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JANUARY 1969

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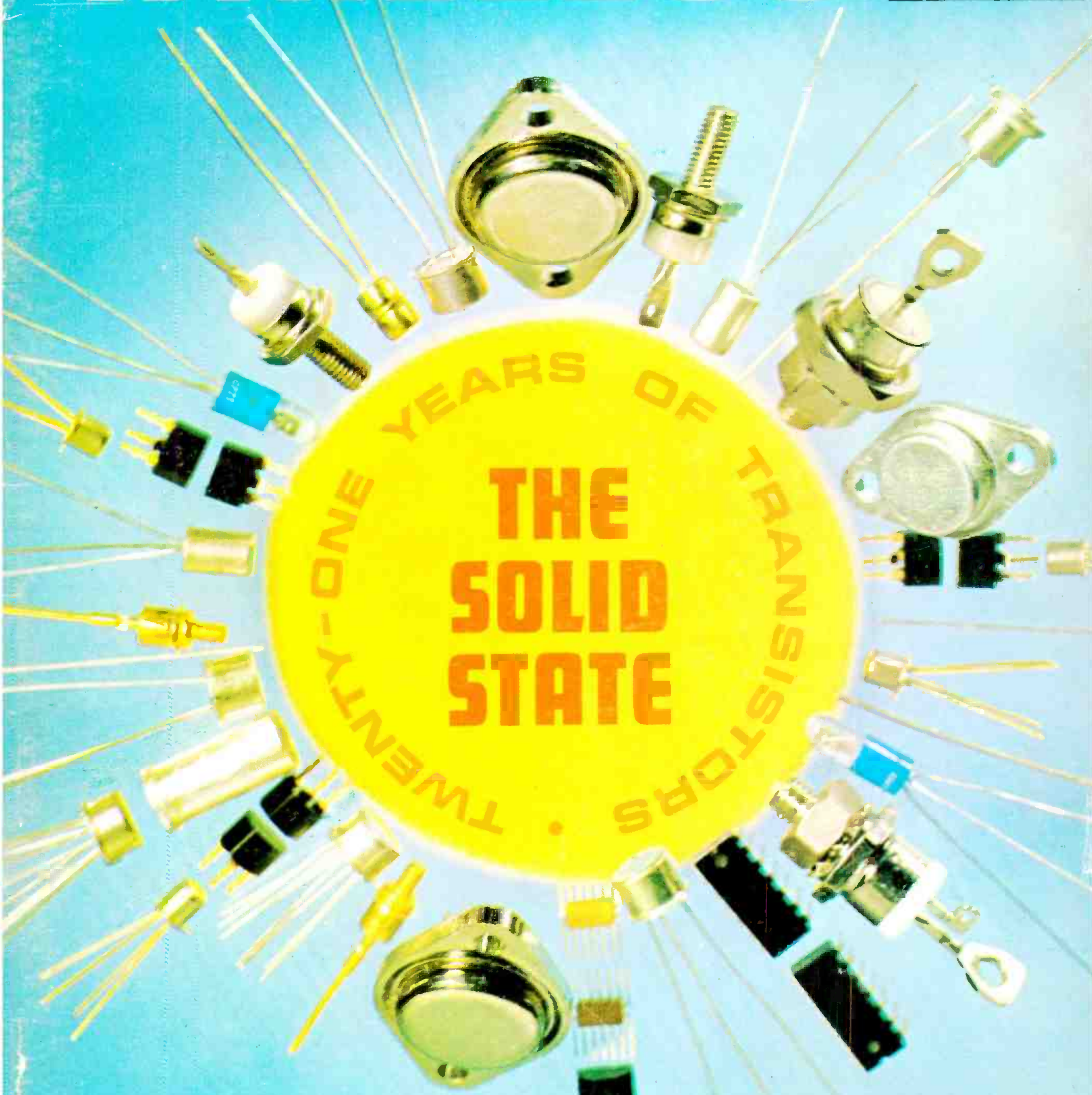

