed i.f. stage.

circuits by the same amount thus ensuring that the oscillating frequency is always 460kc/s above the incoming signal.

The tuned circuit marked i.f.t.1 is tuned to the intermediate frequency (460kc/s) in order to select this difference signal and reject all others. Note that the lead from pin 8 of L2 is connected to pin 2 of the i.f.t., i.e. the signal is tapped into the coil. If it were taken to pin 1 of the i.f.t. there would be a mismatch between the collector and the i.f.t. tuned circuit which would make the circuit tune very broadly. In this case it would be very undesirable since we only want our i.f.t. to tune sharply to 460kc/s.

The coupling winding on i.f.t.1 (which is not tuned) couples the signal to base of the i.f. stage Tr2. Here it is amplified at 460kc/s and appears at the collector of Tr2 which is again tapped into the tuned load formed by i.f.t.2. The small untuned coupling winding feeds the signal to the diode detector which in turn feeds the resultant audio signal to the volume control VR1. Capacitor C4 couples this (now audio) signal back again to the base of Tr2 which now acts as an audio amplifier. The amplified audio appears across the 1kΩ resistor R8, the tuned circuit of i.f.t.2 will not affect this audio signal since it is tuned to 460kc/s which is well outside the audio range. From R8 the audio signal is fed, via C6, to the base of Tr3, which amplifies the signal and feeds it to the miniature loudspeaker or headphones.

The dial was made from a small scrap of scraper board, obtainable from most good art shops, a small packet

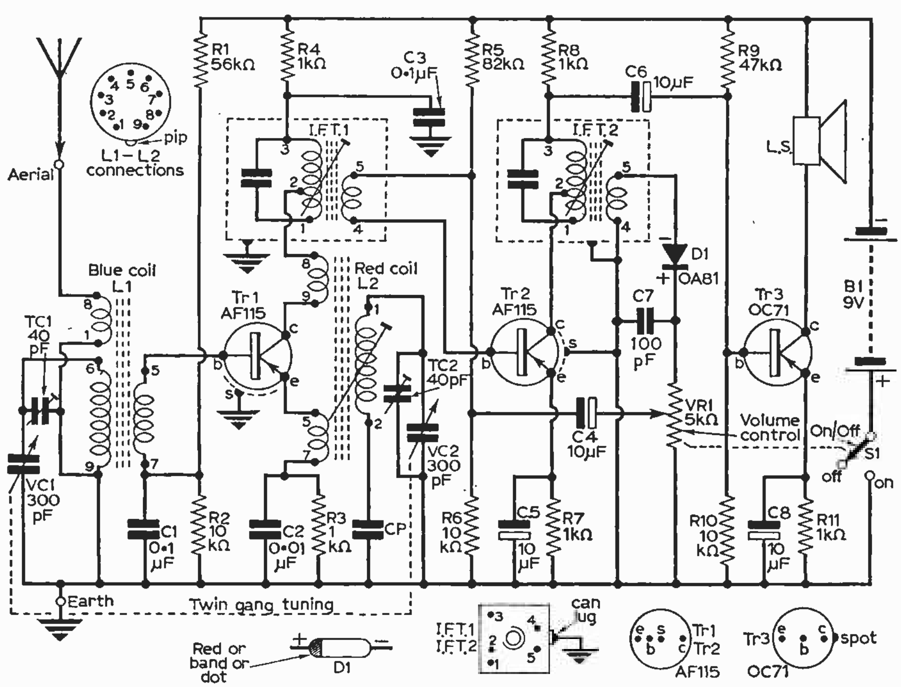


Fig. 5: Circuit diagram of the reflexed superhet receiver.

costing 2s. 6d. Alternatively, a piece of white card marked with Indian ink etc., would prove equally suitable.

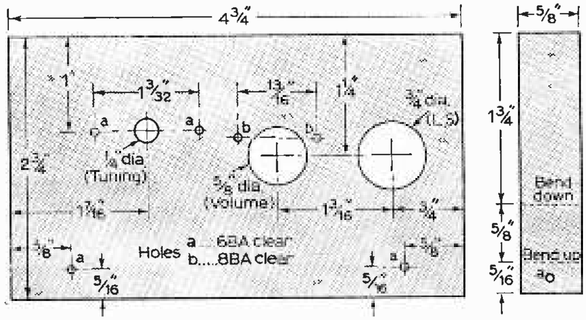
Construction

First, take a piece of aluminium $4\frac{5}{8}$ x $4\frac{1}{2}$in. and cut out, bend and drill as indicated in Fig. 7. Either 18 or 20 gauge aluminium will suit, 20 gauge being used in the prototype. The lighter gauge makes cutting and drilling a little easier and is quite good enough since the chassis does not have to bear any great weight.

Next, mark out and drill the front panel. The larger holes may be first drilled with the largest drill to hand, usually a $\frac{1}{4}$ or $\frac{3}{8}$in., and then enlarged carefully with a half-round file. Any plastic material will do but extra care is needed since plastics, especially Perspex, is easily cracked and chipped.

Take the veroboard and drill the four 6BA mounting holes, again exercising care. Now, fix together the front panel and chassis. Mount the three items on the front panel—VC1/VC2, VR1/on-off and the "speaker".

Wiring of the veroboard is the next job, so first insert pins into the board as indicated. Carefully drill the board and mount the coils and i.f.t's. The



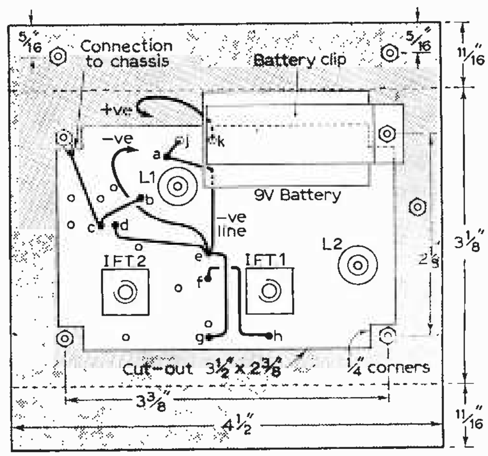


Fig. 6 (above): Drilling details of the front panel and battery clip.

Fig. 7 (below): Chassis drilling and under-chassis wiring.

cut-outs for the i.f.t's are made by drilling a number of small holes with a 3/32in. drill, and then filing to the final size with a small thin file. The i.f.t's are held in place by bending over the lugs connected to the metal screening cans. Make sure to earth these lugs or the screening will be ineffective and instability could easily result.

Wire in the transistors and diode last of all and use a heat shunt for the purpose. The finished wiring should be carefully checked against the circuit and layout diagrams, Figs. 5, 7 and 8. Note that the coils are held in position by a small plastic nut which should be only finger tight since it is easy to crack the nut or even sheer off the thread if too much force is applied.

Finally, wire in the battery but do not connect the terminal clips until you have checked the completed wiring against Fig. 5. Check carefully the connections to the transistors and the diode. Now connect the battery and the set is ready for alignment.

★ components list

Resistors:

R1	56kΩ	R5	82kΩ	R9	47kΩ
R2	10kΩ	R6	10kΩ	R10	1kΩ
R3	1kΩ	R7	1kΩ	VR1	5kΩ
R4	1kΩ	R8	1kΩ		edgewise pot. with switch

Capacitors:

C1	0·1μF
C2	0·01μF
C3	0·1μF
C4	10μF 16V electrolytic
C5	10μF 16V electrolytic
C6	10μF 16V electrolytic
C7	10μF 16V electrolytic
TC1, TC2	30pF miniature ceramic trimmers
VC1, VC2	300+300pF twin gang variable
CP	350pF padder (300+50pF in parallel)

Semiconductors:

Tr1	AF115 Mullard	Tr3	OC71 Mullard
Tr2	AF115 Mullard	D1	OA81 Mullard

Inductors:

L1	Miniature transistor Type 2T Blue	Denco (Clacton) Ltd.
L2	Miniature transistor Type 2T Red	
IFT1	Type IFT 14	
IFT2	Type IFT 14	

Miscellaneous:

Veroboard $3\frac{3}{4}\times2\frac{1}{2}$in.; material for front panel $4\frac{3}{4}\times2\frac{3}{4}$in.; aluminium $4\frac{1}{2}\times4\frac{5}{8}$in.; dynamic mike insert (L.S.) 2kΩ impedance, model MM2 (Henrys Radio); nine 6BA and two 8BA nuts and bolts; dial to suit; white pointer knob; solder tags; screened lead—about 6in.; wire; solder, wire for aerial and earth; 9 volt battery (PP3); battery terminal clip; strip of aluminium to hold battery $2\frac{3}{4}\times\frac{5}{8}$in.

Alignment

If you have a signal generator and know how to use it then you should experience no difficulty in alignment. If not, and you do not have any experience in aligning superhet receivers, it would be wise to enlist the aid of the local radio dealer who might do this for you at a small fee. It is possible to align the receiver by ear and for this purpose you will need an insulated trimming tool plus, of course, an ear! A plastic knitting needle filed to the shape of a screwdriver will do. A metal screwdriver is no use since the metal would de-tune the circuitry.

With a suitable aerial and earth connected, the core of the oscillator coil (L2) is adjusted until a station is heard at the low frequency end of the dial i.e., with the vanes of VC1/VC2 almost completely enmeshed. When a signal has been located, the core of the blue coil (L1) is adjusted for maximum volume.

VC1/VC2 are now tuned to the other end of the band so that you should seek a signal which comes in when the vanes are now almost fully open. Now, gently adjust the oscillator trimmer (TC2) for maximum volume after which the other trimmer (TC1) is also gently adjusted for a further possible increase in output. Now return to the first station with the vanes of the gang more enmeshed, and again slightly adjust the cores of the coils for any slight increase in volume. After this the other station is returned to and the trimmers again adjusted. These adjustments will get smaller and smaller until no further improvement can be realised. At this point you should turn the set over and very carefully adjust the cores in the tops of the i.f.t's starting with i.f.t.2. The adjustment will be extremely small since these are aligned before dispatch, so it may be that very little improvement will be effected. This adjustment will, in any case, be very slight and it would probably be in order to leave the cores of the i.f.t's alone.

The small "speaker" should give reasonable volume for bedtime listening; however, with the prototype, a pair or 2,000Ω headphones connected in its place worked extremely well if not as good as the speaker.

Aerials from 30 to 150ft. were tried and all gave good results, several foreign stations coming through very well after dark including Radio Luxembourg. A case would be easy to make, and this is left to individual constructors. Any plastic, wood, or even aluminium would suit and should present no problems. It would be in order to fit a headphone jack for late night headphone listening.

Although this receiver is the most complicated of the three in this series, if you think of it as three separate one-transistor circuits, then the wiring is not really so difficult. The circuit, as it stands, is not considered suitable for conversion to other wavebands. ■

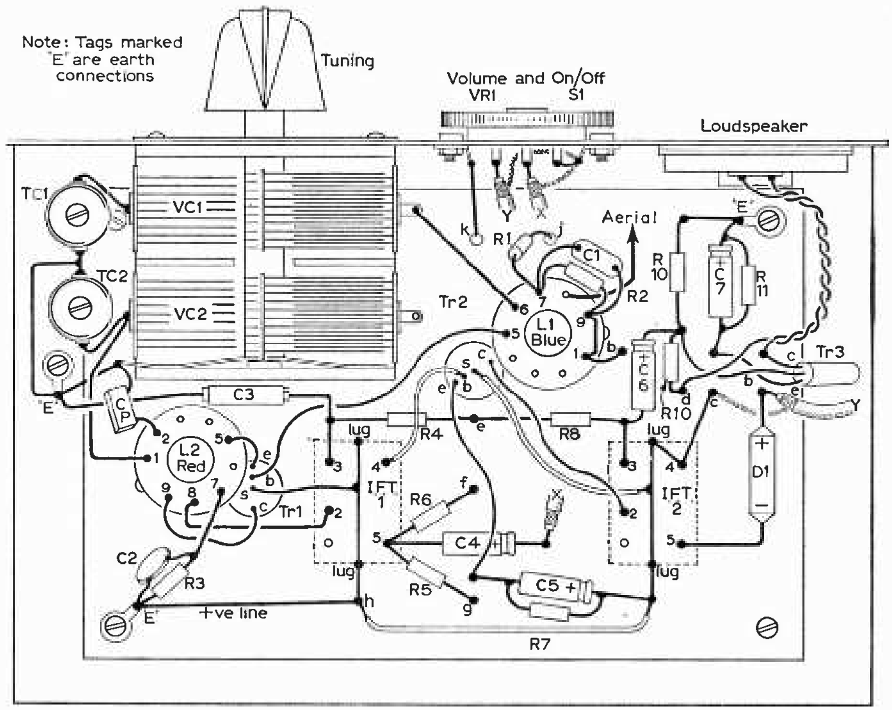


Fig. 8: Layout and wiring of components above chassis.

Preamplifier for 'RADIO 2' on 1500 metres

J. B. WILLMOTT

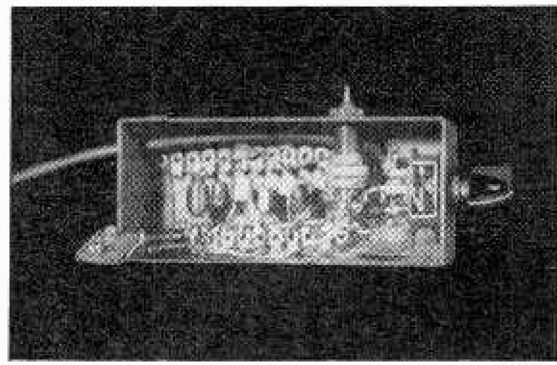
AS a result of the recent reorganisation of BBC programmes and in particular the allocation of the 247 metres wavelength to transmitters radiating the new "Pop Music" programme "Radio 1", listeners in many parts of the country who formerly enjoyed good reception of the Light Programme on 247 metres from their local medium waveband transmitter, are now faced with reception of the "Radio 2" programme on 1500 metres, unless of course they are fortunate enough to possess a v.h.f. receiver, in which case Radio 2, 3, and 4 are readily available (but an a.m. receiver is still necessary for reception of Radio 1!).

Whilst the Radio 2 transmitter on 1500 metres is an extremely powerful one, being rated at 400kW radiated power, its situation at Droitwich inevitably means that some parts of Great Britain are situated at a considerable distance therefrom, and as a result, listeners in these areas are finding that reception of Radio 2 on 1500 metres compares very unfavourably with their former reception of the Light Programme on 247 metres. Not everyone is prepared, or financially able, to face the expense of purchasing a combined f.m. a.m. receiver to ensure reception of all four BBC radio programmes; this problem is particularly acute in the case of elderly persons, frequently pensioners of modest means, to whom radio is a great boon. Equally understandably, this section of the community tends to rely on radio receivers which have seen many years of service and which do not possess v.h.f. facilities.

Aerial systems

However, before going to the expense of installing a preamplifier such as is described later in this article, it is advisable to first of all ensure that as good an aerial system as possible is in use. The proverbial piece of flex dangling at the rear of the set, or hooked to the nearby picture rail, which sufficed for reception of the local 247 metres transmitter, just will not do to provide a reasonable signal from Radio 2 at a range of 150 miles or more.

The days when practically every house boasted an "L" type aerial reaching from chimney stack to a pole (or convenient tree) in the back garden are long past, but if an outdoor aerial of this type can be erected, using good quality aerial wire and porcelain insulators, it is amazing the degree of improvement in reception which results. A good second best is a vertical rod aerial, mounted on a chimney stack, or on a stand-off bracket from the wall of the house as high above the ground as possible. Suitable copper aerial rods and fixing brackets can be obtained from suppliers advertising in this magazine. Another effective alternative is an aerial mounted in the loft, using the maximum feasible length of good quality aerial wire and proper porcelain or glass insulators. The downlead should



Underside view of the preamplifier.

be taken out at the base of the roof, and carried down the side of the house (separated as widely as possible from any metal rainwater pipes etc.).

None of the abovementioned suggestions can be readily used by people living in flats, bed sitting rooms etc. Modern blocks of flats frequently have a communal TV aerial system, with an outlet in the living room of each flat. This outlet forms a reasonably satisfactory aerial connection for radio purposes, but it is absolutely essential to ensure that the radio receiver to be used has no direct connection between the mains supply and the aerial and earth sockets, i.e., the power supplies to the receiver should be by means of a fully isolating mains transformer, or, if a.c./d.c. techniques are used, both the aerial and earth sockets must be isolated by means of high voltage working capacitors, otherwise there is danger of mains voltage finding its way into the TV aerial distribution system, with possibly costly, and dangerous, results. If no TV aerial outlet is available, one can only "make do" with a picture rail aerial;

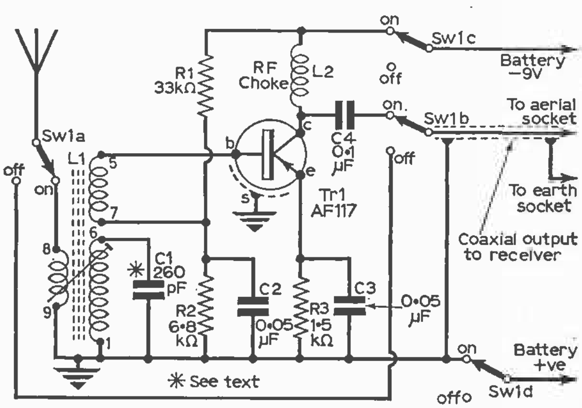


Fig. 1: Circuit of the preamplifier.

this should be confined to the length of not more than two walls of the room, extending the wire to completely circuit the room usually provides a weaker rather than a stronger signal.

If after everything possible has been done to improve the aerial system (attempts to provide a more efficient "earth" connection seem to have little beneficial results in the case of mains operated receivers, at any rate, on Long and Medium wavebands), the 1500 metres programme is still weak, and suffers from excessive background hiss and hoise, consideration should be given to the provision of a preamplifier, which for cheapness and simplicity, can be designed to provide r.f. amplification ahead of the main receiver at the predetermined frequency of 200kc/s (1500 metres), being switched out of action when any other frequency is desired. Such a unit was constructed by the author, firstly using valves, and then later a transistorised version was built; both have given excellent results in two difficult reception areas in which they have been tried out. It is the latter, the transistorised unit, which will probably appeal to most constructors, and full details of this unit are accordingly given.

Preamplifier circuitry

The circuit was designed around an AF117 transistor, which is capable of a high level of gain at radio frequencies, yet has a commendably low noise level, and has been found inherently stable in use. After a number of trial and error adjustments to the breadboard prototype, the circuit values shown in Fig. 1 were adopted, and the entire unit re-constructed in a plastic box, with removable lid, measuring approximately $4\frac{1}{2} \times 2 \times 2$in. A metal container should not be used, as this could seriously lower the "Q" of the coil L1, quite apart from possible insulation problems.

The circuit (see Fig. 1) operates as follows. Signals from the aerial are fed to section (a) of the changeover switch; with this switch in the "off" position, signals are bypassed, via section (b) of the switch, direct to the coaxial link feeding into the radio receiver's aerial and earth sockets. With the switch in the "on" position however, signals are fed to the aerial coupling winding of L1, this being a Denco Transistor Coil, Type Blue, Range 1, specifically designed to cover the Long Waveband. Signals are induced in the tuned winding (between pins 6 and 7), where, as only a frequency of 200kc/s is required to be tuned in, the more usual variable capacitor is replaced by a fixed capacitor C1 connected across the winding.

Denco Ltd., in their data sheet, indicate that a fixed capacity of about 260pF is required to tune to the Radio 2 frequency, but in the prototype the author

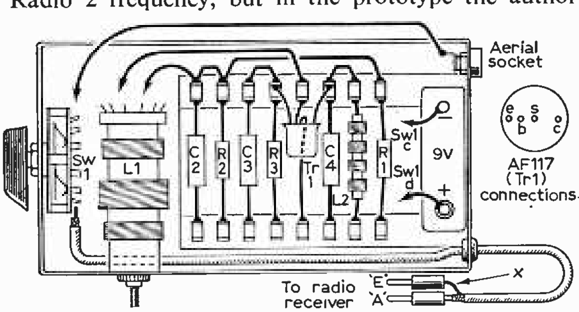


Fig. 2: Layout of main components. Fig. 3 (right): AF117 connections.

found that a value of 180pF provided resonance at a midway setting of the coil core. This may possibly have been due to excessive external capacity in the rest of the circuit, constructors should therefore be prepared to experiment with the value of C1 to find the most suitable value. The coupling winding (between pins 5 and 6) provides the necessary low impedance coupling link to the base of Tr1, whose correct working conditions for r.f. amplification are set by the values of R1, R2 and R3 in conjunction with their respective bypass capacitors. The amplified r.f. signal appears at the collector of Tr1, and the choke/capacity coupling provided by L2 (an r.f. choke of approx. 10mH) and C4 (0·1μF) is used to couple the output to the radio receiver via the aforementioned section (b) of the changeover switch.

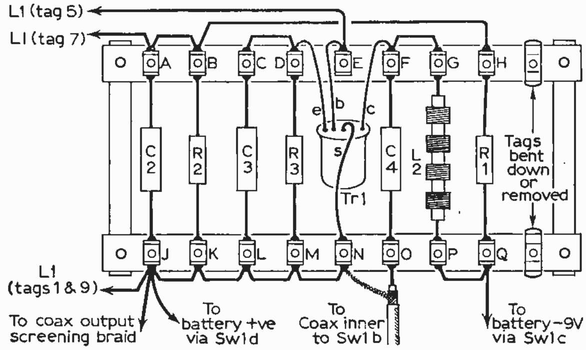


Fig. 4: Wiring and component layout of the tagboard.

Output is via the shortest convenient length of standard coaxial cable, terminated at the receiver end by suitable plugs to fit the aerial and earth sockets. The inner conductor is of course connected to the aerial plug, and the screening braid to the earth plug.

It will be noticed that sections (c) and (d) of the changeover switch provide a double pole, on/off switch

★ components list

Resistors:
R1 33kΩ R2 6·8kΩ R3 1·5kΩ
all 10% miniature $\frac{1}{4}$W.

Capacitors:
C1 see text (silver mica) C3 0·05μF 150V
C2 0·05μF 150V C4 0·1μF 150V
all miniature foil, unless otherwise stated.

Transistor:
Tr1 AF117 Mullard

Miscellaneous:
Plastic container (with lid) approx. $4\frac{1}{2} \times 2 \times 2$in.; 4 pole-2 way switch; Denco Blue, Range 1 (transistor) type coil L1; PP3 battery and connector clip; aerial socket; pointer type control knob; 9-way miniature group panel; r.f. choke approx. 10mH; connecting wire; coaxial cable.

The following additional components would be required for the mains supply system in Fig. 7:
6·3V pilot bulb and holder; 2—OA81 diodes; 3—25μF 25V capacitors; 1—2·2kΩ $\frac{1}{2}$W resistor (see text); twisted flexible wire; tagboard to mount the aforementioned components.

for the battery supply, so that in the "off" position, the battery is completely disconnected, and simultaneously, any signal received by the aerial is bypassed around the preamplifier direct to the radio receiver.

Current consumption was found to be 2·5mA, so that a PP3 battery, which fits snugly into the space available, will give many hours of useful life. It is a simple matter to remove the lid of the container to replace the battery when necessary.

All the capacitors, resistors, and the transistor, are mounted on a standard miniature 9-way group panel, only 8 ways being used, the 9th pair of tags being either bent flat or removed, thus providing a space for the PP3 battery to stand in an upright position. Wiring of the group panel is clearly shown in Fig. 4, whilst Fig. 5 gives wiring details of the changeover switch. In conjunction with Fig. 1, and the layout indicated in Fig. 2 which was used in the prototype, the intending constructor should have no difficulty in assembling this unit.

Connect approx. 6in. of insulated wire, or coaxial cable where applicable, to the changeover switch tag as shown in Fig. 5 before mounting this component through a ⅜in. hole in the front of the plastic container. These leads are subsequently shortened as required, to connect to the group panel, battery etc. Smaller holes, ¼in. dia, are drilled in the rear of the container to accommodate the aerial socket and the exit of the coaxial output cable, and a 0BA hole is required in the side to allow for fixing of L1. Mount all resistors, capacitors and Tr1 on the group panel (do not shorten the leads of Tr1, and do not forget to use a heat shunt when soldering these leads). Place the completed group panel on the "floor" of the container, and make all external connections from the panel as shown. Lastly, mount L1, and make the necessary connections to its pins, referring to the coding shown in Fig. 1. C1 is soldered directly across pins 1 and 6. Note that both pins 1 and 9 are connected to the positive "earth" line of the unit, using tag J of the group panel for this purpose. It was not found necessary to secure the group panel to the plastic case in the prototype, as stiffness of the external wiring retained it firmly in position. The fact that the battery stands upon the unused end provides additional anchoring; the battery can be wedged securely in position with scraps of plastic foam pressed down between it and the walls of the container.

Testing

When assembly has been completed, and all wiring checked, set the changeover switch to the "off" (anticlockwise) position. Insert battery, and connect battery clip. Take great care that polarity is correctly observed (a reversed battery will almost certainly cause instant destruction of Tr1). Replace lid of container. Remove aerial from socket of receiver, and re-insert in aerial socket at rear of preamplifier.

Connect the preamplifier coaxial output lead to the aerial and earth sockets of the receiver. Switch on the radio receiver, and tune to "Radio 2" on 1500 metres, which should be received exactly as before the preamp was placed in circuit. Now turn the switch to "on", and adjust core of L1, as resonance is neared, a very distinct improvement in reception will take place. The increase in volume will be partly masked by the a.v.c. action, but a big drop in background noise will be noticed. Adjust L1 for best possible reception. Return switch to "off", and the dramatic diminution

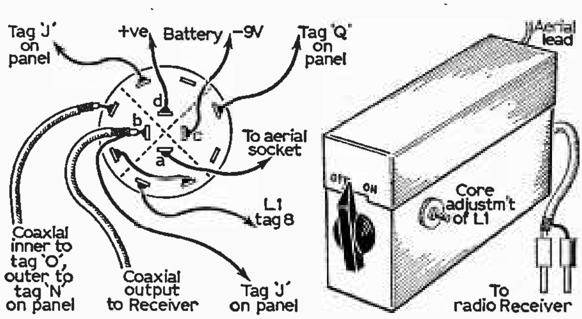


Fig. 5 (left): Connections to SW1. Fig. 6 (right): View of the complete unit.

in performance will be immediately apparent. The preamplifier is left connected at all times, but is of course only switched "on" when listening to "Radio 2". There is only one drawback to the unit, namely that it is possible to inadvertently switch off the main receiver, yet leave the preamplifier switched "on", with consequent unwanted drain on the internal battery. A small pilot lamp could be fitted to show when the preamplifier was "on", but the consumption of even the smallest pilot lamp would be almost ten times that of the unit itself!

Mains power unit

It is possible to obtain a suitable supply for the preamplifier from the radio receiver, provided this is of the fully isolated a.c. mains type (with double wound mains transformer) using 6·3V heater supply to the valves. The theoretical circuit of such a supply is shown in Fig. 7. As one side of the receiver's heater supply is normally connected to chassis, as shown in Fig. 7, it will be necessary to insert a 0·1μF 150V capacitor in the "earth" lead from the preamp. (point X Fig. 2). Switching off the main receiver would of course automatically remove the power supply to the preamplifier. The author has not tried out this modification, but there is no reason why it should not be satisfactory. Some adjustment of the value of the 2·2kΩ smoothing resistor (in the negative supply lead) might be required to ensure a supply as near as possible to 9V "on load".

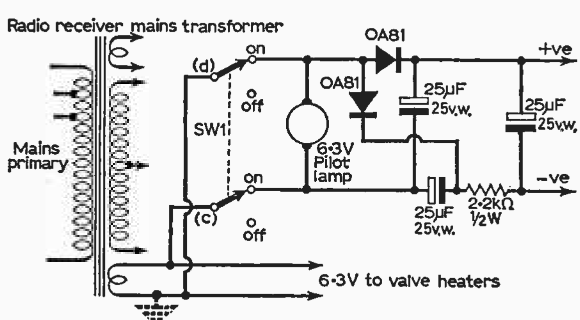


Fig. 7: Circuit of the mains power unit.

However, in view of the low price and long life of a PP3 battery, many constructors may feel it would not be worth while to go to the added expense of a mains power supply for the unit. On no account should any attempt be made to supply the unit from an a.c/d.c. receiver with series heaters and a live chassis. ■

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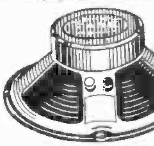

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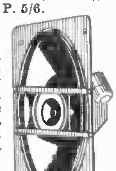

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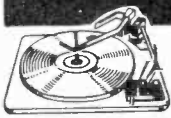

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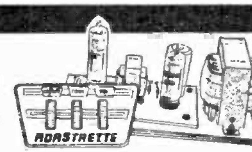

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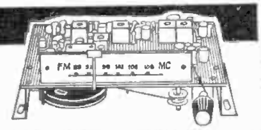

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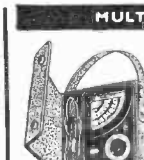

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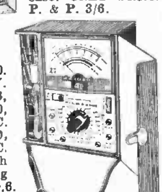

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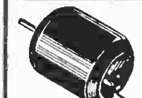
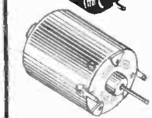
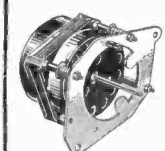


6.3 D.C. Motor. 10,900 r.p.m. at 230mA. 1½in. x 1in. diameter. Shaft ⅜in. long x 3/64in. diameter, 9/6. P. & P. 2/6.



9v. D.C. Gram deck replacement motor. 2in. x 1⅛in. diameter. Shaft ⅛in. long x 3/32in., 17/6. P. & P. 2/-. TWO FOR **30/-** P. & P. 2/6



R. H. Take up Motor made for Collaro Decks. Many other uses, supplied with suitable resistor for 240V A.C. operation. Spindle 1⅛in. x $^3/_{16}$in. diam. ONLY 24/6. P. and P. 4/-.

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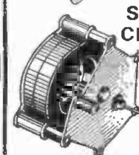

Geared for 40 revolutions per hour. 230v. 50 cycle, with mounting flanges. Size approximately 1⅛in. deep x 2⅛in. diameter ONLY 22/6. P. & P. 2/6.

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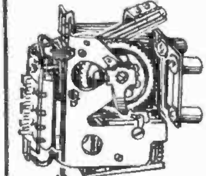

Numerous applications. Electro magnet and brass tooth wheel. A switch wafer and contacts are coupled to this and arranged to be on for 10 pulses and off for 15. An Auxiliary contact is normally on but off 1 in every 25. Complete with suppressor, resistors, plus series contact for continuous operation. Ideal window displays, switching lamps, models, etc. 12v. or 24v. D.C. Brand new and boxed, 12/6. P. & P. 2/6.

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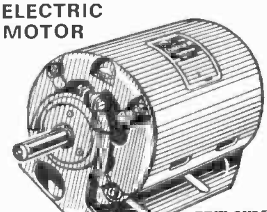

FEW ONLY LEFT!

Made by Crompton Parkinson. Single phase ⅙th h.p. Motor 230/250v. 50 cycles. 1·3 amps. 1,425 r.p.m. Continuous rating. Spindle 1⅞ x ½in. dia. Overall size less spindle approx. 8 x 6in. Perfect condition. A bargain for the work bench. 69/6. Carr. 12/6.

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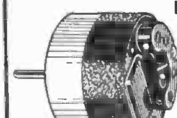


Made by Smiths. A.C. operation 200/250v. Double pole. Will give time delays from 0–10 minutes. Size 2¼in. dia. x 2⅞in. long inc. ⅜in. x 3/16in. dia. spindle. **BARGAIN PRICE** 17/6. P. & P. 2/6.

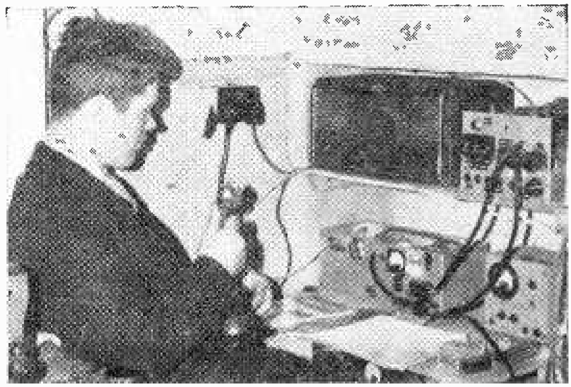
CLUB SPOT No. 20 Paddington & District AMATEUR RADIO SOCIETY G3PAD

THE Society, formed in January 1960 by 6 stalwarts living in the district, now holds its regular weekly meetings on Thursdays at the Beauchamp Lodge Settlement, 2 Warwick Crescent, London W.2. The meetings cater for all interests commencing with c.w. tuition from 7 to 7.45, and then follows a meeting consisting of lectures, quizzes, film and slide shows, junk sales etc.

The club is on the air most Thursday nights with its own callsign—G3PAD which it also uses regularly in contests, field days, demonstrations at local events etc. The equipment includes a 160 metre home-brew transmitter for phone and c.w.; the "Buccaneer" multiband h.f. transmitter (as described in PRACTICAL WIRELESS, September 1964 (jolly good show—Ed.) for all bands 80 to 10 metres; an HRO receiver; 4 and 2 metre transmitters with complimentary crystal-controlled converters working into a common 10 to 12Mc/s i.f. strip.

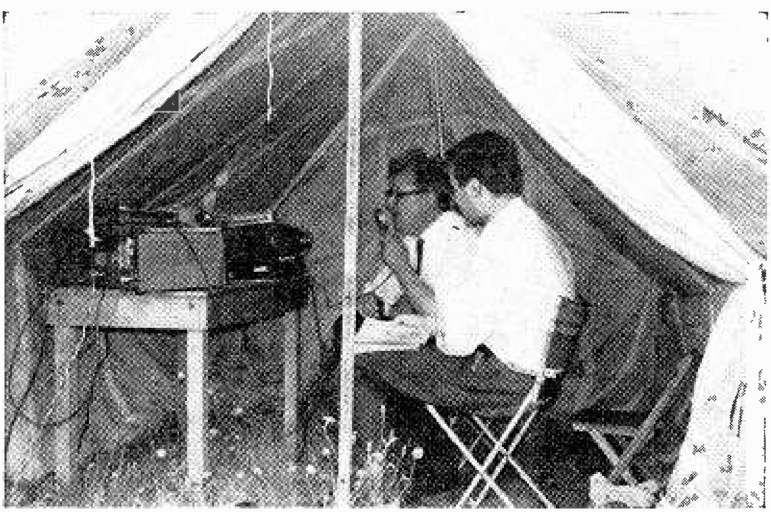
Antennas include a 400ft. long wire for 160 and 80 metres; a T2FD (terminated tilted folded dipole) for the h.f. bands; fully rotatable six element yagi for 2 metres mounted on the roof approximately 80ft. up; while a 3 element beam for 4 metres with a 14 element 70cm beam are to be mounted shortly. The club also possesses a 300 watt generator for portable use.

Membership includes a wide variety of types from topband addicts to DX operators. There is also a v.h.f. section. All these are in addition to the many keen s.w.l's who attend the club. Many of the s.w.l's have benefited, from practical experience gained at the club, in their careers. There is also an active group of G8 plus 3's on 432Mc/s, and 1296Mc/s equipment is at present under construction.



Lorry (G8AZX) operating the 2 metre station.

Being situated in the centre of the town, many overseas visitors find their way to the club and are often persuaded to give impromptu talks on amateur radio operation from their own country. Due to the large number of members who live in flats and are thus deprived of constructional facilities, the club holds a constructional evening on Wednesdays at 8 p.m. with a workbench and test equipment provided.



Eric (G3MHQ) and Alan (G8AQO) at the 1966 Club Field Day.

The club gave a demonstration on amateur radio to the Hackney group Queen's Scouts at Gilwell Park last year, and also intends to enter for the 70cm contests to be held this year, and v.h.f. n.f.d., also to hold its own h.f. field day.

The club has its own quarterly news letter *Key Klix* edited by Alex Summers, G3AWS. Each year the Beauchamp Award is presented to the member who has served the club best in the past year. This year it was awarded to s.w.l Terry Collins.

Visitors are always welcome and full details are available from the Hon. Secretary, M. A. Pawley, G8AWV, who is known to lurk at 52 Sumatra Road, West Hampstead, London, N.W.6. Why not drop in and see us?

Five steps to hi-fi

PART FOUR ...... LOUDSPEAKERS

IAIN SMITH

SO far in this series I have given some general notes on pick-ups and amplifiers, two links upon which lie a great deal of responsibility for the performance of the whole system. Together, of course, with the turntable drive. These links, however, besides giving a good flat, distortion free, overall response have little else about them to determine the final sound, the tonal balance, of the system. This is the job of the loudspeaker. The quality of the loudspeaker and its enclosure is of the utmost importance. The loudspeaker is the second weakest link in the reproducing chain but whereas one pick-up can *sound* the same as another, loudspeakers can sound as different as Beethoven and The Beatles. Let us now examine why choice of a loudspeaker is so important. Remember that at one time the loudspeaker was the weakest link. This does not mean that pick-ups have degenerated, rather that loudspeaker design has advanced in leaps and bounds. Research has concentrated on the past weaknesses of loudspeakers and made discoveries and improvements.

Principles

A loudspeaker works on the motor principle. It consists of a frame with a magnet assembly attached. Within this frame is a wax paper cone with a coil wound on impregnated paper. This coil is suspended in the magnet air gap and the a.c. signal is fed to the coil. This causes the coil to move in and out at varying distances and speeds depending on the signal.

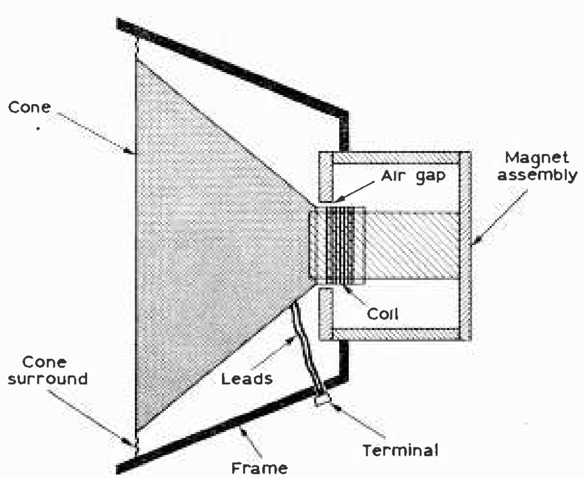


Fig. 5: Cross - section of a typical loudspeaker assembly.

The paper cone, being attached to the coil, moves in sympathy and displaces similar airwaves around the speaker. A cross-section of a loudspeaker assembly is shown in Fig. 5.

Response

Generally speaking, loudspeakers vary in size according to the job they have to do. Smaller units, 5in. diameter or less, are usually designed to handle higher frequencies above 3,000c/s because these frequencies require smaller mechanical masses to reproduce with minimum distortion. Larger units, of 10 and 12in. diameter, are better for lower frequencies in the middle and bass register, because these frequencies require larger volumes of air to be moved due to the longer wavelengths involved. Specially designed high frequency units can handle frequencies from 3,000c/s to 20,000c/s quite efficiently. The same applies to low frequency units in the 20c/s to 3,000c/s region.

So we have two individual units which if used together can reproduce the whole audio spectrum. How, then do we connect them? We cannot just connect both units in parallel across one signal source. This is because the high frequency unit output will be distorted by the fact that it is being fed by low frequency signals and vice versa for the low frequency unit. Obviously, then, a frequency selective circuit is required and this brings us to the L-C Crossover Filter network.

Figure 6 shows a schematic diagram of a network. Speaker LS1 is the low frequency unit, LS2 is the high frequency unit. High frequencies cause capacitors to present a low reactance and inductors a high reactance and vice versa for low frequencies. Use is made of these reactive properties in this network. High frequencies are easily passed by C2 into speaker LS2 while L2 shunts off the low frequencies. Meanwhile low frequencies are easily passed by L1 into speaker LS1 while C1 shunts off the high frequencies. By careful choice of capacitors and inductors the response of LS2 can be made to fall off at the same point as the response of LS2 rises, say, 3,000c/s. This point is known as the crossover frequency or point, hence the name of the circuit.

A unit becoming increasingly popular is the dual cone unit. This is a low frequency type cone with a small high frequency unit attached to the centre. Although more efficient, as far as power consumption is concerned, than a crossover system, the frequency range does not extend as far, either end of the spectrum. However, development goes on and in the future the crossover network may disappear.

Two main drawbacks of conventional loudspeakers are "cone break-up" and "Doppler distortion". Let us deal first with cone break-up. This occurs due to movement of the cone distorting its shape and hence distorting the waveform produced. Aluminium cones help overcome this problem, being stiffer, and one manufacturer sandwiches aluminium between two layers of conventional cone material, a development which has met with success.

Most readers will be familiar with the Doppler effect, when a moving object emitting sound, shortens the wavelengths in front of it and lengthens those at the rear. The effect is to make, say, the engine note of an approaching car appear to rise in frequency and suddenly decrease as the car passes the listening point. Now imagine a loudspeaker cone emitting two frequencies 100c/s and 6,000c/s. During one cycle of the low note, sixty cycles of the higher note occur, half of them with the cone approaching the listener, the other half with the cone receding. From the explanation of the Doppler effect it can be seen that this is a form of f.m. distortion that can only be produced by the loudspeaker in any sound system.