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P.W.167

Lasky's Radio

SPEAKERS

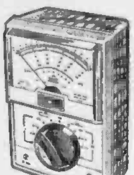
FOSTER CRITERION HI-FI BOOKSHELF SPEAKER SYSTEM

This extremely high quality bookshelf speaker system by the world famous Foster Co. of Japan incorporates an acoustical suspension woofer and cone tweeter in a sealed infinite baffle enclosure with handsome oiled walnut finish. The performance of the Criterion is superior to many larger and far more expensive units and at Lasky's special purchase price is quite without equal! SPECIFICATION: Air suspension type 6½in. bass-midrange woofer with rolled cloth edge. 2½in. HF cone type tweeter. Frequency range 65–20,000c/s. Maximum power handling 15W. 8Ω impedance. Cabinet constructed from ⅝in. laminate with oiled walnut veneer finish; size 13¾ × 7⅞in. square. Dark green woven acoustic gauze. Phono input at rear. List Price £12.10.0 each.

Lasky's Price £8.8.0 or 2 for £16 Post 1—7/6, 2—12/6

TEST EQUIPMENT

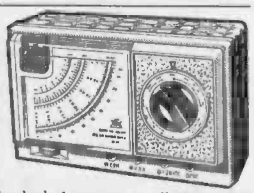
TTC Model C-1000



A really tiny 1,000 O.P.V. pocket multi-tester with "big" meter performance. Precision 2 jewel meter movement. Hand calibrated to ±3% accuracy on full scale of d.c. ranges, 4% on a.c. ranges. 2½in. square meter. SPECIFICATIONS a.c./V ranges: 0–10, 50, 250, 1,000V at 1K/O.P.V. a.c./V ranges: 0–10, 50, 250, 100V at 1K/O.P.V. D.c. current: 0–1–100mA. Resistance: 0–150K/ohms (3,000 ohms centre scale). Decibels: −10 to +22dB. Operated on one penlight cell. Two colour buff/green case—size only 3¾ × 2¼ × 1in. Click stop range selection switch. Ohms zero adjustment. Complete with test leads, battery and instructions with circuit data.

Lasky's Price 39/6 Post 2/6

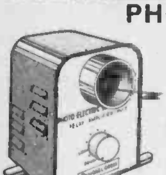
TTC Model C-1051



A completely new design 20,000 O.P.V. pocket multimeter with mirror scale and built in thermal protection circuit. 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: 0–60µA–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 4¾ × 3¼ × 1½in. Two colour buff/green finish. Complete with test leads and battery. Original list price £5.5

Lasky's Price 75/- Post 2/6

PHOTO ELECTRIC RELAY



TTC MODEL Q4001 Photo Relay System—comprising "exciter" lamp and relay unit. Any interception of the light beam instantly triggers the relay which in turn will operate light, alarm bell or buzzer, electronic counter, heavy duty relay or electric motor. Many useful applications in the home, office, shop, factory, etc. Operates on 240V. A.C.; exciter lamp 12V. 20W. effective up to 15ft. in daylight or 50ft. at night. Very simple to install. In strong metal cases size (each) 6 × 4½ × 3in. Complete with mounting brackets wire and instructions.

Lasky's Price £7.19.6. Post 5/-

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3in.	Message tape, 150ft.	2 6	5¾in.	Standard play, 850ft. PVC	11 6
3in.	Message tape, 225ft.	3 9	5¾in.	Long play, 1200ft. Mylar	15 0
3in.	Message tape, 300ft.	7 6	5¾in.	Triple play, 2400ft. Mylar	45 0
3¾in.	Triple play, 600ft. Mylar	10 0	7in.	Standard play, 1200ft. Acetate	12 6
4in.	Triple play, 900ft. Mylar	17 6	7in.	Standard play, 1200ft. Mylar	12 6
5in.	Double play, 1200ft. Mylar	15 0	7in.	Long play, 1800ft. Mylar	19 6
5in.	Long play, 900ft. Acetate	10 0	7in.	Double play, 2400ft. Mylar	25 0
5in.	Standard play, 600ft. PVC	8 6	7in.	Long play, 1800ft. Acetate	15 0
5in.	Triple play, 1800ft. Mylar	35 0	7in.	Triple play, 3600ft. Mylar	50 0
5¾in.	Double play, 1800ft. Mylar	22 6			
5¾in.	Long play, 1200ft. Acetate	12 6			