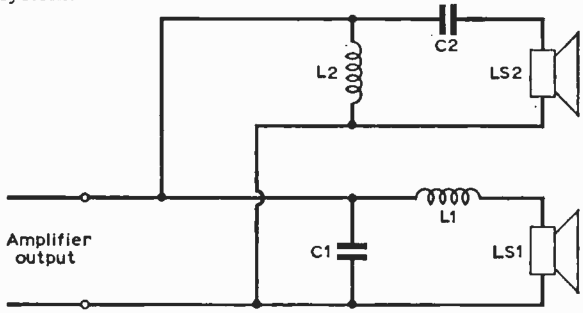


Fig. 6: A simple crossover filter network.

Cone break-up can be overcome, Doppler distortion is a little more difficult but one new development which should help both is the Electrostatic speaker. In this type of speaker an electrostatic charge is applied to two diaphragms. Application of the signal between the two diaphragms alters the stress between them and hence produces an audio note. At the moment these speakers are mainly used for treble units.

Returning to the conventional type speaker, some points to remember when making a choice. It should be large enough, both in power handling capacity and diameter, to satisfy your needs. Its impedance should be matched to the output impedance of your amplifier. The low frequency resonance should be between 30c/s and 45c/s for a good low frequency response. The magnet should be a high flux magnet, say 15,000 lines. The cone surround should be flexible but not too sloppy.

No matter how good your speaker is it will only be as good as the enclosure which houses it. For small enclosures the infinite baffle or IB enclosure is the best. The only opening is the speaker aperture and the enclosure must be carefully designed to be tuned to a reasonably low frequency. An enclosure for the home constructor is the bass reflex enclosure. This type of enclosure relies on the fact that most of the bass notes come from the rear of the speaker. Below the speaker is another aperture or port through which the bass notes are reflected to appear in front of the speaker with the treble notes. The area of this port should be approximately equal to the working area of the speaker cone.

What size should the cabinet be? Approximately 2½ to 3 cu. ft. minimum for a 10in. speaker and 5 to 6 cu. ft. minimum for a 12in. speaker. An ideal material is ¾in. thick chipboard because of the high density and sound absorbent properties. A speaker cabinet should not resonate or reverberate. This adds "coloration" to the sound and can alter the resonant frequency of the enclosure, usually making it higher. An ideological example is a cabinet of concrete but most wives would strongly object to this purely from an appearance point of view!

Internal damping of the cabinet to prevent resonance can be done with acoustic wadding but the amount must be determined by trial and error. Glasswool 1in. thick is another good material and in a small unit I have used ½in. thick foam rubber sheeting with some success. To prevent the speaker aperture being seen through the speaker fabric, paint the board, under the fabric, matt black. To ensure that the speaker fabric is taut use a synthetic material known as Tygan. This can be tightened after the glue has dried by holding an electric fire in front of it for half a minute or so.

Remembering that a good speaker and cabinet is worth the expense, I would summarise as follows:

1. If using a dual cone unit choose one with the widest frequency response.
2. For a good low frequency response the cone resonance should be 30c/s to 45c/s.
3. The magnet should be high flux around 15,000 lines.
4. The impedance should be matched to the amplifier.
5. The power rating should be matched to the amplifier.
6. With separate units for bass and treble a crossover filter network will be required.

To be continued

TECHNICAL QUERIES

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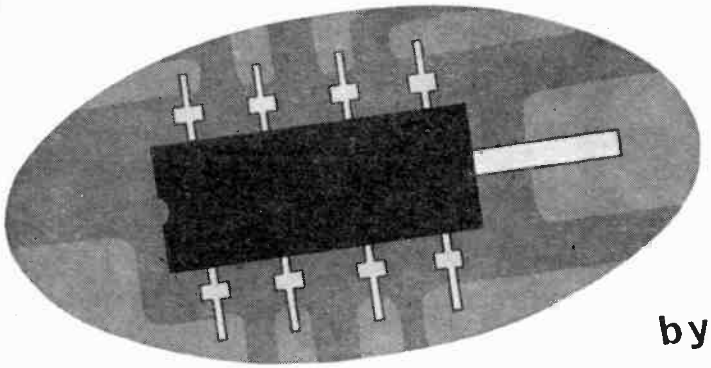


1 WATT INT

by A. J. McEVOY, B.Sc.

RECENTLY we read in P.W. of the RCA CA3020. This is a neat little product, providing 500mW in a single-ended push-pull circuit. The unit appears in a transistor style TO-5 twelve lead container, and is quoted as being capable of operation from −55°C to 125°C. In consumer and industrial products, however, the ruggedness specified for military applications is unnecessary, but a little more power would be appreciated, and it is at this point that the General Electric Corp. makes a challenge with its PA222, now available in the UK at 42s. It can provide up to 1·2 watts into a load of not less than 15Ω. As in most things, however, the result is reached by a compromise, and it should not be concluded that the CA3020 amplifier, described some time ago in these pages by L. McNamara, is superseded by the design which follows. The earlier circuit operated from a 9 volt battery, and therefore was compatible with portable transistorised apparatus, whereas the G.E. unit requires a 22 volt supply for full output. Similarly, some form of heatsink proves essential, as a result of the greater power dissipated in the circuit, and the extremes of temperature which the CA3020 can tolerate would endanger the PA222. None the less, it is an example of competent semiconductor engineering, and the manufacturer is justified in recommending it for record players, radio sets and intercoms. In the circuit to be described, the power supply is not included on the circuit board, as some constructors may wish to use the unit on batteries, e.g. two PP9's in series; a suitable power unit could consist of a transformer with a 15-18V secondary, plus 0·5A bridge rectifier and a 5000μF smoothing capacitor.

Circuit operation

Now to examine the circuit itself. It is somewhat larger than the integrated circuits the constructor may already be familiar with, being a full 0·77in. long! This epoxy moulded shell is a G.E. modification of the 14-pin "dual in-line" package, introduced in the USA for more economical integrated circuits not subjected to environmental extremes. The modification consists in the reduced pin requirement, and the provision of a heatsink tab at the end of the unit. In fact, this tab extends right to the centre of the moulding, and the chip of silicon, into which all the components of the circuit are integrated, is mounted on it. In use, the tab is soldered to an area of copper foil, which should be as extensive as is convenient for better heat dispersal. However, even with a good thermal contact, at full rating it is still possible for the tab to reach 50°C.

Electrically, the circuit follows established IC practice, being a monolithic epitaxial silicon unit with a preference for N-P-N transistor configurations. Seven active elements are integrated into the chip—six transistors and a diode, as well as six resistive areas.

As can be seen in Fig. 1, the signal is first applied to the base of Tr1, a conventional common emitter amplifier stage. Here provision is made for an external load resistor, and due to the spread of characteristics between individual units, no definite value for this resistor is specified in the components list. Instead, as part of the test programme at the factory, a suitable value is determined by the manufacturer, and this is stamped on the plastics moulding of each IC. The resistor will be 68kΩ, 100kΩ, or 150kΩ, so the moulding will be marked R68k, R100k, or R150k. The amplified signal developed across this resistor, R7 in the circuit diagram, then enters the base of Tr2, a split load phase splitter. It may be objected that the resistive elements serving as emitter and collector loads here are unequal; but then, so also are the impedances into which the signals developed across them are fed, and signal equality is thus maintained.

It is now possible to regard Tr4 and Tr5, and Tr3 and Tr6, as super alpha pairs in series connected single ended push pull. Since a low output impedance is a characteristic of this type of circuit,

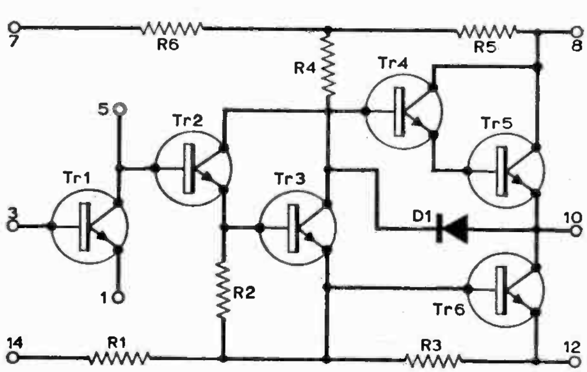


Fig. 1: Diagram of the G.E. PA222 integrated circuit.

GRATED CIRCUIT AMPLIFIER

a good match to a 15 to 25Ω loudspeaker will be obtained. The diode D1 operates as a latching diode in the negative half of the output signal cycle, maintaining full drive.

The performance of the unit in a practical amplifier is in great measure controlled by the external elements used with the IC, and in the circuit to be described, two separate feedback loops are used. First there is a d.c. feedback through R8; this is in fact the base bias supply for Tr1, which due to the internal circuitry of the IC, is dependent on the currents in the emitters of Tr2 and Tr3. Should these increase, the base bias will increase; since then the current in R1 will increase, the base voltage on Tr2 will drop, tending to restore the original situation. The effect on the overall d.c. stability of the amplifier is obvious. Further, the reader will now realise the importance of the correct choice of R7; if it is too low, the power dissipated in the circuit will be unnecessarily large, whereas if it is too high, the output stages are starved, resulting in distortion.

The question of a.c. stability should also be considered. As is well known, the epitaxial transistor excels at high frequencies, and in a direct coupled amplifier such as this, there is no inherent frequency limitation. An r.f. suppressor C4 is therefore added across the input terminals, and together with the impedance of the signal source, it introduces a time constant limiting high frequency performance. (If necessary, with a very high impedance source, a 27kΩ resistor may be placed across the input terminals.) To this high frequency cut-off eliminating r.f. instability there is added an a.c. feedback loop to correct the performance of the unit for audio frequencies. R9 and R11 form a potential divider across the audio output of the unit, and the signal developed across R11 is returned to pin 1 of the IC, the emitter of Tr1. This transistor acts as a common base amplifier towards this feedback signal, and therefore the performance of the circuit over the audio range is linearised. Other r.f. suppression components are C7 in the collector circuit of Tr1, and R10-C6 across the audio output.

Construction

With this understanding of the operation of the circuit, construction can begin. The regular reader will be familiar with the procedure for preparing printed circuit boards, using lacquer paint to protect the conductor areas of copper foil on a sheet of laminated paxolin while removing the unwanted areas with a concentrated $FeCl_3$ solution. Remembering the function of part of the copper foil as a heatsink as well as an electrical conductor, it will be realised that veroboard is unsuited to this application, unless a separate square of copper, 1in. square, is soldered to the reverse side of the board, bridging several of the conducting strips, close to the tab of the IC.

★ components list

Resistors:

R7	see text	R10	22Ω
R8	22kΩ	R11	10Ω
R9	470Ω		

(R1–R6 are contained within the integrated circuit).

Capacitors:

C1	0·1μF	C5	10μF 25V
C2	200μF 25V	C6	0·001μF
C3	10μF 25V	C7	350pF
C4	0·001μF		

Integrated circuit type G.E. PA222, Jermyn Industries, Vestry Estate, Sevenoaks, Kent.
Price is 42/– plus p. & p.

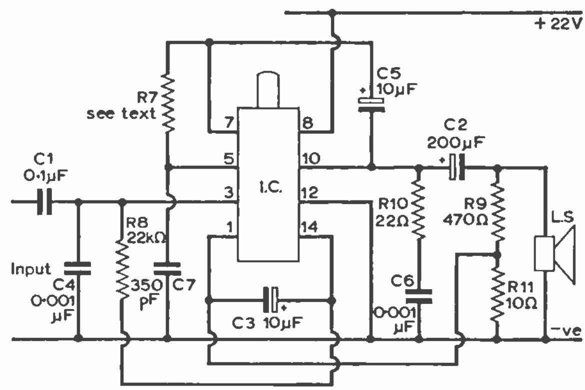


Fig. 2: Circuit diagram of the complete amplifier, suitable for use with a medium impedance microphone or pick-up.

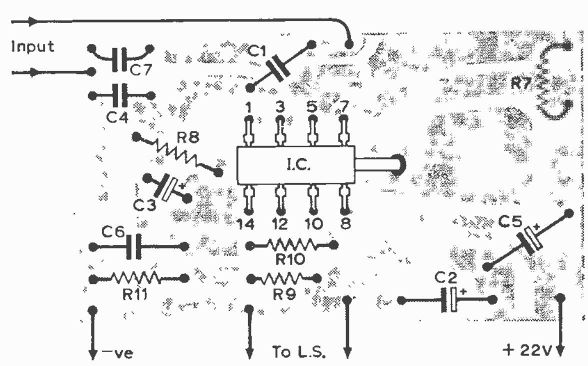
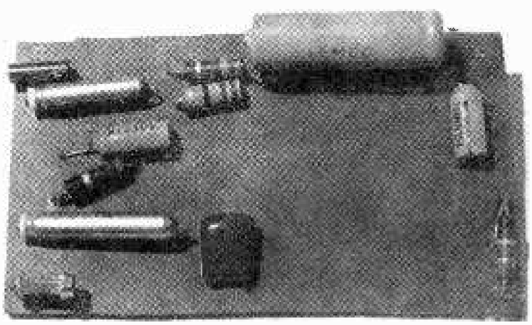


Fig. 3: Layout of the printed circuit board (copper side). Only the PA222 is mounted on this side.

Actual assembly of the unit on the circuit board follows standard methods. It might be well to mount the IC last, to avoid damage due to overheating. The soldering of the tab should be done with special care as it is to be a thermal and electrical conductor, so that a generous amount of solder, on the tab and the surrounding copper, is worth while. This area should be pretinned, so that the solder will be in place when the IC is inserted, and only the proximate area will require remelting to adhere to the tab. Then the rest of the solder will rapidly dissipate the heat in the melted zone.

Testing

All will now be ready for test, and a signal source, power supply and loudspeaker can be connected. As already mentioned, the speaker should be of at least 15Ω, and there should be vigilance to prevent accidental short circuits of the loudspeaker connections; should these be allowed to persist for more than a very short time, there will be excessive dissipation in the chip, with the possibility of damage. When switching on for the first time, it would be wise to insert a milliammeter in the power supply line; the current drawn should be approximately 25mA. with no signal. This will rise immediately any audio output is drawn from the circuit, a characteristic of all class B push-pull amplifiers, reaching a maximum of 115mA at full output. This figure, for 1 watt output, indicates an overall efficiency for the amplifier of almost 50%, a quite creditable performance.



Underside view of the complete amplifier showing layout of components, other than the I.C.

As most of the assembly of electronic elements in the circuit is completed in the manufacturing of the IC, it is unlikely that any troubleshooting will be necessary. The following points are, however, worth noting. Provided the correct value for R7 is used, the most probable cause of excessive dissipation, or high quiescent current, is a leaky capacitor C3 changing the base bias applied to Tr1. Should distortion occur, suspect the capacitor C5, which is intended to ensure full drive during the positive half of the output signal. (Diode D1 has this function for the negative half.)

The applications of the amplifier are left to the initiative of the reader; it is hoped that successful assembly and operation of this IC amplifier will inspire the same enthusiasm for these components in the constructor as it has in the writer of this article. ■

practically wireless commentary by HENRY

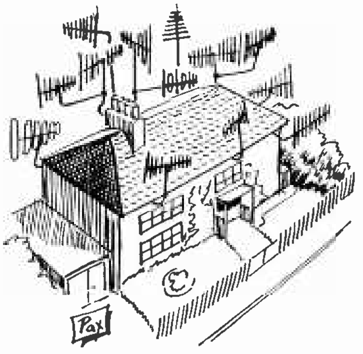
No. 47

Piping up

LAST month's venture into the hurly-burly of wireless politics may be expected to give Henry—and the Editor—a few bruises. So, while the liniment is still out, let's look at the parallel problem of wired systems.

Problem it is, for the Radio and Television Retailers' Association is still, at the time of writing, having a bitter wrangle with the Greater London Council over an award of a contract to Rediffusion that involves a cool £600,000. This was a 15-year contract awarded early in the year for wiring a v.h.f. distribution system for television and sound to 9,000 council dwellings and 8,000 homes by private developers.

Let me block in a few details. By 1970 all three existing television programmes should be radiated on 625 lines u.h.f., and duplicated (BBC and ITA) on 405-lines v.h.f. This means that all dual-standard receiver owners will be able to receive the broadcast programmes, provided that they have an adequate aerial installation and live within the 99·5 per cent coverage area. For those that don't, and for many others that receive unacceptable quality of picture or sound, the various relay systems will be a necessity.



An adequate aerial installation

But—and it is a big but—relay systems are formidably costly when translating u.h.f. signals, and relaying u.h.f. is out of the question because of cable losses. And whereas the BBC is battling hard for better u.h.f. coverage, and has evinced an optimism about future developments which members of the Royal Television Society regarded with some scepticism at a recent forum, the ITA appears to be thinking along different lines.

The radio retailer wants to be able to sell a set that satisfies his customer aesthetically, as well as being capable of picking up the programmes in any given area, whether these are broadcast or piped. Which argues that v.h.f. wired systems are the answer. The normal dual-standard television receiver will pick up the radiated u.h.f. and v.h.f. signals, plus any piped signal from a relay company on an unused v.h.f. channel. A relay network should work with normal sets, they say.

But Rediffusion are battling hard for h.f. systems. At an earlier Royal Television Society meeting, R. P. Gabriel, technical director of Rediffusion Research, brought up some impressive arguments for h.f. systems. Even on grounds of costs in rural areas, he asserted that wired sound-and-vision could hold its own. A feasibility study at Wooler showed that transmitter costs could be up to £50 per home, while the network cost, based on three-core cable, reed switches and diode logic, and even assuming new cable posts for all remote areas, could be reduced to £32 per home. He forecast that purely broadcast reception would eventually nullify any of the advantages at present enjoyed by the higher frequency bands and lead to the sort of chaos we are all familiar with on the medium waves.

Moreover, he argued, the wired systems eliminated the real weak spot of the average receiver, the tuner unit, if h.f. relay rather than v.h.f. wired systems were employed.

Which is where we came in, for it was a v.h.f. system that was agreed in principle by the G.L.C. for the Thamesmead contract. Five firms tendered for this (including Rediffusion,

There are hot words flying

we should add), and then the committee decided to extend the invitation to h.f. systems, and Rediffusion collared the award.

Mr. Michael Keegan, director of RTRA, is understandably up in arms. H.F. systems rule out Woolwich and District Traders TV Relay Ltd., and prevent the ordinary dealer from selling any set 'from the shelf'. But Rediffusion argue that normal sets are simplified front ends can always be used, and that special sets are available from a number of firms, and can be installed by local dealers.

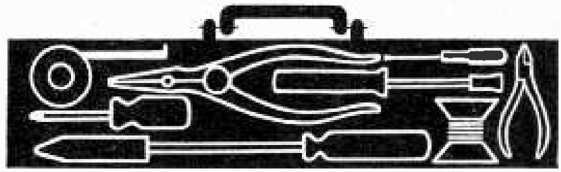
Altogether, there are hot words flying. Henry has tried to be objective, and feels sure that readers with a vested interest in wireless reception will have a few opinions to offer.

The floor is yours, gentlemen.

repairing radio sets

PART 5

GORDON J. KING



We have now arrived at the stage where we will examine, step by step, the servicing of a six transistor domestic receiver.

NOW that we have a reasonable grounding in the elementary theory of semiconductor diodes and transistors and a fair knowledge of the static and dynamic conditions under which "circuit blocks" in transistorised equipment operate, we are in a good position to concentrate more on the servicing angle, based on the popular transistor radio.

It has already been intimated that general servicing resolves to three basic actions. These are (i) locating the faulty stage or section (fault diagnosis), (ii) finding the faulty part or wiring in the located stage and (iii) making the repair (such as clearing the short- or open-circuit or replacing the component). Sometimes action (i) will reveal some maladjustment, like misalignment of the tuned circuits, in which case the "repair" will be to restore the tuning by realignment and so forth.

Mr. Hellyer, in his parts, is telling about making the actual repair, soldering and the mechanical aspects of the exercise, so this final article dealing mostly with the electronics of radio will focus most attention on actions (i) and (ii).

A block diagram of a typical "domestic" transistor set is given in Fig. 22. Recapitulation on the process involved will not be amiss: the aerial, which is a ferrite rod, abstracts the electromagnetic component of the passing radio wave and produces an r.f. signal voltage across its appropriate winding(s). This is fed to the frequency changer to produce the i.f. signal by heterodyning with the local oscillator signal. The oscillator is tuned "in gang" with the aerial tuning to maintain a frequency-difference equal to the i.f., and this signal is then amplified by the i.f. stage.

The detector rectifies the modulated i.f. signal and delivers an a.f. signal corresponding in nature to the envelope of the modulation. It also produces a d.c. voltage from the i.f. carrier-wave, which is fed back to the i.f. stage as a.g.c. bias.

The a.f. signal is applied to the a.f. stage and thence to the output stage which drives the loudspeaker. In other words, the output stage converts the a.f. signal to *power* required by the loudspeaker. Power for the transistors is usually given by a battery or series of cells, although some sets have mains power packs.

FIRST CHECK— TOTAL CURRENT

Now, if we are presented with a "dead" set, the first move is to discover where the discontinuity exists. However, before this trend is commenced, it is just as well to make sure that the battery or power supply is "energising" the circuits. The quickest action here is to break the supply positive lead and introduce a current meter in series, as shown in Fig. 23. An average transistor set passes about 14mA when there is no output from the loudspeaker. This is called the quiescent current, and when delivering about 250mW (about maximum for a small set) the current can rise to almost 50mA.

Since the set is "dead", we should not get a reading anything like 50mA. Indeed, the reading could be below the quiescent current value as a result of the fault. On the other hand, it could be well above the quiescent value even with zero loudspeaker output if the fault is caused by a bad electrical leak or short in component, transistor or circuit

If the current is substantially above the quiescent value, the battery should be disconnected and an attempt made to locate where the extra current is being dissipated. Large current means that something must be getting pretty warm, and this might be a transistor. A transistor warm to the touch when the set is quiescent is a fair indication either

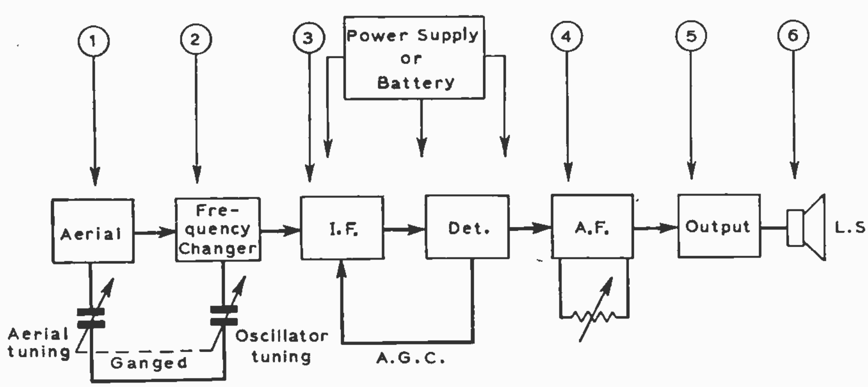


Fig. 22: Block diagram of a typical transistor set.

that the transistor is faulty or that its biasing is seriously incorrect.

This is where our grounding in the static conditions of transistor circuits will pay dividends, and it is not intended here to repeat what has already been said on this subject.

If there is a zero current, check the battery voltage under load conditions. This requires the connection of a resistor across the battery, as shown in Fig. 24, for open-circuit voltage measurement with a high resistance voltmeter means nothing! The resistor should have a value to pass about 50mA, but do not leave it connected across the battery too long. Calculation is easy, calling for the application of Ohm's law. That is, dividing the battery voltage by the current in amperes. The resistance value is then in ohms. A value of 180 ohms will thus pass 50mA at 9V. Use the nearest preferred value. If the battery then measures more than 1V below its nominally rated voltage, its resistance is rising; but it would still work. If the voltage falls by 25 per cent or more the battery should be replaced.

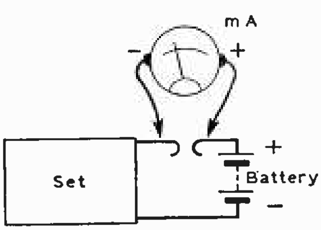


Fig. 23: Showing how the total current of a transistor set is measured.

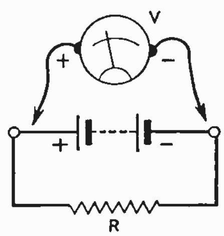


Fig. 24: A transistor battery should be checked under load, as this diagram shows.

Assuming now that the quiescent current is reasonable we can start hunting for the faulty stage. There are two basic ways of doing this: (i) using the loudspeaker as an indicator of signal and (ii) using a separate indicator which can be moved from stage to stage. Let us take (i) first.

STAGE-BY-STAGE TESTING

The plan is to apply suitable signal to each stage in turn until (a) we get an output from the loudspeaker or (b) until the output ceases; (a) and (b) depend on whether the test signal is applied at the front working towards the loudspeaker or at the loudspeaker working back towards the aerial. If we use (a) we would (1) apply modulated r.f. signal to aerial circuit, (2) to the frequency change, (3) modulated i.f. signal to the i.f. stage, (4) audio signal to the a.f. stage, (5) audio signal to the output stage and, finally, (6) audio signal (power) to the loudspeaker. At some point along the line we would get a response from the loudspeaker. Say there was no response with input at (1) or (2) but response with input at (3), the trouble would obviously lie in the frequency changer or coupling to the i.f. stage.

By using scheme (b) we would apply the audio first to the loudspeaker and then work back towards the aerial until the response ceases. If, for instance, we get a response with the input at point (5) but not at point (4), the discontinuity would exist in the a.f. stage or coupling to the output stage. The signal injection point numbers used above are indicated on the block diagram in Fig. 22.

Whether scheme (a) or (b) is used is essentially a matter of preference. One is not particularly quicker than the other, for if we use scheme (a) and find that the loudspeaker is open-circuit we would not have used any more time than if (b) were used and the aerial was found to be open-circuit. Many technicians, including H.M. Forces, prefer scheme (b). The practising service technician is used to employing both schemes. If one is measuring the performance of the equipment, stage by stage, then by establishing a calibrated output meter in place of the loudspeaker, the level of test signal required to give a "standard" output can quickly be determined at each stage.

SIGNAL TRACING

Method (ii), involving the use of a signal detector, or *signal tracer* as it is called, has much in its favour from the domestic transistor set point of view. In many cases the signal as picked up by the set's aerial can be used, and the idea is to tap the probe, stage by stage, from the aerial towards the loudspeaker, listening for the signal at each point.

Very sensitive probe-type detectors use headphones or earpieces, and the signal actually at the ferrite rod aerial winding can be heard on some of them. This equipment consists of a simple rectifier followed by a stage or two of a.f. amplification, terminating across the 'phones or earpiece.

The plan, then, is to tap along the circuit until the signals cease, at which point the break exists. If we use Fig. 22 for illustration again, signal at (1), (2) and (3) but not at (4) would indicate discontinuity somewhere between the i.f. and a.f. inputs. A signal tracer can also be used to "test" the detector stage more conveniently than the schemes previously outlined. This is because this sort of instrument is designed for switching straight into its audio stages, thereby permitting amplification of any audio present across the set's detector load.

For example, if i.f. signal is "heard" at the detector input, while no signal can be heard across the load, the detector diode is probably shorting or open-circuit.

In practice, it is rarely necessary to run through the whole sequence of signal tracing or stage-by-stage testing because the set itself, even in its "dead" condition, often yields clues. Most sets give a "thump" from the loudspeaker when switched on due to the output transistors passing a current pulse through the loudspeaker. If this occurs on the faulty set, one can be sure that the loudspeaker and output transistors are passing current, at least; also, of course, that the power supply is active.

The first move in this event, therefore, would be establishing that the rest of the audio section is active. This can be done by applying an audio signal to point (4) in Fig. 22. If this signal gets through to the loudspeaker, then one would signal-trace or stage-by-stage test in the r.f. and i.f. stages.

A quick test for audio "liveliness" in valved sets is to touch the control grid of the a.f. valve with a finger or with the blade of a screwdriver with a finger resting on the blade. A very loud hum is produced by the loudspeaker if all is well. This same test does not work so well in transistor sets or amplifiers because there is no mains input, and the hum that is heard is mains hum. Nevertheless, a weak hum is often present when the set is being serviced in mains-wired environments, and when a finger-connected screwdriver blade is used very loud crackles (if not hum) should emanate from the loudspeaker when the blade is scraped on the a.f. transistor base.

Complementary to the signal tracer is the "signal injector". This is a small transistorised testing probe or box containing a multivibrator. This is rich in harmonics of the fundamental frequency, and wherever applied to a transistor signal circuit will give an output from the loudspeaker. Thus, it is a simple matter to work to and fro' along the stages until the point where the signal appears or ceases is located. More detailed testing might then be needed to reveal the actual component responsible for the defect.

One disadvantage of this instrument is that it can give an output when applied to the aerial circuit, even though the set is otherwise dead. This is when the trouble is due to failure of the local oscillator; so really the instrument could be used indirectly to tell whether the local oscillator section is at fault!

TRANSISTOR SET CIRCUIT

So much for stage-by-stage testing and signal tracing in transistor sets. Let us now try to tie this in with the circuit. Figure 25 shows a circuit of a fairly recent transistor portable, and this is divided into the stages shown in Fig. 22.

The ferrite rod aerial contains two main sets of windings, one tuning the medium-waves and the other the long-waves. The top winding allows the connection of a car-type aerial.

The signals are tuned by the aerial section of the gang, C3, and applied to the base of the frequency changer transistor Tr1. The collector/emitter circuit of this transistor is also arranged in the form of an oscillator in conjunction with the oscillator coils, and tuning here is by C8, ganged to C3.

The i.f. signal developed in the collector circuit of Tr1 is tuned by the first i.f. transformer (i.f.t.1) and thence coupled to the base of the i.f. transistor Tr2. The second i.f. transformer (i.f.t.2) tunes the signal again in the collector and couples it to the detector diode D2. R11, in conjunction with the volume control R12, forms the detector load, with C16 acting as the i.f. bypass.

The a.f. section consists of the complementary transistors Tr3 and Tr4, the collector of the former in d.c. connection with the base of the latter. Tr5 and Tr6 are the output transistors, also in complementary mode. These complementary circuits were considered in Part 3.

The loudspeaker is coupled to the junction of Tr5 and Tr6 emitters through the electrolytic capacitor C23. The jack socket for headphones or tape recorder coupling disconnects the loudspeaker when a jack plug is inserted.

Tr1—Tr4 are in the common-base emitter (signal-wise), Tr1 having R4 and R5 to set the base bias and Tr3 having R13 and R14. Base bias for Tr4 is achieved by the d.c. coupling, as explained in Part 3, while the bias for the i.f. transistor Tr2 is obtained by the potential-divider effect (across the supply) of R8 in the upper leg and the series combination of R10, R11 and R12 in the lower leg.

This is where a.g.c. is applied, for across the detector load (R11 and R12) develops a positive potential of magnitude depending on the strength of the i.f. signal applied to the detector diode D2. This potential counters the negative position at Tr2

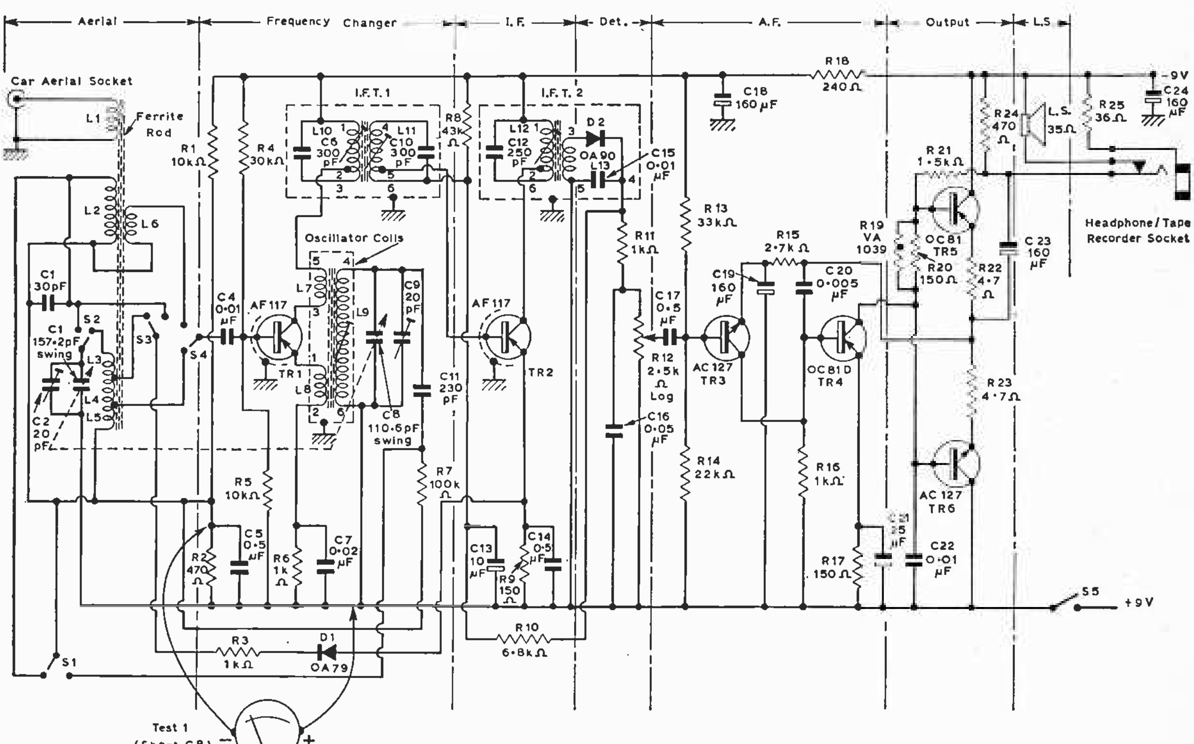


Fig. 25: Circuit diagram of a commercial transistor set, showing the stages detailed in Fig. 1.

base fixed by the potential-divider, and the stronger the i.f. signal (i.e., signal picked up by the aerial), the greater the counteracting effect. This reduces the gain of the i.f. stage accordingly, and thus sets the gain to suit the strength of the input signal.

This is called *reverse a.g.c.* Sometimes *forward a.g.c.* is applied. In this case the a.g.c. potential *adds to* the potential at the base supplied by the potential-divider. This causes an increase in collector current, and a resistor in series with the "cold" side of the collector load produces a greater volts drop, which is reflected as a decrease in collector voltage. Special transistors are also available for optimum forward a.g.c. effect.

Diode D1 assists the a.g.c. action by damping the tuned circuits when the input signal is very strong. This diode is biased from the emitter of Tr2, and the circuit is arranged so that the damping increases when the diode conduction increases, as happens when Tr2 collector (and hence emitter) current falls due to the a.g.c. action earlier described.

The transistors in Fig. 25 circuit are alloy-diffused type, and the high gain possible from the i.f. stage satisfies the requirements for a small set. Some sets, especially earlier models using alloy-junction transistors, feature two i.f. stages. The line-up would then be OC44 frequency changer followed by two OC45 stages.

The low value of feedback capacitance of the alloy-diffused AF117 makes i.f. neutralisation unnecessary, but some earlier models will be found to have neutralised i.f. stages. These were illustrated in Part 3.

So far, we have investigated the action necessary with a "dead" set. In practice, the connection of instruments and test probes is nowhere near as easy as verbal description implies! Most sets are built upon printed circuit boards, making it very difficult to establish connection to the required circuit. Fortunately, the components are numbered on the printed circuit boards (in many sets, anyway!), so it is really essential to have to hand a circuit diagram on which the components carry the same reference numbers. It is then relatively simple to locate the circuit to which instrument or test connection has to be made.

CONNECTING-IN

It is virtually impossible to clip on to a conductor, or even component wire, of a printed circuit board assembly, so once the required circuit has been located it saves a great deal of time to solder on a short length of 22 s.w.g. tinned copper wire as a "test point". This facilitates the connection of test equipment.

Signal from a generator can easily be coupled to the aerial from the "car aerial" socket if fitted. Alternatively, a loop of three or four turns of wire placed near the ferrite rod should be connected across the generator output lead. On no account should the generator be connected direct to the aerial coils themselves, as this practice heavily damps the tuned circuits and makes alignment and tuning tests virtually impossible.

Tests in the i.f. stages can be at either base or collector, depending on the requirements. But it is best to feed the generator signal to points such as these through a capacitor of about 0·01μF (a higher value is needed to couple-in and extract audio signal).

There should be no problem in identifying the positions marked on the block diagram in Fig. 22 with the actual circuit positions in Fig. 25. All sets follow the general pattern outlined.

So much, then, for the "dead" set; let us now investigate other faults that occur in transistor sets.

LOW SENSITIVITY

This is a fairly common symptom, and the most common cause is a battery nearing exhaustion. This should be the first test, as shown in Fig. 23. Transistors, unlike valves, rarely lose "conductivity" (emission, so to speak), so while it is desirable to check valves on a tester or by substitution, this should not be one of the initial actions when testing a transistor set for low sensitivity. Indeed, it is often a watchmaker's job extracting transistors from small sets.

D.C. testing, as explained in Part 1, will generally bring to light a defunct transistor without having to remove it from circuit. Open-circuit bypass capacitors in the base or emitter circuit will cut sensitivity without affecting the d.c. conditions. The best check is by shunting each suspect in turn with a test capacitor of about 0·5μF.

The stage gain of a section can be measured, if one has the equipment, by applying a signal of known level to the input and measuring the signal on a valve-type voltmeter (or transistor-type voltmeter) at the output. The gain, of course, is given by dividing the output signal by the input signal, and this can be converted to decibels if required. Input and output impedance is important with this kind of test, especially when decibels are used to express the gain.

If the gain appears to be low in a stage or stages containing a tuned circuit, misalignment could well be responsible, and this may come about by alteration in value of a fixed tuning capacitor as well as by unskilled tampering with the tuning cores. For example, C6, C10 or C12 in Fig. 25 (across the i.f. transformer windings) could have altered in value. This is shown up, however, by the associated core failing to bring the circuit into proper tune. A word of warning here: it is bad practice simply to "peak" the i.f. tuning to improve sensitivity, for in some sets the tuning is staggered and peaking could encourage instability.

When realignment of transistor sets becomes necessary (or if it has to be checked), it is highly desirable to refer to the maker's manual or to a service sheet for the correct procedure, as this differs between sets. Remember, though, that the sensitivity of the aerial is adjusted by sliding the coils along the ferrite rod (in addition to the trimming of the aerial coils). This action changes the inductance, being maximum with the coils in the middle of the rod and decreasing as they are slid towards either end.

A broken ferrite rod will impair the sensitivity considerably. The best action here is to replace the rod. If a replacement is not available, however, it is possible to cement the broken pieces together, using a commercially produced cement that adheres without heat treatment. The broken section or sections should be pushed very tight together and it is important that the rod remains straight when repaired.

INSTABILITY

Open-circuit decoupling capacitors can cause this symptom, especially in the audio stages. (Such effects are given on *Bands 6 and 7* of the fault symptoms record).

Open-circuit C18 or C24 in Fig. 25 are a common source of instability, especially noticeable as the internal resistance of the battery rises.

Peaking i.f. transformers which are designed for "stagger tuning" is another cause in which the amateur becomes involved. Sets with neutralising of the i.f. stages are particularly prone to instabilty if the i.f.'s. are maladjusted or if the neutralising capacitor changes in value. When replacing i.f. transistors in sets of this kind, it may be necessary to re-neutralise, depending on the stability of the basic design.

It is often necessary to replace older transistors with more recent ones of higher gain. This can encourage instability, and to overcome this the base potential-divider values should be altered to reduce the base bias (i.e., increase the value of the top arm). When a higher-gain frequency changer transistor is used, the set may burst into oscillation towards the high-frequency end of the medium wave band. Again, reduce the base bias; but if this does not cure the trouble, the value of the emitter capacitor should be reduced. This is C7 in Fig. 25. Incidentally, this capacitor controls the amplitude of local oscillator signal, and when a lower gain transistor is used, the value may have to be increased to sustain oscillation over the bands.

Lack of oscillation is a common fault, particularly with older sets. The oscillator coils are sometimes responsible, but in some cases the older type frequency changer transistor has a reluctance to oscillate. Oscillation can be checked by connecting a voltmeter across the emitter resistor and shorting out the oscillator tuning capacitor (C8 in Fig. 25). If the stage is oscillating, a change in meter reading should occur when the oscillator tuning is shorted (see Test 1 in Fig. 25).

DISTORTION

Distortion (Symptom 9) mostly results from unbalance or incorrect biasing in the audio sections. Low-level distortion is often caused by unbalance of the two output transistors. This causes second-harmonic distortion at low as well as high levels.

Another common distortion, explained in Part 3, is crossover distortion due to the quiescent current of the output transistors being too low. Crossover distortion is also present at low levels, and can be seen by monitoring the signal across the loudspeaker on an oscilloscope when a sinewave signal is applied to the driver stage.

Remember, also, that low battery voltage greatly encourages distortion, and the first action, therefore, should be to test the battery or replace that in use with one known to be in good condition.

Other causes of distortion have already been given in Part 3.