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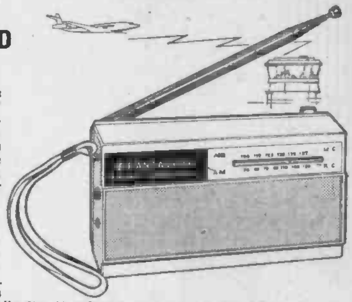
NEW *LASKY'S EXCLUSIVES*

FANTAVOX TV-1008 VHF AIRCRAFT BAND AND AM RECEIVER



The first pocket size Receiver of its type allowing you to "tune-in" anywhere to the entire air-to-ground, ground-to-air communications band covered by 108–137Mc/s in addition to full AM medium wave band cover of 535–1605Kc/s. An extremely sensitive 10 transistor and 2 diode, superhet circuit plus 1 variable capacitor and 1 thermistor. Intermediate frequencies: AM-455 Kc/s; VHF-10·7Mc/s. Output power: 200mW. 2½in. Permanent Dynamic 8 ohm speaker, earphone also provided for "silent" listening. A built-in ferrite rod aerial is provided for AM reception and a fully directional telescopic antenna for VHF reception—the latter when collapsed neatly clips across the top of the set. Power is from 4–1·5v penlight cells and a jack socket for connection to a suitable AC converter is also provided. The Model TV-1008 is extremely well made and finished in grey plastic with metallic blue speaker baffle, chrome telescopic antenna; attached wrist strap is also provided. Size 6¾ × 3¾ × 1½in. Complete with batteries, magnetic earphone, instructions and circuit data.

Lasky's Price £11.10.0 P. & P. 5/-

MIDLAND Model 10-502 VHF AIRCRAFT BAND CONVERTER

An entirely new item for the radio enthusiast bringing instant reception of the ground-to-air, air-to-ground waveband. For use with any standard AM or FM radio covering 535 to 1605Kc/s, 88 to 108Mc/s respectively—with no electrical conversion or connection required. The Model 10-502 (self powered by one 9V (PP3 type) battery) is merely placed close to the receiving set and then tuned over 110 to 135Mc/s which covers the whole aircraft communications band. Volume and reception effectiveness is adjusted by moving both sets to the most favourable position and balancing the vol. controls of each accordingly. The Model 10-502 has a smartly designed black plastic cabinet with brushed metal front panel and 18in. chrome telescopic antenna, size only 4 × 2¾ × 2¼in. (inc. knobs). Complete with battery and full instructions.

Lasky's Price 79/6 Post 3/6

REMOTE CONTROL SWITCHING SYSTEM

An extremely compact, simple to use and install remote switching system for use with a wide range of mains operated equipment. High freq. signal from the transmitter is relayed to the remote switching unit via the AC mains circuit into which the units are plugged—providing instant on/off—off/on control of appliance. Spec.: 3 transistor and 1 diode circuit. Frequency 190Kc/s (pre-set). Power 220/240V AC. 50/60c/s. Max. power of equip. to be switched—300W plastic cabinets size: 5½ × 2½ × 1⅞in., each with neon indicator lamp. Comp. with flex and instructions.

Lasky's Price £7.19.6 Post 5/-

MOVING MAGNET CARTRIDGE AD-76K

Lasky's are first again with this new high compliance moving magnet stereo cartridge that really breaks the quality/price barrier. The performance of this cartridge is equal to others costing many £'s more and will bring out all the subtleties of the finest microgroove recordings and is suitable for use with all the latest high sensitivity amplifiers. SPECIFICATION: Diamond Stereo LP stylus. Compliance 10×10^{-6}cm/dyne. Frequency response 20–20,000c/s. Channel separation 20dB. Output 7mV. Tracking pressure 2 grammes ±0·5grm. Standard ½in. mounting. Total length (inc. pins) $1^{3}/_{16}$in. Replacement Diamond stylus available. Fully guaranteed.