We have now covered almost all aspects of transistor radio servicing, but it is essential for the amateur and student to read this final electronics article in conjunction with Parts 1 and 3, which deal with d.c. and signal operating conditions.

TO BE CONTINUED

YOUR ? QUESTIONS ANSWERED

Audio Thump!

Is there any way of eliminating the "thump" in the loudspeaker when switching on a mains-energised transistor amplifier?

This appears to be due to the smoothing capacitor in the power supply being uncharged at the moment of switching on and therefore momentarily inoperative.

If, having switched on, the amplifier is then switched off and then immediately on again, there is no thump. However, if a few seconds are allowed to elapse before switching on again, the thump returns.—S. Pinder (Weston-super-Mare).

If the thump is due to the charging action of the capacitors in the power supply, then we suggest that you check that these capacitors are in good condition. You might also try the effect of including a small resistor of suitable wattage rating between the output of the rectifier and the reservoir capacitor which will limit the charging current. The value of this resistor might prove fairly critical and perhaps a value of 47Ω would be a suitable value to start.

You should also investigate the possibility of employing a suitable Thermistor in series with the feed to the capacitors. This would give a high series resistance until current was drawn from the power supply. Suitable Thermistors are made by firms such as Standard Telephones and Cables Limited, Footscray, Sidcup, Kent.

Technical Terms

Could you please send me a complete list of the technical terms in use in wireless and electronics today as I am a comparative newcomer to the world of electronics?—J. Edwards (Anglesey, N. Wales).

It is far beyond the scope of our query service to supply a complete list of technical terms. We suggest, however, that you obtain a copy of our *Practical Wireless Radio and Television Reference Data* from your local bookseller. Another useful book is *Dictionary of Radio and Television* which is also published by this company.

S.W. Converters

I am hoping to build a shortwave converter but I am not sure of the principle involved. Each time the tuning capacitor in the converter is altered to cover a different frequency its output frequency will alter and therefore the broadcast receiver, which it is feeding, will need to be re-tuned for each station received. Is this so?—C. Reading (Ruislip).

Converters for use with broadcast receivers, in effect, enable the broadcast receiver to be used as an i.f. amplifier. All of the incoming signals are converted, and appear at the output of the converter at one single frequency—often 1·6Mc/s. In effect, a converter is the front-end of a normal superhet receiver, in which the role of the i.f. amplifier is played by the broadcast receiver which remains tuned to the unvarying i.f. of the output of the converter. Thus the output of the converter remains constant.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

THE year is certainly on the move, with July upon us and with good conditions, especially during night hours those log books should be full of interesting entries. So to help you even further here are this month's propagation predictions.

West Africa: 1000-1600, 25, 21, 17 and 15Mc/s; 1600-1800, 25, 21, 17, 15 and 11Mc/s;1800-2000, 25, 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2000-2400, 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2400-0200, 17, 15, 11, 9, 7, 6 and 5Mc/s; 0200-0600, 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 0600-0800, 21, 17, 15, 11 and 9Mc/s; 0800-1000, 21 17 and 15Mc/s.

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

East 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; 2000-0200, 15, 11, 9, 7, 6 and 5Mc/s; 0200-0400, 15, 11 and 9Mc/s; 0400-0600, 17, 15 and 11Mc/s; 0600-0800, 21, 17 and 15Mc/s.

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

South East Asia: 0600-1000, 21Mc/s only; 1000-1200, 21 and 17Mc/s; 1200-1400, 21, 17 and 15Mc/s; 1400-1600, 21, 17, 15 and 11Mc/s; 1600-1800, 17, 15, 11 and 9Mc/s; 1800-2200, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2200-2400, 15, 11, 9 and 7Mc/s; 2400-0200, 15 and 11Mc/s; 0200-0600, 17 and 15Mc/s.

North East Asia: 0600-2000, 17 and 15Mc/s; 2000-2200, 15 and 11Mc/s; 2200-0600, 15Mc/s.

Australia via Asia: 0600-1000, 21Mc/s; 1000-1200, 17Mc/s; 1200-1400, 15Mc/s; 1400-1800, 11Mc/s; 1800-2200, 11, 9, 7 and 6Mc/s; 2200-2400, 15 and 11Mc/s; 2400-0200, 15Mc/s; 0200-0400, Circuit closed to BC bands, 0400-0600, 17Mc/s.

South America (*North of the Amazon*): 1200-1800, 21Mc/s; 1800-2000, 21 and 17Mc/s; 2000-2200, 21, 17 and 15Mc/s; 2200-2400, 17, 15 and 11Mc/s; 2400-0400, 17, 15, 11, 9, 7 and 6Mc/s; 0400-0800, 15, 11, 9, 7 and 6Mc/s; 0800-1000, 17, 15 and 11Mc/s; 1000-1200, 17 and 15Mc/s.

Those were propagation conditions from various parts of the world to the UK for July 1968. Now on to this month's DX-tips.

EUROPE

Belgium: *Radio Belgium,* Brussels, is now giving very strong signals from 2115-2300 on 6,010 daily.

Denmark: *R. Denmark,* Copenhagen, is now on the following schedule—Danish only daily: 1130-1155, 1330-1345, 1730-1815 all on 15,165. Danish daily and English for last 30 mins on weekdays only: 0730-0845, 1200-1315, 1400-1515, and 1830-1945 all on 15,165, 0100-0215 on 9,520. Danish daily and Spanish for last 30 mins on weekdays only: 2200-2315 on 15,165. On Saturdays and Sundays only for the UK and Europe in English on 9,520.

Monaco: *Trans-World Radio,* Monte Carlo, is now using 7,260 in its English transmissions on Sunday afternoons from 1415-1530.

Poland: *Polish Radio,* Warsaw, is now on the following schedule for its transmissions to the UK and W. Europe in English—0730-0800, 11,840, 11,725, 9,675 and 9,525; 1830-1857, 11,815 and 7,125; 1930-2000, 11,815, 9,570 and 7,125; 2030-2100, 11,815, 9,570 and 9,540; 2130-2155, 11,815 and 7,125; 2230-2300, 9,540, 7,285, 6,005 and 1502Kc/s; 2303-2330, 818Kc/s. Daily classical music concerts: 1500-1600 on 7,285, 6,005 and 1502Kc/s; 1900-2000 on 7,285, 6,005 and 1502Kc/s. Music by Chopin daily: 0630-0700 on 7,125, 6,005 and 1502Kc/s; 1600-1630 on 7,285, 6,005 and 1502Kc/s. Light and popular music programmes: 1230-1400 on 11,955, 6,005 and 1502Kc/s; 2330-0100 on 9,540, 7,125 and 1502Kc/s.

Sweden: *Radio Sweden* is now operating as follows: 0445-0615 on 17,845; 0630-0715 on 6,065; 0830-0900 on 17,800 and 15,240; 0930-1030 on 21,690 and 9,625; 1030-1100 on 9,625; 1100-1215 on 15,240 and 9,625; 1230-1330 on 21,675 and 15,310; 1400-1530 on 21,585 and 17,760; 1600-1700 on 21,585 and 15,310; 1730-1800 on 15,240 and 6,065; 1800-1830 on 15,240; 1830-1930 on 21,690 and 15,240; 1945-2015 on 6,065; 2015-2115 on 11,915 and 6,065; 2130-2230 on 11,705 and 6,065; 2245-2345 on 15,445 and 11,705; 2400-0230 on 15,275 and 11,705; 0300-0430 on 11,705. English programmes are transmitted for 30 minutes daily at 1100, 1230, 1400, 1600, 1900, 2045, 2245, 0030, 0200 and at 0330.

AUSTRALASIA

Australia: *R. Australia* has more alterations to its transmission schedule: 1800-2115 now on 9,600 and 9,540 to the Pacific Isles in English; English to S.E. Asia now on 17,870 from 2245-0930; English to N.E. Asia now on 11,765 from 0900-1400; English to Mid-Pacific from 0030-0830 on 15,240, 0830-1215 on 7,190; New transmission in English from 0200-0800 to South Pacific on 15,180; The North American Service from 0100-0300 is now on 21,740, 17,840 and 15,320.

Many thanks for the *Polish Radio* schedule to A. Golics, and to others who have sent in items for use in the column. Deadline this month is the 15th, so good listening.

THE AMATEUR BANDS by DAVID GIBSON, G3JDG

BIT of a mixed bag this month, some heard quite a lot of DX while others fished around at the wrong times. Never mind, reel in the antenna and stick another worm on. **Stephen Herod** (Suffolk) says that ten is best at weekends. **Philip Batt** (Lancs), informs of great doings on 21Mc/s from 2115 to 2245 but says he can't often take advantage because he has to be up for school in the mornings. **D. Spooner** overheard 5H3JS saying that there are only eleven amateurs in Tanzania and only five of those are active.

Jim Baker has been given the go-ahead to arrange skeds between G stations and JA1PFU in Yokohama on 21Mc/s A.M. ONLY. (Down, you s.s.b. devils.) Any G's interested should drop Jim a line, his address is—86 Max Road, Liverpool 14, Lancs. How about trying it with the club station?

10

S. Herod (Suffolk), R1O9A, 50ft. end-fed indoors plus an R.A.P. broadcast s/het logged these on 28Mc/s—CN8BG, CR4BL, CR7CI, ET3REL, LU1DAB, KV4DC, PY4KL, ZS1AX.

M. Pasek (Notts), QP-166 into an HRO, 150ft. end-fed, detected the following hoard on ten—CR6KK, CR7GH, LU6DRB, PY2ERS, VR6EBE (Pitcairn Island), VU2FN, VU2ER, ZC4RAF, ZC4RB, ZD8Z, ZE1CCF, ZE1TX, ZS1XX, 4U1TTU, 5Z4JH, 9J2WR, 9J2RA.

R. Dinning (Ayrshire), HA-350+PR30, 252ft. end-fed b.f.o'd these s.s.b. types into intelligibility on ten—ET3FMA, KP4CRD, LU1DAB, LZ2KKZ, OD5BA, UF6CR, VP8JC, XW8BS, ZE1WPC, 5Z4LG, 9J2BC, W1—WØ.

P. Baker (S. Wales), HE30, 150ft. end-fed, says 98% of these were s.s.b.—CR6BF, ET3REL, HR1JMF, IT7GAL, K6PXQ/MM, KØVPX/MM, OD5—BA, BZ, CN, EP, FB, PZ1AW, SV1AN, SVØWL, TI3ALV, UF6CK, VO1AI, W9IOV/MM, YV5ADI, ZC4RB, ZC4RM, ZE2JA, ZS1FH, 5Z4LG, 9J2DT, and all on 28Mc/s too.

20/15

Still the favourite for most DX chasers, probably because it is the most consistent band of the lot.

R. Pusey (London, N.2), KW201 (I just went all green), 40ft. inverted L at 15ft. suffers from local QRM from underground trains and a factory. At times, this beautiful QRM was almost completely spoilt due to interference from—CN8BB, CP1HB, CR6DO, HBØAG, HC5DR, HK6AWX, HL9KR, KH6FIL, OH6NS, PJ2CE, VE8ML, VK3IP, VK5HV VK5WD, W9ISN/MM, XEØRZW, 9Q5HF, 9X5SP. Cor, wish I got QRM like that. It doesn't even keep to twenty, on fifteen he got savage bursts from—JA1DJL, KP4CRD, KV4AD, OD5BZ, OD5FG, PY2ARS, PY4DLH, ST4MO, SVØWM, VK9LR VK9WD, W4CQC/MM, ZE1AA, ZL1AIX, ZL1TU, 5H3JL, 6W8DY, 9M2NS, 9M2PO, 9Q5TR, 9V1MS, 9X5SP.

B. Bashford (Sussex), C52 set, 45ft. end-fed, queries QQ7A heard in QSO with LA5YJ and claiming to be on Ganzo Island. Any comments? Brian also sends in the following log for twenty s.s.b.—AP2SG, CM5AFF, CR6CN, CT2AP, F9HP/M, FC2CD, FK8AU, HM1AJ, HV3SJ, IØART, UA9WJ, UB5KMS, UI8AG, UO5AM, VP2KBE, UV3TQ, VE1DW, VE7TD, VK2DI, VK6SM, VU2HL, ZE2HW, ZL1AJ, ZS1JM, ZS3HX, 4X4HQ.

D. Higgins (Lanarkshire), KT340, 40ft. end-fed indoors, is having a crack at the RAE—hope you passed OM. Meanwhile, he's been keeping his hand in on twenty and fifteen. His log for 20 reads—CE3AEV, CN8AAW, CR6BX, CT2AS, CX7AP, EA6ITU, EL4WI, EP3AM, ET3USA, HB4FE, HBØLL, HC8BY, HI3ELJ, HK7YA, HP1AA, HR1DB, HV3SJ, IZ6KDB (Ponza Island), LU4DEG, LU6AHI, OA4O, OY5NF, PI8LS, PJ2CB, PY9AI, PZ1BW, SK6AB, TF2WKM, TG9EP, UAØNM, UG6AW, UJ8AC, UL7LA, UV9OP, VK2NN, VK3XO, VK4SD, VK5HV, VK6FD, VK7RX, VP2AL, VP7NF, VP8HZ, 9H1T, 9K2AG, 9K2AM, 9M2XX, 9Q5HF, 9V1NV, 9X5CG.

On fifteen metres—CR6GM, CR6LF, EA6ITU, EA8FG, EAØAH, EL2AL, ET3NPV, FG7XT, GB2SM, HL9TG, HP1LB, IZ6KDB, K3MFJ/MM, KC4CKW, LU1VH, MP4TCE, OD5FB, PY2BGL, SV1CD, UD6BD, UF6FE, VK3AMK, VS9MB, VU2JM, W1PYM/P/KP4, WA4NMA/AM, XE3PI, XW8AX, ZD8RB, ZE1CX, ZL1JN, ZL1TU, ZP5JB, ZS4IO, ZS6AO, 4S7PB, 4Z4HF, 5A4TZ, 5W1AS, 5Z4KK, 9G1DY, 9H1BD, 9K2BV, 9M2DW, 9M2PO, 9V1CN, 9U5SK, 9X5AA, 9X5SP.

40

Yep, on its lil ol' own, coz only one person sent in a log I could put in.

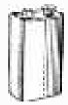
F. McVerry (Lanarkshire), RF24 into an R1155, 40ft. end-fed indoors, did a "lone ranger" on 7Mc/s. His catch included-CN8AW, CT1RR, EA8EZ, K3LLR, K5DJH/4, WØNEU/P/LA, PY1TX, PY2EGA, PY6NG, PY7APS, PY7ARP, PY7GAI, PY7VNY, TF3TF, UA9KPO, W1RGB, W2DIR, W2BHK, WA2JLJ, W3NNX, W4TLI, WA4WKM, WB4DGT, W4URR/MM, ZB2AP, ZS1JA, ZS2H.

NEWS

July is a good month for contests and rallies. July 6th-7th, Topband Contest; 6th-7th, Cheltenham Festival Rally; 7th, South Shields Mobile Rally; 13th -14th, Field Day—High power h.f., this is a new contest. It is c.w. only from 3·5 to 28Mc/s and the power limit is 150 watts; 14th, Worcester Mobile Rally; 21st, 70Mc/s contest (portables); 21st, Cornish Mobile Rally at Newquay; August 3rd-4th, 144Mc/s contest.

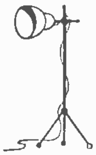
Letter from Fred (G3SVK) with all the gen on his DX-peditions (tnx OM) to the Channel Is. Pens ready? **Sark:**—28-31 July; **Alderney:**—August 1-4; **Guernsey:**—5-6; **Jersey:**—7-9. All c.w./s.s.b. 1·8 to 28Mc/s with calls GC3SVK, GC3TTN, GC3LDH, GC3KNZ. QSL's via bureau or s.a.e. to home QTH *except* GC3SVK via G3TZZ.

Isles of Scilly, callsign to listen for—G3SVK/P August 31-September 2, 1·8 to 28Mc/s c.w./s.s.b. QSL's to G3TZZ with s.a.e. or via bureau.



PP3 Eliminator. Play your pocket radio from the mains! save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. only **6/6** plus 1/- post.

FLOOD LAMP CONTROL



Our dim and full switch is ideal for controlling photo flood lamps: it gives two lamps in series, two lamps full brilliance and lamps off. Similar control of other appliances can be arranged where used in pair or where circuit can be split exactly in half. Technically the switch is known as a double-pole change over with off. Our price **6/6.**

3 kW TANGENTICAL BLOWER UNIT

Winter is coming but act today and you won't dismay. This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Units complete, wired ready to fit into cases, i.e. motor, impeller, 3 kW heater switching 1, 2 and 3 kW, and with thermo safety cut-out. Can be fitted into any metal line case or cabinet. Only needs on/off switch. **59/6.** Postage and Insurance 6/6. Don't miss this.

THE TUBE IS FREE

This month with our 15/20 watt fluorescent kit we give a free 15in. tube. Ideal for fish tank, plant growing, or any normal lighting situation. Costs less than 1d. per day if left on all the time. Kit comprises Atlas choke, TV suppressed starter, three lampholders and two terry tube clips. Only **19/6** plus 4/6 Post and Packing, and the tube is yours for nothing, but you must collect this.

0–1mA Full Vision Moving Coil Meter. 2in. sq. full vision. **19/6** plus 2/- post.

300 pF Silicon Tuning Condenser, 2/6 each. 24/- doz.

0–500mA 3in. Flush Mounting Moving Coil Meter 10/-.

G.E.C. Black Light Tube for experiments and special lighting effects—40 watt 2ft. tubes only **14/6** each, holders and control gear **19/6** plus 4/6 post.

You never need buy another battery for your transistor radio. Stupendous offer this month—a 6–9V Nickel Cadmium battery stack together with a mains operated charger which you mount on the back of your set. The mains flex unplugs so the set remains completely portable. Offered for less than the cost of the batteries alone. ONLY **29/6** plus 3/6 post.

Experimenting with Ultra Violet? Philips UV lamp **16/6**, holder and control gear **19/6** plus 4/6 post.

Double pole push to test switch. Spring return 10 amp. 250V. **2/9** each. **30/-** doz.

A.E.I. FRACTIONAL H.P. MOTOR. 200/250v. 50/60 c.p.s. enclosed, continuous rating 1/40 h.p., ex. equipt. Perfect order **19/6** plus 4/6.

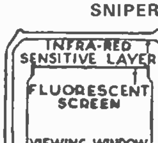
A.C. FAN, powerful mains motor with 6½in. blade, ideal blow or extract. **17/6** plus 3/6.

1·2v. NICKEL CADMIUM CELLS, dia. ⅝in. by ⅝in. thick (approx.) **3/6** each, charger for two cells **12/6.**

OIL THERMOSTAT, Teddington type, T.B.B. with capillary tube and sensor adjustable by knob (not supplied), controls ¼ h.p. motor or up to 15 amp. resistive load, **9/6.**

5 PUSH SWITCH, one push operates mains on/off switch. the other four operate various on/off and change-over switches, **2/6.**

SNIPERSCOPE



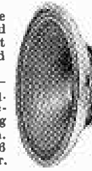
Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments. **7/6** each, post 2/6. Data will be supplied with cells, if requested.

FIELD TELEPHONE UNIT. Each unit contains magneto type ringer and bell—as well as transformer—relay and switches. A pair of these with suitable hand-telephone (not supplied) will give two-way communication over distances of up to 5 miles. Unused but in stored condition. **19/6** plus 10/6 carriage.

Multi Purpose Neon Test Unit

Robust, useful and instructive—tests insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and L.T. fault finder—kit comprises neon indicator—4-way wafer switch—ebonite tubes—resistors-condensers—terminals, etc. with diagram only **9/6**, plus 2/- post and insurance.

HI FI BARGAIN



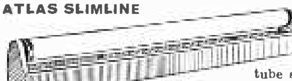
FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.
Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S.—Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5⅛in. A £6 speaker offered for only **£3.9.6** plus 7/6 p & p. Don't miss this offer.

GARRARD Model 3000

This is one of the latest products of the World's most experienced maker of fine record reproducers. Its superior features include—automatic playing of up to 8 mixed size records—stopping and starting without rejecting—manual playing—pick-up pivots to give low stylus pressure—large diameter turntable for max. stability adjustments include pick-up height—pick-up dropping position and stylus pressure. Size is 13¼ × 11¼in., clearance 4⅞in. above, 2½in. below—Fitted with the very superior ceramic stereo cartridge type 9TAHC with diamond stylus which is listed at over £4. Price complete **£10.9.6**, carr. and ins. 7/6.

THIS MONTH'S SNIP

THE TWENTYLITE ATLAS SLIMLINE



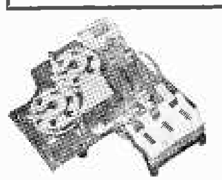
A Fluorescent lighting unit made by the famous Atlas company, with super silent polyester filled choke and radio suppressed starter. The tube springs in and out and the whole unit is beautifully made and finished white enamel. Amazingly economical. If left on all the time costs only one penny per day (uses ⅛ unit). Measures 2ft. long. Is ideal in Kitchen, Bedroom, Hallway, Porch, Loft, etc. Don't miss this amazing offer. **39/6** with tube. Assembled ready to install. Postage and Insurance 6/6 extra.

BARGAIN OF THE YEAR

MICRO-SONIC

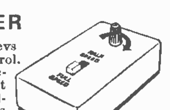
7 transistor Key chain Radio in very pretty case, size 2⅞ × 2⅛ × 1⅛in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 Kcs, or 455 Kcs. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type.
In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new **19/6** plus 2/6 post and ins., less batteries.

BATTERY OPERATED TAPE DECK



With Capstan control. This unit is extremely well made and measures approx. 6 x 5 x 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5 volts. Supplied complete with 2 spools ready to install. Record, Replay head is the sensitive M4 type intended for use with transistor, amplifier. Price **£4.15.0.** Post and insurance 4/6.

DRILL CONTROLLER

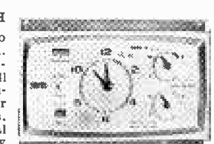


Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **19/6**, plus 2/6 post and insurance. Or available made up **32/6**, plus 2/6 P. & P.

CENTRIFUGAL FAN

CENTRIFUGAL BLOWER or extractor by Torrington, very low noise but large capacity air flow, designed for central heating and air conditioning, ideal also for fume extraction over cooker, duct type outlet, 200-250v. 50 C.P.S. motor, **£3.19.6** post and insurance 7/6.

ELECTRIC CLOCK WITH 20 AMP. SWITCH



Made by Smith's these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set—also on the left is another timer or alarm—this may be set in minutes up to 4 hours. At the end of the period a bell will sound. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **39/6**, less than the value of the clock alone—post and insurance 2/9.

CASSETTE LOADED DICTATING MACHINE

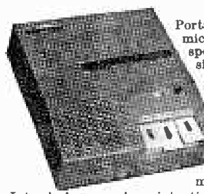
Battery operated and with all accessories. Really fantastic offer a British made £31 outfit for only **£6.19.6**, brilliantly designed for speed and efficiency—cassette takes normal spools, drops in and out for easy loading—all normal functions—accessories include: stethoscopic earpiece—crystal microphone has on/off switch—telephone pick-up—tape reference pad—DON'T MISS THIS UNREPEATABLE OFFER—SEND TODAY **£6.19.6** plus 7/6 post and insurance. Footswitch 18/6 extra. Spare Cassettes at 7/6 each, three for £1.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6**, plus 3/6 postage.

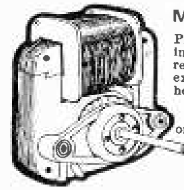
CAPSTAN DRIVEN TAPE RECORDER. Only £5/19/6.

(Batteries extra)



Portable with built-in microphone and loudspeaker using a 5 transistor amplifier with P.P. output. Operation by chargeable batteries. Tape capacity 25 mins. Tape position indicator. Recording level automatically preset. Inter-lock prevents unintentional erasures. Tape speed controlled by flywheel driven capstan. Neat case with carrying handle, size approx. 6½ x 7½ x 2in. Postage and insurance 7/6. *Unused but not tested nor guaranteed. Originally sold as the "Talking Book" at £30.*

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fans, blower, heater, etc. New and Perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. **19/6.** Kit B—30-40 w. **19/6.** Kit C—80 w. **17/6.** Kit D—125 w. **22/-.** Kit E—65 w. **19/6.** Kit MF1 is for 6in., 9in. and 12in. miniature tubes **19/6.** Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 on each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

AUDIO SWITCH

Want to open your garage door with a toot? Or close your curtains with a whistle? Or make anything obey your command? Then first you need an Audio Switch. We offer complete kit, including 5 transistors, Veroboard panel, all the resistors and condensers and the relay with diagrams, etc., for making. **48/6** plus 2/6 post and insurance.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

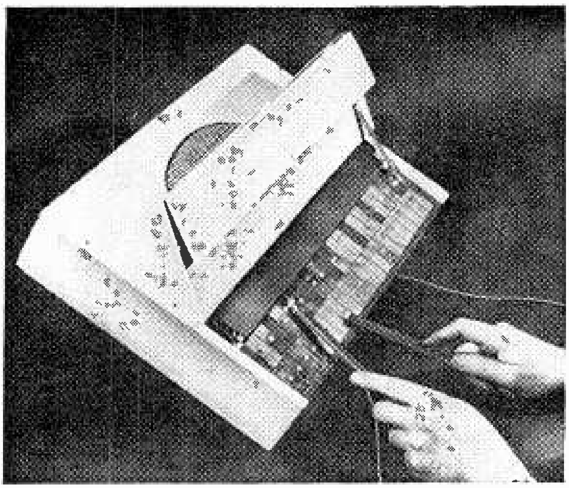
ELECTRONICS (CROYDON) LIMITED

(Dept. P.W.) 102/3 TAMWORTH RD., CROYDON, SURREY *(Opp. W. Croydon Stn.)*

also at **266 LONDON ROAD, CROYDON, SURREY** *S.A.E. with enquiries please*

PART TWO

G.W. HARDY'S portable KEYLESS ORGAN



—continued from the July issue

MATERIALS required for the Plate Contact Board are the piece of exterior quality hardboard 18 x 5½in. also 2 x 18in. lengths of ½in. square wood (ramin is ideal), 37 half-inch 6BA round head screws and nuts, 37 half-inch 6BA cheese head screws and nuts. The latter are for fixing the contact plates, and the cheese heads will be of assistance in holding a crocodile clip, while tuning that particular note. Thirty-seven double-ended tags will also be needed for the tuning resistance strip. The ¼in. square strips of wood are fixed along the back and front edges of the board underneath flush with the edges. Glue and screw with countersunk heads, these act as stiffeners.

Place the resistance strip on the board as positioned in Fig. 5. Hold firmly in position, and choosing a hole near the centre, pencil mark a small circle through the hole on to the board. With a block of wood underneath, punch in the centre and drill through and bolt together, correctly align the strip and mark similarly, about quarter way along from each end, drill through and bolt up, and similarly deal with the first and last holes. With strip securely bolted up drill the remainder of the holes, using the tops ones as a guide.

Unbolt and remove the strip, and place aside, clean level if necessary with a flat file, where the board has been drilled. We now follow on with fitting the plates. This is a prominent part of the instrument, and is well worth doing neatly. First mark a pencil line $1\frac{13}{16}$in. from the front edge of the board, and parallel to it, a piece of hardboard, or wood about 1in. wide and 1ft. 5in. long is required as a straight-edge, and should be temporarily fixed, with edge along this line, and covering where the sharps will come later. It could be fixed with a screw at each end or between where the plates will come, the coloured felt to be fixed later would hide any holes. Measure along the pencil line, from the bass end edge mark at $9\frac{9}{16}$in. with a set square, draw a vertical line, from front edge up to this mark.

Place plate F No. 18 on this line, so that it passes up under the middle of the plate. The hole in the middle of the plate should now be on this line. Draw a small circle through the hole to confirm. Punch and drill, and place a cheese head bolt through the two holes, put a single-headed tag and nut underneath and screw up finger tight. Should there be a gap between plate and straight-edge, or perhaps too tight, unbolt and elongate the hole in the board in the required direction to rectify the fault, using a small rat-tail file or wire file. When the plate is positioned correctly, bolt up securely. Now we need some thin cardboard spacing pieces, say ⅛in. wide strips of visiting card 1½in. long and a few 2½in. long, preferably cut off with a sharp knife, any spare phosphor bronze strip might serve. Take No. 17 plate and place on the left of No. 18, with a spacing piece in between and touching the straight-edge, mark centre hole as before and drill. Bolt up finger tight and correct as before if necessary. Keep proceeding in this manner, until all naturals are fixed. Tighten up with a screwdriver when satisfied all are straight and neat, remove the straight-edge.

Fix sharps as follows: Looking at D No. 3 Fig. 5 it will be noticed that the "crack" between C and D sharp is in line with a screw place a spacing strip against the top of 1, 3 and 5. The lower edges of 2 and 4 are now placed on the other side of the spacing piece and touching it, and in the correct position with a spacing piece in between them. Mark and drill as before. Looking at sharps 7, 9 and 11, it will be noticed that the "crack" between 6 and 8 is in line with the screw of No. 7, similarly with 8 and 10, and 10 and 12. Follow on in this way throughout.

Elongate any holes in board to shift position of plate where necessary. It is important that the finished job looks regular and neat, and with no shorts between plates.

All the plates are now removed and placed aside in order, and piece of felt laid as indicated in Fig. 5. The author used some scarlet felt as used at the back of piano keys. Use adhesive sparingly, just sufficient to hold the felt in place while fixing plates, overlap edges and trim off for a neat finish.

Commence refixing the plates with No. 18 F. Pierce through the felt into the hole, and fit up as before, keeping the felt flat and smooth, proceed until completed. The 37 holes for connecting wires are marked off in line with the plate screws, as shown in Fig. 5 and drilled with a 1/16in. drill.

Now the resistance strip can be fitted on the board. Lay the strip with the holes corresponding, and start from the middle by placing a double ended tag on a screw and pushing through the two holes, place a nut on the screw under the board, and make finger tight. Soldering tags are usually stamped out on a machine, thus leaving a rounded finish on one side, and a sharp edge on the other. The rounded side should be presented to the graphite track, as the other side could cut it. Work from the centre each way, until all are in place and just finger tight.

Still working outwards from centre, tighten up with slight pressure, at same time placing the double ended tags astride the strip. Now the back part of the tags where projecting are bent down firmly over the back edge. The front part of the tags are left for later soldering a wire which will go through a 1/16in. hole and then underneath to tags, on the bolts which hold the plates. Proceed to tighten up all screws securely on the resistance strip. The success of this idea relies upon rigidity and firmness of contact with the graphite surface. The author does not claim any originality in use of a lead pencil as a resistance, old hands will recollect its use as a grid leak with early detector valves.

To assist in tuning, a paper strip should be prepared with letters aligned with the spaces between the screws, and stuck down in position as in Fig. 5.

Drill a hole at the treble end to take the tuning preset control VR3. In the prototype there was just room to fit a simple on/off switch in this position. The vibrato switch is fitted towards the bass end in the position indicated. It only now remains to wire up the resistance strip tags to their respective plates. Keep wires taut for neatness.

Wiring to VR3 and tuning switch should be followed from Fig. 7. Finally drill a hole about a $\frac{1}{4}$in. from each end of the board, for two fixing screws.

Making the case

Starting with the bottom of the case, we require 1ft. $7\frac{1}{4}$in. x $12\frac{1}{2}$in. of $\frac{1}{8}$in. plywood. The back is made with a piece of wood $\frac{1}{2}$in. x 3in. x 1ft. $7\frac{1}{4}$in. long. The two sides are 3in. wide x 12in. x $\frac{1}{2}$in. We also need some $\frac{3}{4}$in. panel pins.

The long 3in. wide piece is placed along the back, and flush with edge of the bottom board, and pinned together. The two side pieces are placed flush with the sides of the bottom board, and butted against the backboard, fix with panel pins to back and bottom. This makes a shallow box with the long front piece omitted. Inside on the back piece of wood, make a pencil line $\frac{3}{8}$in. down from the top, repeat each side for about 5in. from the back. A 1ft. 6in. length of $\frac{1}{2}$in. square wood is fixed inside on the back, just below this line. Two short pieces continue round on each side. These will support the baffle board.

On the bottom board, inside the case, measure 5in. and mark at each end and middle, parallel with the open front edge of the case. Fix across the case a piece of wood 1ft. 6in. long, $1\frac{3}{4}$in. wide, and $\frac{1}{2}$in. thick along these marks with the $\frac{1}{2}$in. edge downwards, and leaving marks just visible. Fix on the back of this piece of wood another of same thickness and length, but $1\frac{1}{2}$in. wide, so that the uppermost edge is level with the two side fillets, and thus completing the support for baffle board all round. A carrying handle should now be fitted to the right-hand side of case.

For the baffle board, a piece of $\frac{1}{8}$in. plywood is cut to fit on these fillets and approximately 1ft. 6in. x $6\frac{5}{8}$in., check for exact size. The aperture for the loudspeaker should next be cut out. The baffle does not need to be fixed, as the top will be screwed down and will secure it. The material for covering the speaker is later fixed on the *outside* of the baffle, as there will be a corresponding hole cut in the top. Measurements allow for thickness up to $\frac{1}{8}$in. for the material. The top and cover are made in three pieces. The back part is fixed to the back and sides of case with round head screws and is 1ft. $7\frac{1}{4}$in. x 7in. approximately. The front half is about $5\frac{1}{8}$in. wide, exact size is best arrived at by first fixing the back half, and then measuring to front of case. Similarly with the front flap. Three fancy surface fitting hinges secure the back half to the front, and another three secure the flap to the front half. These are obtainable from D.I.Y. shops, as well as the carrying handle. The front flap needs to be held down, and a simple method is to fix a small screw eye in the centre of the $\frac{1}{4}$in. square wood, as described later, to be fixed along and level with the front edge of the bottom board. Where this screw eye marks the inside of the flap cut a corresponding slot to receive it, and it will then only need a turn to secure the flap.

To complete the front compartment, a small panel of aluminium is made up from a piece bent up at right angles, and large enough to take the toggle switch (mellow/bright tone), and just on its right

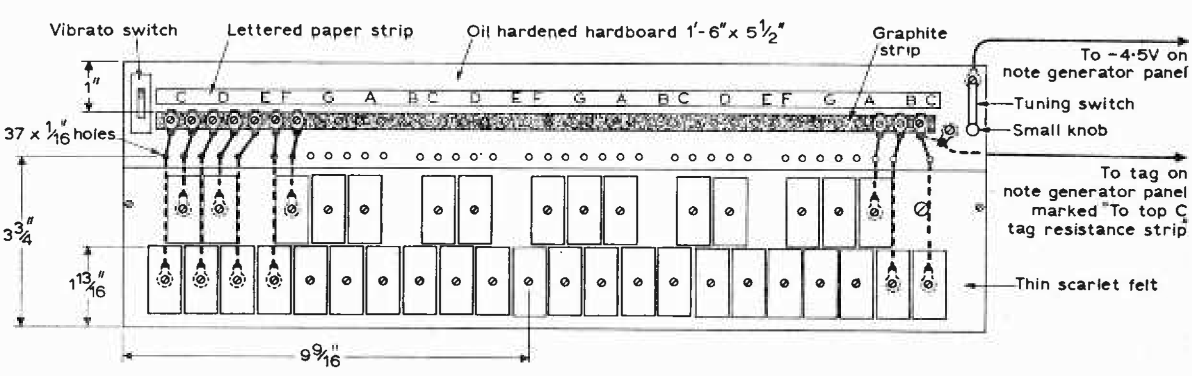


Fig. 5: Constructional details of the contact plate board and tuning strip.

the expression (volume) control. The panel is recessed inside the compartment, so that knobs do not project out of line with the front of the case. A short piece of ½in. square wood is fixed along the bottom edge of the small piece of plywood, and when pinned to it, is placed behind the expression control and fixed to bottom board with a couple of screws through the ½in. square wood. On the right hand side a similar panel is fitted up with the main on and off toggle switch, and also enclosed with a small piece of plywood. A 1ft. 6in. length of ¼in. square wood is fixed flush with the front edge of the bottom board. Bostik No. 1 will hold it well without pins. The compartment now left will later house the two wands etc.

A cover for the resistance strip is made with a piece of matching coloured plastic, similar to formica, purchased as an off-cut. Cut a length to just cover the length of the resistance strip, and wide enough to cover it and the tags with their wires and also allow for fixing two strips of ¼in. square wood along and level with the two edges, and to rest on the hardboard. Attach the wood to the plastic with Bostik No. 1. This cover needs to be easily removed for tuning, and the method used by the author works quite well. About 4in. from each end of the front strip of wood, screw in a small brass screw from underneath. Snip off the head, file clean and slightly round. Fit the two spigots thus left into two corresponding holes of a close fit drilled in the hardboard.

Finishing the case

The author removed all the components and glass-papered all over the exterior, making a slight radius on all edges and corners. File down any protruding pins or screws, fill in as required with Polyfilla. After this has hardened and been glass-papered level, remove all dust and give two coats of emulsion paint all over. The colour should be as near as possible to the finishing colour which was cream in the author's case. With fine glass-paper, give all exterior a gentle rub down and good dusting, and the job will be ready for a finishing coat of any good enamel or paint. Refix the carrying handle.

It is advised that a small square of thick felt be placed and fixed with Bostik at each corner on the bottom of the case. The front half of the top with flap attached will need a support to keep it from closing up the loudspeaker aperture. A narrow strip of leather about 6in. long should be fixed to the front half with a small screw and washer and the other end similarly fixed to the contact board, say at the extreme bass end. When fixed the front half should be held up at an angle similar to a music desk, leaving the loudspeaker well clear. When closed the leather should fold in half, out of the way.

Two more square pieces of felt should be fixed, one at each end, just inside the front compartment. These should receive an occasional rub with the wands to clean the contacts at the ends.

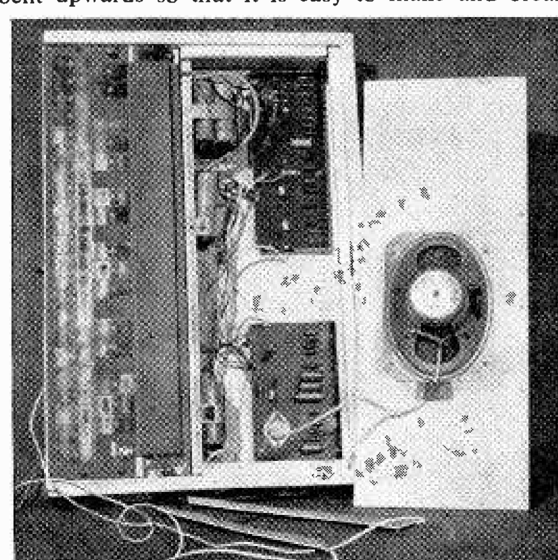
Making the wands

Two are recommended, and their use will be gone into fully later. Two strips of wood about 5/16in. wide and 3/16in. thick of ramin or hardwood, are required, both 9in. long. A ¼in. from one end, in the centre of the widest side, drill a hole to take a ⅛in. aluminium rivet, held firmly. A piece of wood, end grain uppermost is fixed in a vice. A ⅛in. round head rivet is placed head down, held in small pliers and tapped firmly with a hammer to form a depression to match in the wood. Place the rivet head held in the wand to fit into this depression, place a soldering tag on the stem, pointing down the wand. Push down on the tag firmly with a pointed awl, snip off the stem all but 1/16in., this should now be gently tapped with a hammer all round to form a burr to hold the assembly firmly together. This end of the wand is now tapered and filed around the end and close to the rivet head. Drill a 1/16in. hole ½in. from the end of the tag. The fine plastic-covered stranded wire from the tag will go through the hole to the underside of the wand and along its length, to be Sellotaped the other end where it is soldered on to the miniature twin cored and screened cable.

Wand 2 is made in the same way, but this one has a simple on and off switch connected to the control circuit on the output panel, so that the preamp can be controlled to give a gradual decay of the sound, as required. Normal playing will be done with the switch closed with the forefinger.

To make the switch, measure 3½in. and 4⅝in. from the rivet and mark the wood. At each mark drill through the wood to take an 8 or 6BA screw, preferably round head. At the 4⅝in. marked hole, put a round head screw through from the top of the wand, and place a soldering tag on underneath and nut, with the tag pointing away from the rivet. Prepare a piece of p/bronze or spring brass 1¾in. long x ¼in. wide, drill two holes, one at 3/16in. and another at ½in. from one end. The latter should have a round head screw pushed through the spring and the hole in the wood (3½in. from the rivet), put a soldering tag on underneath also pointing from the rivet and fit the nut.

The remaining hole in the spring metal only needs a small round head wood screw to be driven into the wood after the spring metal has been correctly aligned down the wand and resting on the head of the first R.H. screw. The spring metal is now lightly bent upwards so that it is easy to make and break



View of the organ with the loudspeaker panel removed.

contact with the latter screw head. To complete wand 1, as this only requires one conductor, the two cores and screening are soldered together and joined to the thin stranded conductor from the rivet contact, in a neat bundle near the end of the wood farthest from the rivet contact.