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Must be dismantled or exported. Complete with mike/speaker aerial. Work up to 100 miles. Cost Govt. over £40 each. £2.10.0 per set, 10/- P. & P. 2 sets £5, post free.

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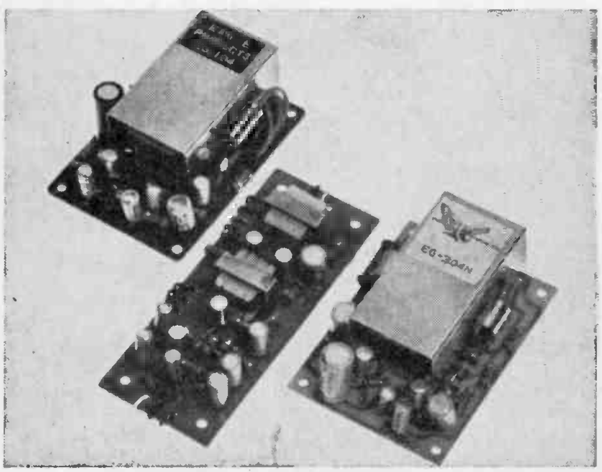

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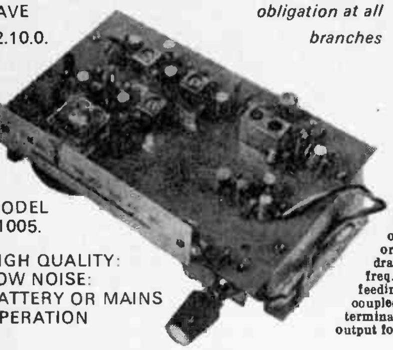

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Model A1005M. Simple instructions to convert any FM tuner. Max input 100 m volts. Power supply 8–14 volts. Mains or batt. (5mA at 12V.) Output 1·5 x input. 4 transistors (2 each) 2SB–202; 2SB–186. 7 diodes IN34 (six) IN60
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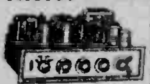
★ **Performance comparable with units costing** Carr. 12/6 **considerably more.** Consists of (1) 12in. 20 watt Bass unit with cast chassis. Roll rubber surround for ultra low resonance, powerful 2in. diam. pole pieces and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range 'speaker. (4) High efficiency tweeter. (5) Measured weight of woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions.
DEMONSTRATIONS AT ALL BRANCHES.

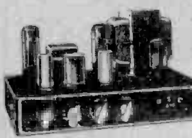
R.S.C. STEREO/20 HI-FI AMPLIFIER PROVIDING



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.*

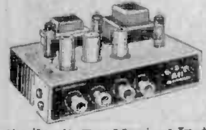
15 Gns. Carr. 12/6

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. 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. **14 Gns.** Carr. 12/6
Twin-handled perforated cover 27/6. Supplied factory built with EL34 output valves. 12 months' guarantee for **17 gns. TERMS: Deposit £5.14.0** and 9 monthly payments of **31/3** (Total £19.15.3). Send S.A.E. for leaflet.

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allowing mixing of "mike" and gram, etc, etc. High sensitivity. 5 valves—ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. IND. BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c/s. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic PUs, all types "mikes". For Musical **Instruments** such as String Bass, Electronic Guitars etc. Size approx. 12 x 9 x 7in. For AC mains 200-250v. 50 cps Output for 3 and 15 ohm spkrs. SAE for leaflet. Complete kit. **9 Gns.** Full instructions and point-to-point wiring diagrams. Carr 11/6 (or factory built **12 Gns.**) Twin handled metal cover 27/6. TERMS ON ASSEMBLED UNITS. Deposit **87/6** and 9 monthly payments of **22/-**. (Total **£14.5.6**).