Wand 2 should have a length of thin stranded connecting wire soldered to the tag on the rivet contact, and cut off at the other end of the wand. We now need two-core screened wire, one yard for each wand, which must be plastic covered. Solder the screening to the wire from the rivet and the two cores to the two tags underneath the switch. Make a neat bundle and bind tightly down on the wood, with coloured Sellotape and along the length of the wand leaving the switch and contact rivet clear.

Testing panels and wiring up to controls

The note generator panel should be tested by inserting a meter in the negative battery lead that goes to the panel. A connection from the positive tag on panel is taken to battery positive. Reading should be about 2mA. The vibrato circuit is similarly tested in a similar fashion. Vibrato switch should be closed, or the terminal tags on the panel shorted temporarily. Reading should also be about 2mA and if oscillating the needle should fluctuate. If all is in order connect up to the output panel, and to loudspeaker as shown in Figs. 2 and 4. The two tags which will later take wand 2 switch should be temporarily shorted. 4·5V negative goes to the tag provided. The positive potential should be provided through the interpanel connection. Before a note will sound it is necessary to connect a wire from 4·5V negative on the generator panel to tag connected to R7 where VR3 will ultimately be connected.

Assuming that the two panels are working all right we can proceed with the wiring up of batteries and controls. The two panels and batteries are all fitted into the back compartment under the baffle board. The note generator panel to the right against the back, and the output panel to the right and against the back. The loudspeaker magnet should occupy the space between the panels. Batteries are held in position with the three aluminium clips, fixed to the top of the dividing board which should have recesses cut into it, and clips fixed

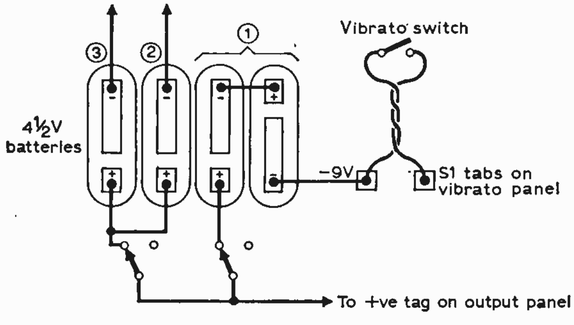


Fig. 6: Details of battery connection.

with countersunk screws, so as not to interfere with the bedding down of the baffle board.

The first battery clip to hold the two 4·5V batteries will need to be about 6in. long by about ¾in. wide. One end will be screwed down on the dividing board at about 3in. from the bass end. The two batteries are laid on their sides, Sellotaped together. The clip can then be pushed down and over them and bent out at the other end to rest on the bottom board to which it can eventually be screwed.

The second clip should be placed about halfway along the dividing board, a ½in. wide strip 3½in. long will be needed and after fixing as before is bent down and over a 4·5V battery lying on its side. Only the one fixing should be necessary for one battery. The third clip is fitted same as the second one and the 4·5V battery is positioned at the treble end with the clip about 3in. from the end.

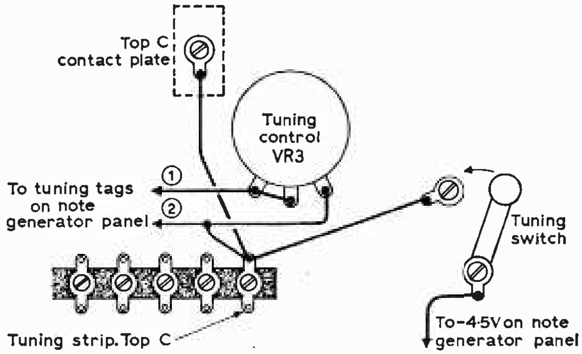
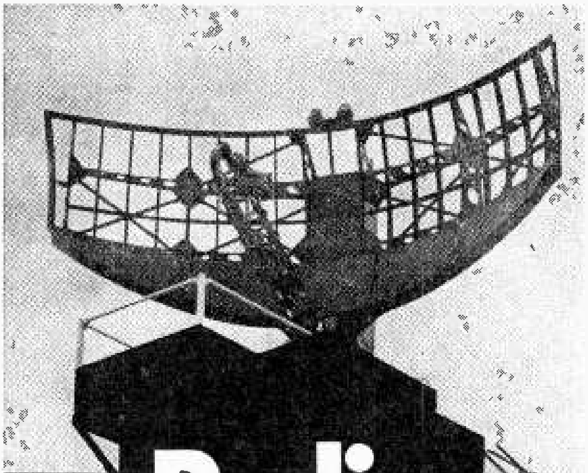


Fig. 7: Wiring of the tuning switch and pre-set tuning control.

Proceed with the wiring up of the expression control as detailed in Fig. 4. It will be necessary to cut a slot in the dividing board to take the cable. The vibrato switch will also need a small slot cut out to take two leads which go to the tags provided on the panel. See Fig. 7 for details of wiring to tuning switch and preset control, more slots or holes will be needed in the dividing board to take the wires. The two wands will need holes drilled at each end of the front stowage compartment, through the dividing board. A hole will also be necessary for the wires to the main switch.

All that now remains is to connect up the batteries to the panels. Commence with the two separate 4·5V batteries, by connecting their positives together and taking to one pole of the main switch, the positive of the 9V battery goes to the other pole of the double-pole switch. While proceeding with the negative connections to panels, see that the main switch is off. It is necessary to have a double-pole switch in this position, as with a single-pole one there would be a difference of potential between the 4·5V and the 9V batteries, causing a continuous slight leak, in spite of the switch being off. The other two connections on the switch are joined together and the wire is taken direct to the positive tag on the output panel, this is detailed in Fig. 6. It only now remains to bring out two wires from the tags marked "to VR3" with an extra one from the tag marked "to top C plate", these can be stranded bell wire, and all three twisted together and brought



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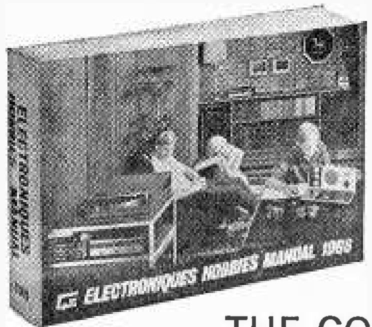

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out through a hole in the dividing board at the treble end and connected up as indicated. Finish with the connections to the tuning switch, see Fig. 7.

Tuning

It is assumed the constructor has arrived at the stage where the top C sounds when tuning switch is on, and vibrato and wands working OK. The next step is to get the resistance strip tuned. With top C sounding, check with a tuning fork. The fork should be struck on the knee, while holding by the stem, and then placed near the ear and tuning control slowly rotated until beats are at zero. The result should be perfect unison, both sounding together as one. If the constructor has access to a piano tuned to pitch, or a piano accordion for this first tuning, all will be straightforward. Tuning must always start from the top note, working down in half-tone stages. It must be explained that the system recommended for this first or rough tuning, in which the strip has been completely covered with graphite, means that they will mostly have to be flattened. From experience this has been found to be the easiest way, for the initial set-up of the tuning strip.

A crocodile clip should be connected to a 2ft. length of flex, and the other end to 4·5V negative (B1) on the note generator panel, and clip placed on the cheese head of the second plate down from the top C. Tuning switch and vibrato should be switched off, now note B should be sounding, tune with B on the piano by rubbing off some of the graphite between the two top screws with a soft pencil rubber. This will flatten the note; if required to be sharpened, use a HB pencil and rub the lead from one tag to the next by the screw round heads, if necessary work outwards each side to the edge of strip. When roughly in tune proceed with the next note A sharp in the same way. When finished start again, check the C is still correct and proceed again downward, this time it will go much quicker, some notes hardly requiring attention. After a recommended break we can tackle the third and last tuning, taking particular care that each note is well in tune with the piano, that is with complete absence of beats.

It is possible that occasionally a case may arise when it is impossible to raise the pitch of a note beyond a certain limit short of that required, this can be the result of a poor contact under the tags on either side, try the left-hand one first by undoing the screw, lifting tag and rubbing the pencil lead well all around the hole and just beyond the area covered by the tag, and replacing the nut very tightly. Make sure that plate screw is still tight. The note will now probably be too high, flatten with the rubber until correctly in tune. Once this tuning has been done, it will require only occasional attention afterwards. The author checks through the tuning with the piano just after that has had its periodical tuning. This takes only a few minutes, and is very pleasurable to play afterwards, when really correctly in tune.

We will now consider the case of a constructor who has no piano or is unable to have the use of one for the first tuning. A tuning fork or pitch pipe is essential, and with the top C tuning switch on, adjust the tuning control as before. Switch off the tuning switch and place the crocodile clip to B cheese head when it should be obvious if that note requires to be sharpened or flattened. Attend to this accordingly as before. It must be mentioned that it is no use humming the notes of the natural scale Doh Te Lah Soh Fah Me Ray Doh because tuning of the sharps afterwards will alter the tuning of these. If the constructor has a good ear and can hum the chromatic scale carry on tuning for a complete octave. Concentrate on this octave until satisfied that it is reasonably in tune. A musical programme from the radio might help in checking. Assuming the octave is reasonably in tune, now place the clip on C one octave below top C and using wand 2 with its switch closed, and top C switched off, touch top C plate, if this is quickly taken off and on the octave notes will sound in a rapid alternating sequence and give a fair indication of in tune-ness, flatten or sharpen as before while doing this. Proceed with the next note B (24) place a clip on this, now use Wand 2 as before, but on the octave higher B (36) proceed as before, until bottom C is reached and tuned.

It is possible to obtain a complete set of tuning forks for one octave, but these would cost a few pounds. A complete octave of pitch pipes would be a cheaper proposition. These use reeds similar to a mouth organ. A chromatic mouth organ would also serve but is fairly expensive. Your local music store might help. These are all tuned to standard pitch, but should be confirmed if one is purchased.

TO BE CONCLUDED NEXT MONTH

LETTERS...

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

Shocking affair

I wish to draw your attention to the practice of some advertisers who advise that "50 volts is easily obtainable between the 200 and 250 volt taps of a mains transformer".

This is extremely hazardous practice, since if the user comes into contact with an earth or negative terminal a violent shock will be experienced which may be fatal under certain circumstances.

Should a 50-volt supply be required, for example with surplus ex-GPO equipment or servo-systems, a suitable double-wound mains transformer should be used to safeguard the user.—**P. White** (*Freckleton, near Preston, Lancs.*).

P.O's and solder

This letter is intended as a warning to be careful when sending a postal order for something to be sent by mail.

I sent a P.O. for 3s. 6d. to a firm in London for a service sheet. The same P.O. was returned to me, which, I should have added, was crossed. I am still stuck with it after two weeks, so make it a s.a.e. every time men.

Also, to Mr. Parkinson of Grimsby (see letters May), a good way to remove solder without expensive gear is to give the object being soldered a quick flick and the hot solder will fly off usually on to your trousers. This is culled from a PRACTICAL WIRELESS from way back which I once read and never forgot.—**J. Martin** (*Southowram, Halifax, Yorks.*).

Instant silence

With reference to the comments on "instant silence" by S. G. Hill (PW, March) I feel I must point out to him that these headset assemblies for W.S. 19 are available from several of the advertisers in P.W., catalogued often as Headset Assembly No. 10, complete with mic. but I know from experience that the No. 10 does *not* ensure silence when there is nothing being played in the phones, merely reducing it to an inaudible level when a signal is being received. The headset, furthermore, looks so ungainly as to make many fellow train passengers doubt the sanity of your correspondent — so I would like to dissuade him from the use of such an assembly.—**R. Davenport** *(address supplied)*.

Death of a diode

On Wednesday, 3 April my crystal set suddenly died out and although I tried changing all the components it did not help. However, when I tried it today it was working all right. Could you possibly tell me why this should happen?—**C. Richmond** *(Hants.)*.

[*Readers' post-mortems gratefully received—Editor.*]

Finale

Your correspondents Finn and Moult have torn me to pieces in your June issue and quite rightly so, under the circumstances they were very polite. I had based my assumption on the fact that I use a BY100 in series with my soldering iron to reduce bit wear when the iron is idling for long periods. My iron is, of course, a 240 volt one running from 240 volt mains.

I now realise that I should have done my "sums" before committing pen to paper and I apologise most sincerely to anyone who has been misled by my letter in your March issue.—**Mark Francis** *(Gloucs.)*.

30-line television

If by any chance a reader has one of the old 30-line mechanical television receivers from the 1930s, we would very much appreciate details, as we are forming a wireless museum in connection with our local amateur radio society.

We would particularly like one of these vintage sets in time for our exhibition of old wireless receivers at our Mobile Rally, to be held on the banks of the River Nene at Peterborough on September 2—**D. Byrne** *(Peterborough Amateur Radio Society, Jersey House, Eye, Peterborough)*.

Radio club—Yorkshire

Would any readers in the Morley area who would be interested in forming a local radio club please contact me. Members of all ages and all radio interests would be extremely welcome.—**B. Mellor** *(15 South View, Churwell, Morley, Yorks.)*.

19 set information

I appeal to any 19 set owners who could tell me the basic procedures of how to handle the receiver. I am having one for my 12th birthday and would be very grateful.—**M. Pickard** *(9 Robincross, Borrowwash, Derbyshire)*.

Turn again Whittington

One has every sympathy with Mr. McLaren who did not receive the information he requested and paid for. (Letters, May issue.)

I recognise the firm from his description, and I do ask him to get in touch with them again even though I know the necessity should not have arisen. I think there must be a genuine mistake because I have dealt with this firm several times recently and have found the service quick and efficient by post, and on the two occasions I have called personally I was treated with the greatest patience and courtesy by the young lads in the shop.

I am a newcomer to the hobby and cannot be the easiest of customers to help. Their time-consuming advice has been quite invaluable to me in completing my relatively simple project.—**J. Hackwood** *(London, S.E.9)*.

Time Gentlemen please

Reference "MW Column" page 57 of the May 1968 issue of PRACTICAL WIRELESS. Alistair Woodland states: "The fact that GMT has now disappeared completely, etc., etc.". I must point out that this statement is erroneous and can be very misleading to a beginner.

It is only for an experimental period of three years that we are on British Standard Time, and it will then be decided one way or another what we finally do. However, GMT will always remain for reporting, and it is certain to remain where shipping is concerned, especially for navigation.

Further, on a point of interest, GMT is now more widely known as "Universal Time".—**Lt.-Com. F. Behenna** *(London, S.W.1)*.

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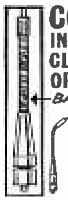

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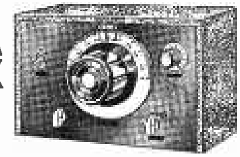

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'Crackle' pattern appears like magic on wood and metal. No undercoat. Air dries 15 min. to hard glossy finish. Heat, liquid and scratch-proof. Lt. and Dk. Blue: Bronze; Silver Green; Black. Send NOW for free list, or 8/- (+ 1/9 post and packing) for trial ½pt. tin, colour samples and instructions.

FINNIGAN SPECIALITY PAINTS, Dept. P.W. STOCKSFIELD (Tel. 2280), Northumberland.

PERSPEX clear and coloured sheet. Equipment panels drilled and cut to your specifications. Please supply accurate measurements or brown paper pattern. Send S.A.E. for quotation by return. Open all day Saturday. PARKRIVER ELECTRICS LTD., 2 Worsted Street, Mill Street, off Marsh Lane, Leeds 9.

YUKAN SELF-SPRAY

Get these NOW! air drying **GREY HAMMER OR BLACK WRINKLE (CRACKLE) finishes**

Yukan Aerosol spraykit contains 16 ozs. fine quality durable easy instant spray. No stove baking required. Hammers available in grey, blue, gold, bronze. Modern Eggshell Black Wrinkle (Crackle) all at 14/11 at our counter or 15/11, carriage paid, per push-button self-spray can. Also Durable, heat and water resistant Black Matt finish (12 ozs. self-spray cans only) 13/11 carriage paid.
SPECIAL OFFER: 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11, carriage paid. Choice of 13 self-spray plain colours and primer (Motor car quality) also available.

Other Yukan Air Drying Aerosols, 16 ozs at 15/11 carr paid include Zinc Chromate Clear Lacquer Metallic Grey Blue Bronze and Gold.

Please enclose cheque or crossed P.O. for total amount to:

YUKAN, Dept. PW/H **307a, EDGWARE ROAD, LONDON, W.2.**

We supply many Government Departments, Municipal Authorities, Institutes and Leading Industrial Organisations—We can supply you too.

Open all day Saturday. Closed Thursday afternoons.

(continued on next page)

FOR SALE
(continued)

Boxes of B.A. Nuts and Bolts, all Brand new and high grade machine cut items, invaluable to all Service men, experimenters etc. Bolts include 2.BA 4.BA and 6.BA up to 2" long, various heads, mainly brass, approx. 3—400 items per box, our Special Price 7/6d. plus 2/-d. Post and Packing. WALTON'S WIRELESS STORES. 55a Worcester Street, Wolverhampton, Staffs.

RADIO KNOBS, 1in. dia., ¼in. fitting. Black. 3/- doz. inc. post. G4MH, 8 Townend, Golcar, Huddersfield.

MORSE MADE EASY !!

FACT NOT FICTION. If you start **RIGHT** you will be reading amateur and commercial Morse within a month. (Normal progress to be expected.)

Using scientifically prepared 3-speed records you automatically learn to recognise the code RHYTHM without translating. You can't help it, it's easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.

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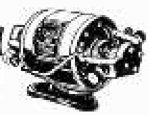
G3CHS/P. 45 GREEN LANE, PURLEY, SURREY

ELECTRICAL

240 VOLT ELECTRICITY ANYWHERE

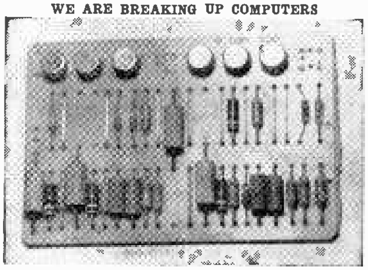


MOST BRILLIANT PERFORMANCE EVER
from 12 volt Car Battery

BRILLIANT HEAVY DUTY 240 volt AMERICAN DYNAMOTOR with BIG 220 WATT OUTPUT. Marvellous for TELEVISION, ELECTRIC DRILLS, MAINS LIGHTING and ALL UNIVERSAL AC/DC MAINS EQUIPMENT. Marvellous for Fluorescent lighting. Thousands of uses. Tremendous purchase makes fantastically new low price possible.
ONLY £4 each plus 10/- delivery. C.O.D. with pleasure. MONEY BACK if not DELIGHTED.
Please send s.a.e. for full illustrated details.
(Dept. PW) STANFORD ELECTRONICS
Rear Derby Road, North Promenade, BLACKPOOL, Lancs.

RECEIVERS & COMPONENTS

WE ARE BREAKING UP COMPUTERS



COMPUTER PANELS (as shown) 2 x 4in. 8 for **10/-** POST FREE, with min. 30 transistors.
100 for **65/-** + p. & p. 6/6. 1,000 for **£30** + carr.
GIANT PANELS 5¼ x 4in. with 20 Transistors, 30 Min. Diodes, 36 Min. Resistors and 9 56uH Inductors on each board. 3 for £1. Post Free.
PANELS with 2 Power Transistors sim to OC28 on each board + components. 2 Boards (4 x OC28) **10/-**.
SILICON F.W. BRIDGES on Finned Heat Sink. 150 p.i.v. 20 amp. Tatty but guaranteed and a bargain at **10/-** each. p. & p. 2/- each.
OVERLOAD CUT OUTS Panel Mounting in the following values at **5/-** each. 1½, 2, 3, 4, 5, 7, 8 amp.
TO5 TRANSISTOR COOLERS, 7/6 doz.
MINIATURE GLASS NEONS, 12/6 doz.
LONG ARM TOGGLE SWITCHES, ex eqpt. **15/-** doz., p. & p. 2/-.
NEW MIXED DISC CERAMICS. 150 for **10/-**, p. & p. 1/-.
LARGE CAPACITY ELECTROLYTICS, 4½in. 2in. diam. Screw Terminals. All at **6/-** each. + 1/6 each. p. & p.
4,000 Mfd. 72v. D.C. wkg. 16,000 Mfd. 30v. D.C. wkg.
6,300 Mfd. 75v. D.C. wkg. 25,000 Mfd. 15v. D.C. wkg.
10,000 Mfd. 35v. D.C. wkg.
KEYTRONICS, 52 Earls Court Road, London, W.8
Mail order only.

RECEIVERS & COMPONENTS
(continued)

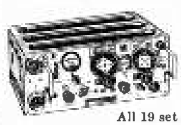
PEAK SOUND SA 8-8 Kit, Ampl. and Power Pack, brand new, complete, £9. C. TOLSON, 367 Kensington Street, Bradford 8, Yorkshire.

BRAND NEW TELEVISION TUBES
2 YEAR GUARANTEE. HUGE RANGE
12" £3; 14" £4.15.0; 17" £5.15.6
19" £6.17.6, etc., etc. Carriage, etc. 12/-
Also British and Telefunken valve lists!
PHILIP H. BEARMAN, 6 Potters Road, New Barnet, Hertfordshire. Tel. 449/1934

BARGAIN PARCELS of new surplus Electronic Components, 3/-, 5/-, 10/-, post free. DOLPHIN ELECTRONICS, 5 Pooles Way, Briar Close, Burntwood, nr. Lichfield.

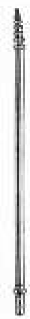
SURPLUS (EX GOVT.) BARGAINS

FAMOUS NO. 19 SET TRANS/RECEIVER



Covers 2–8 Mc/s in 2 bands. 11 valve superhet transceiver including 807 P.A. Power reqs. LT 12v. H.T. rec. 275v. H.T. transmit 500v. D.C. Slightly used **55/-**. Selected condition **85/-**.
All 19 set ancillary parts available.

COLLINS (U.S.A.) RECEIVER 7 valve superhet. (Int. Octal valves). Exceptionally stable for SSB. Frequency coverage 1·5–12 Mc/s. Power required 250v. D.C. 80mA. 12v. A.C. 1·25A. Excellent condition **£12.0.0.**
No. 31 TRANSCEIVER. VHF 40–48 Mc/s. Tunable. 90/60/4½v. battery operation. **70/-.**
No. 88 TWO WAY RADIO. 40–42 Mc/s. Crystal controlled. 4 channel. **50/-** each.
B44 VHF RADIO TELEPHONE. 60–95 Mc/s. Crystal controlled. 12v. D.C. operation. **£7.10.0.**
No. 62 TRANSMITTER RECEIVER. 1·6–10 Mc/s. Tunable or crystal controlled. 12v. D.C. operation. **£18.10.0.**
R.C.A. C29 TRANSMITTER RECEIVER. 2–8 Mc/s. Complete station. Brand new. 12 or 24v. D.C. operation. **£19.10.0.**
No. 52 RECEIVERS. Few left. Used (serviceable). **£7.10.0.**



TUBULAR STEEL TELESCOPIC AERIAL MASTS. 20ft. 4 section **70/-.**
32ft. as above with 12ft. whip **80/-.**
34ft. 6 section **90/-.**
MAKE YOUR OWN AERIAL MAST!
5ft. 8in., 2in. dia. interlocking steel sections. (7 sections make 35ft. mast). **20/-** per section.
NYLON GUY ROPES with semi-automatic tensioner. 33ft. **6/6**; 50ft. **7/6**; 60ft. **9/-.**
ROTARY TRANSFORMERS BY HOOVER. 12v D C input. Output 250v. D.C. at 125mA **25/-**. 12v. D C input. Output 490v. D.C. at 65mA. **25/-.**
REJECTOR UNIT. For rejecting unwanted signals. Switched 4 ranges. 1·2–10 Mc/s. **30/-.**
R.F. ANTENNA TUNER (A.T.U.). 160/80/40 metres. **25/-.**
MOVING COIL HEADPHONES. Soft rubber earpads. **19/6.**
D.L.R. BALANCED ARMATURE HEADPHONES. 12/6.
HEADSET WITH BOOM MICROPHONE. As used with 88 Set. **22/6.**
MOVING COIL HEADPHONES AND MIKE 21/6.
TRANSMITTER. 1·75–16 Mc/s. 3 waveband tunable. 813PA. Complete all valves, circuit. **£7.10.0.**
POWER SUPPLY. 12v. D.C. input. 285 and 1300v. D.C. 300mA output. Incorporating 230v. D.C. 80mA vibrator pack. Circuit. **£7.10.0.**
ALL ITEMS CARRIAGE EXTRA MAINLAND ONLY. List giving fuller details of these and many other surplus bargains **2/-**. S.A.E. all enquiries (Please print clearly).

A.J.THOMPSON (Dept. P.W.)
"EILING LODGE", CODICOTE, HITCHIN, HERTS.
Phone: CODICOTE 242
Hours of business Monday to Friday 8–5. Sat. 8–12.
Prices correct at time of press but subject to increase

RECEIVERS & COMPONENTS
(continued)

SUPERIOR QUALITY NEW RESISTORS

Carbon film Power	Low noise range	High stability series	per doz	per 100
⅛W 5%	5·1Ω to 330kΩ	E24	1/10	14/6
⅛W 10%	1Ω to 4·7Ω	E12	+½d. per resistor	
¼W 10%	4·7Ω to 10MΩ	E12	1/9	13/6
½W 5%	4·7Ω to 10MΩ	E24	2/2	17/-
1W 10%	4·7Ω to 10MΩ	E12	3/3	25/10

1/6 less per 100 in 100's of one ohmic value.
PLEASE state your choice of values.

QUALITY CARBON SKELETON PRE-SETS: 100Ω, 250Ω, 500Ω, 1kΩ, 2kΩ, 2·5kΩ, 5kΩ, 10kΩ, 20kΩ, 25kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1MΩ, 2MΩ, 2·5MΩ, 5MΩ, 10MΩ.
Available in horizontal or vertical mounting **1/-** each.

LOW COST VOLUME CONTROLS: 100Ω to 10MΩ lin 2/3 each. 5kΩ to 5MΩ log 2/3 each.

CERAMICS: 100, 220, 470, 1000, 2200, 4700pF, 500V 5d. 0·005, 0·01, 0·02, 0·05µF 50V 5d.

ELECTROLYTICS: 5, 10, 25, 50µF 10V., 5, 10µF 25V 9d. 100, 200µF 10V., 25, 50µF 25V 1/-. Sub-min Mullard C426 range: all values in stock.

Large or small orders despatched same day.

EVERYTHING BRAND NEW . NO 'SURPLUS'

SEND 1/- *for our catalogue containing data on 200 up-to-date semiconductors available from stock, as well as many other components, also transistor equivalents table. Invaluable to every serious experimenter and designer.*

DISCOUNTS: 10% *over £3,* 15% *over £10.*
Post and Packing: 1/- *under £1, free over £1*

ELECTROVALUE
6 MANSFIELD PLACE ASCOT BERKSHIRE

DUXFORD ELECTRONICS (PW)
Duxford, Cambs. (Sawston 3031)

MINIMUM ORDER VALUE 5/-
C.W.O. Post and Packing 1/-
DISCOUNT 10% over £2 15% over £5

ELECTROLYTIC CAPACITORS (Mullard).—10% to +50%. **Subminiature (all values in µF)**

4V	8	32	64	125	250	400
6·4V	6·4	25	50	100	200	320
10V	4	16	32	64	125	200
16V	2·5	10	20	40	80	125
25V	1·6	6·4	12·5	25	50	80
40V	1	4	8	16	32	50
64V	0·64	2·5	5	10	20	32
Price	1/6	1/3	1/2	1/-	1/1	1/2

POLYESTER CAPACITORS (Mullard)
Tubular 10%, 160V: 0·01, 0·015, 0·022µF, **7d.** 0·033, 0·047µF, **8d.** 0·068, 0·1µF, **9d.** 0·15µF, **11d.** 0·22µF, **1/-.** 0·33µF, **1/3.** 0·47µF, **1/6.** 0·68µF, **2/3.** 1µF, **2/8.**
400V: 1,000, 1,500, 2,200, 3,300, 4,700pF, **6d.** 6,800pF 0·01, 0·015, 0·022µF, **7d.** 0·033µF, **8d.** 0·047µF, **9d.** 0·068, 0·1µF, **11d.** 0·15µF, **1/2.** 0·22µF, **1/6.** 0·33µF, **2/3.** 0·47µF, **2/8.**

Modular, metallised, P.C. mounting, 20%, 250V: 0·01, 0·015, 0·022µF, **7d.** 0·033, 0·047µF, **8d.** 0·068, 0·1µF, **9d.** 0·15µF, **11d.** 0·22µF, **1/-.** 0·33µF, **1/5.** 0·47µF, **1/8.** 0·68µF, **2/3.** 1µF, **2/9.**

POLYSTYRENE CAPACITORS: 5% 160V (unencapsulated): 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820pF, **5d.** 1,000, 1,500, 2,200pF, **6d.** 3,300, 4,700, 5,600pF, **7d.** 6,800, 8,200, 10,000pF, **8d.** 15,000, 22,000pF, **9d.**
1%, 100V (encapsulated): 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820pF, **1/-.** 1,000, 1,200, 1,500 1,800, 2,200, 2,700, 3,300, 4,700pF, **1/3.** 5,600, 6,800, 8,200, 10,000, 12,000, 15,000pF, **1/6.** 18,000, 22,000, 27,000, 33,000, 39,000pF, **1/9.** 0·047, 0·056µF, **2/-.** 0·068, 0·082, 0·1µF, **2/3.** 0·12µF, **2/9.** 0·15, 0·18µF, **3/-.** 0·22µF, **4/-.** 0·27, 0·33µF, **5/-.** 0·39µF, **5/9.** 0·47µF, **6/3.**

POTENTIOMETERS (Carbon), miniature, 1in. × ¼in. spindle. Lin. 100Ω to 10MΩ, Log 5kΩ to 5MΩ, **2/3.**
SKELETON PRE-SET POTENTIOMETERS (Carbon): Lin. 100Ω to 5MΩ. Horizontal and vertical P.C. mounting. Miniature (0·3W), **1/-.** Submin. (0·1W), **10d.**

RESISTORS (Carbon film), very low noise. Range: 5%, 4·7Ω to 1MΩ; 10%, 10Ω to 10MΩ.
¼W (10%), 1¾d (over 99, 1½d), 100 off per value **12/-.**
¼W (5%), **2d** (over 99, 1¾d), 100 off per value **13/9.**
½W (10%), **2d** (over 99, 1¾d), 100 off per value **13/9.**
½W (5%), **2½d** (over 99, 2d), 100 off per value **15/6.**

SEMI-CONDUCTORS: OA5, OA81, **1/6.** OC44, **2/-.** OC45, **1/9.** OC71, OC72, OC73, OC81, OC81D, OC82D, OC170, OC171, **2/3.** OC140, AF115, AF116, AF117, **3/-.** Also entire current Newmarket range.

SILICON RECTIFIERS (0·5A): 170 P.I.V., **2/9.** 400 P.I.V., **3/-.** 800 P.I.V., **3/3.** 1,250 P.I.V., **3/9.** 1,500 P.I.V., **4/-.**

Send S.A.E. for May, 1968 Catalogue

(continued on facing page)

RECEIVERS & COMPONENTS
(continued)

150 NEW ASSORTED Capacitors, Resistors, Silvered Mica, Ceramic, etc. Carbon, Hystab, Vitreous, ½-20 watt, 12/6 Post Free. WHITSAM ELECTRICAL, 33 Drayton Green Road, West Ealing, W.13.

QUALITY NEW VALVES

Guaranteed six months. Post 6d. Five post free.

DAF96	6/6	ECL80	6/9	EL84	4/6	PL36	9/–
DF96	6/6	ECL82	6/–	EY86	5/9	PL81	7/3
DK96	7/–	EF80	4/6	EZ80	4/–	PY33	8/6
DL96	7/–	EF85	5/–	EZ81	4/9	PY81	5/3
EABC80	5/3	EF86	6/–	PCC84	6/3	PY82	5/–
EBF89	5/6	EF89	4/9	PCC89	9/9	UABC80	5/9
ECC81	3/–	EF91	2/–	PCF80	6/6	UBF89	6/3
ECC82	4/–	EF93	3/6	PCL82	6/3	UCH81	6/3
ECC83	4/6	EF95	2/6	PCL83	9/–	UCL82	6/6
ECC85	5/6	EF183	6/–	PCL84	7/3	UL84	5/9
ECH81	5/–	EF184	6/–	PCL85	8/–	UY85	5/–

SEMICONDUCTORS

Guaranteed twelve months. Post free.

AC107	4/–	BC108	3/6	OC25	5/4	OC71	2/5
AF114	3/8	BF180	7/6	OC35	6/6	OC75	2/8
AF117	3/2	BFY50	5/–	OC44	2/6	OC83	3/–
AF239	11/–	BY100	3/6	OC45	2/6	OC170	3/3

Lists valves, semiconductors, components on request.

J. R. HARTLEY
2 Waterloo Terrace, Bridgnorth, Shropshire

STELLA NINE RANGE CASES.

Manufactured in Black, Grey, Lagoon or Blue Stelvetite and finished in Plastic-coated Steel, Morocco Finish with Aluminium end plates. Rubber feet are attached and there is a removable back plate. There is also a removable front panel in 18 s.w.g. Alloy.

LIST OF PRICES AND SIZES
which are made to fit Standard Alloy Chassis

Width	Depth	4" Height			6" Height			7½" Height		
		£	s	d	£	s	d	£	s	d
6¼"	3⅞"		10	0		12	6		14	6
6¼"	4⅞"		11	6		14	6		16	6
8¼"	3⅞"		12	6		16	0		17	9
8¼"	6⅞"		17	9	1	1	6	1	5	0
10¼"	7⅞"	1	3	0	1	8	0	1	11	9
12¼"	3⅞"		17	9	1	1	9	1	4	9
12¼"	5⅞"	1	2	3	1	7	0	1	10	6
12¼"	8⅞"	1	8	9	1	14	6	1	18	9
14¼"	3⅞"	1	0	6	1	5	0	1	7	3
14¼"	9⅞"	1	15	0	2	4	9	2	7	0
16¼"	6⅞"	1	11	0	1	17	0	2	1	3
16¼"	10⅞"	1	19	3	2	10	0	2	17	6

Cases—Post 4s. 6d.

CHASSIS in Alumiuium, Standard Sizes with Gusset Plates

Sizes to fit Cases. All 2½" Walls.

	s	d		s	d		s	d
6"×3"	5	6	10"×7"	8	6	14"×3"	7	3
6"×4"	5	9	12"×3"	6	9	14"×9"	14	6
8"×3"	6	6	12"×5"	7	6	16"×6"	10	9
8"×6"	7	9	12"×8"	10	9	16"×10"	16	0

Chassis—Post 3s. 0d.

CHASSIS. Made up to your size, 1in., 1½in., or 2½in. walls up to 16in. wide × 10in. deep. 18 s.w.g. half hard aluminium at 7/6 per sq. ft., total area. This price includes gusset corners fitted. Add 3/- postage.

ALUMINIUM PANELS. Cut to size 5/- sq. ft., 18 s.w.g. 5/9, 16 s.w.g. 6/9, 14 s.w.g. Add sufficient post. Surplus refunded or send for postal rates.

E. R. NICHOLLS
Manufacturer of Electronic Instrument cases

46 LOWFIELD ROAD
STOCKPORT - CHESHIRE

Tel: STOckport 2179

RECEIVERS & COMPONENTS
(continued)

MARCONI INSTRUMENTS SIGNAL GENERATOR TFY62C/2. 480-900 megacycles. £20. Carriage £1. Waveform Generators Type 51, mains, 30/-. Carriage £1. Indicator Type 95, 25/-. Carriage 12/6. S.A.E. for list. NOYCE, High Laws, Silloth, Cumberland.

D.C. TO A.C.

Convertor kit 12 volt D.C. input 240-250 volts A.C. output. 40 watt, 50 cycles. Ideal for running tape recorders, lights etc. Fully transistorised with easy to follow circuit, £5.5.0 post paid.

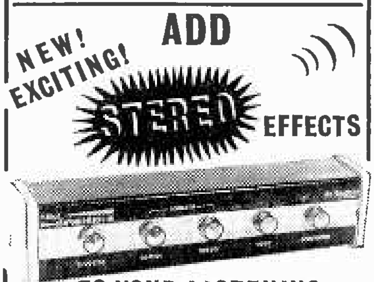
J. ROBINSON (Radio/TV)
Dept. (PW) 4, Highcliffe Road, Blackley, Manchester 9
Tel 061-740-1175

FOR SALE. HEATHKIT RECEIVER GR 64E, new Jan 1968. Factory aligned, perfect condition. £15. NO OFFERS. DAWBARN, 8 Daylesford Close, Parkstone, Poole.

WAVE TRAP

The Dewtron Wave Trap for portables

- ★ **Boosts Radio 1, Luxembourg, Pops etc.**
- ★ Eliminates 'fading'.
- ★ Extends battery life.
- ★ Replaces car aerial for portable sets.
- ★ 7-day refund trial. £2 post free.



TO YOUR LISTENING...

with "NEW DIMENSIONS" effects amplifier. Adjustable echo, vibrato, tone, giving fabulous 3-Dimension musicl 9V battery model for radio, tape or player 8 gns., speaker 25/– extra. Car version for 6 or 12V, positive or negative earth 10 gns. with speaker. Add 5/- post and insurance.

D.E.W. LTD.,
P.W., RINGWOOD ROAD, FERNDOWN, DORSET

MOBILE S.W. LISTENERS

The Halson Mobile Antenna for AMATEUR RECEIVING and TRANSMITTING

The most efficient mobile All-Band Whip on the market. COILS FOR ALL BANDS. Complete with one coil £6.17.6, plus 3/6. Extra coils £3.17.6, plus 3/–.

New Sprung Extension safeguards your whip from damage.

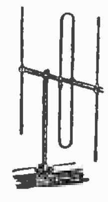
From leading amateur radio stores or direct from the manufacturers:

HALSON ELECTRICAL SERVICES
Dover Road, off Ansdell Road, Blackpool

NEW RANGE BBC 2 AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors. **Loft Mounting Arrays**, 7 element, 37/6. 11 element, 45/-. 14 element, 52/6. 18 element, 60/-. **Wall Mounting with Cranked Arm**, 7 element, 60/-, 11 element, 67/-. 14 element, 75/-. 18 element, 82/6. **Mast Mounting** with 2in. clamp. 7 element, 42/6. 11 element, 55/-, 14 element, 62/-. 18 element, 70/-. **Chimney Mounting Arrays, Complete.** 7 element. 72/6. 11 element. 80/-. 14 element, 87/6. 18 element, 95/-. Complete assembly instructions with every unit. **Low Loss Cable**, 1/6 yd. **U.H.F. Preamps** from 75/-. State clearly channel number required on all orders.

BBC · ITV AERIALS



BBC (Band 1). Telescopic loft, 25/-. External S/D, 30/-. "H" £2.15.0. **ITV (Band 3).** 3 element loft array, 30/-. 5 element, 40/-. 7 element, 50/-. Wall mounting. 3 element, 47/6. 5 element, 52/6. **Combined BBC/ITV.** Loft 1+3, 40/-; 1+5, 50/-; 1+7, 60/-; Wall mounting 1+3, 57/6; 1+5, 67/6; Chimney 1+3, 67/6; 1+5, 75/-. **VHF** transistor pre-amps, 75/-.

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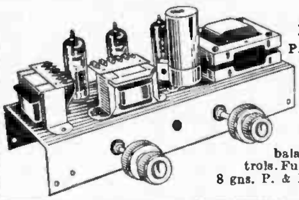

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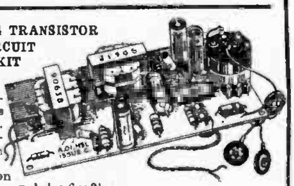

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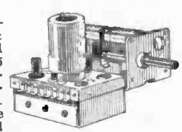

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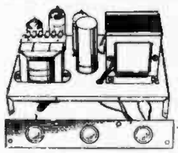

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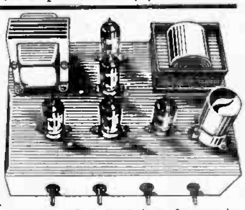

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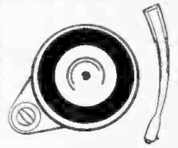

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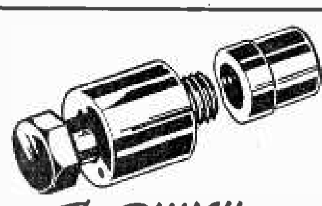

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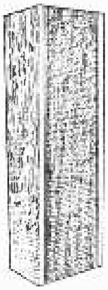

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PRACTICAL WIRELESS, AUGUST 1968

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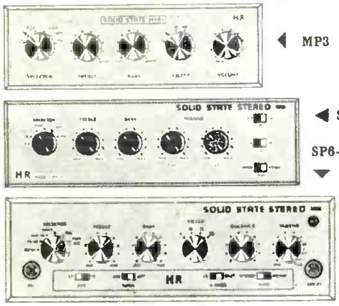

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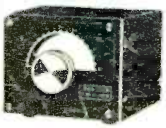

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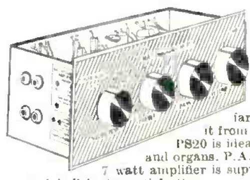

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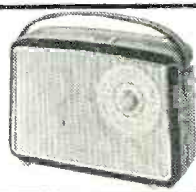

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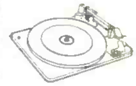

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