RSC A11T TRANSISTORISED VERSION of above complete kit **9 Gns** (Assembled 13 Gns)

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". Bass and Treble controls.
52 Gns. Carr. 30/- or dep. **£10.1.9** and 9 monthly payments of **£5.11.9.** (Total **57½ gns.**). Send S.A.E. for leaflet.
Also B20 Bass inc. 15in. 25w Spkr. 29½ gns. G15 inc. 12in. 20w Spkr. 19½ gns.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1 An all-dry battery eliminator. Size 5¼x4¼x2in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram **49/11** 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 × 2½ × 2¼in.

250v., 60mA, 6·3v. 2a.	15/11
250-0-250v., 60mA 6·3v. 2a.	16/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	21/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
300-0-300v. 130mA, 6·3v. 4a., c.t., 6·3v. 1a. For Mullard 510 Amplifier	43/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	45/9
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	69/9
425-0-425v. 200mA, 6·3v. 4a., 6·3v. 4a., 5v. 3a.	75/-
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	85/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a.	21/9
250-0-250v. 100mA, 6·3v. 3·5a.	28/9
250-0-250v. 100mA, 6·3v. 2a, 6·3v. 1a.	24/9
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	25/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
300-0-300v. 130mA, 6·3v. 4a., 0-5-6·3v. 1a. Suitable for Mullard 510 Amplifier	42/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	35/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	43/11

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 7/9; 6·3v. 2a. 8/9; 6·3v. 3a. 10/9; 6·3v. 6a. 21/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1·5a. 21/9; 0-9-18v. 1½a. 17/9; 0-12-25-42v. 2a. 29/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 14/11; 2½a. 17/9; 3a. 19/11; 5a. 23/9; 6a. 27/9; 8a. 33/9.

AUTO (Step UP/step DOWN) TRANSFORMERS

0-110/120v. 200-230-250v. ......50-80 watts	15/9
150 watts, 29/11; 250 watts 49/9; 500 watts	99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	8/9
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	12/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15 Ω	22/9
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	21/9
Push-Pull Ultra Linear for Mullard 510, etc.	38/9
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	33/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	59/9

SMOOTHING CHOKES
150mA, 7-10H, 250 Ω 12/9; 100mA, 10H, 200 Ω 10/9; 80mA, 10H, 350 Ω 8/9; 60mA, 10H, 400 Ω 4/11.

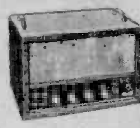
BLACKPOOL AGENT APPOINTED | O. & C. ELECTRONICS 227 CHURCH ST.

R.S.C. COLUMN SPEAKERS

RSC HI-FI CENTRES LTD.

Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 30 watts.** Fitted four 8in. high flux 8 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **16 Gns.**
Type C412S, 50 watts. Fitted four 12in. 11,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/-. **24 Gns.** Or Deposit **£4.13.6** and 9 monthly payments of **52/6** (Total **£28.5.0**).

30 WATT HI-FI AMPLIFIER



for Guitar, Vocal or Instrumental Group
A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. 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. Deposit 3 gns. and 9 monthly payments of 39/8 (Total £21). **18 Gns.** Carr. 12/6

12in. HIGH QUALITY LOUDSPEAKERS

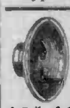
In Teak veneered or Rexine covered Cabinets
10 Watt 11,000 lines 3 or 15 ohms **£5.15.0** 20 Watt 10,000 lines 3 or 15 ohms **£8.19.9**

LOUDSPEAKERS

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

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

FANE 'POP' 100 LOUDSPEAKER

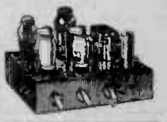


18" 100 Watt POST FREE
Fantastic power handling. Guaranteed 2 years. **19 Gns**

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 28/11. Or assembled 39/11. **24/11**

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 Feedback 15dB. For A.C. mains 200-250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions. **£4.17.9**

CLEARANCE LINES

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

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

EMI PLAYER T/TABLES
with P.U. 4 speed. T/D cartridge. Limited number mail order only.
Mono **79/9** Stereo **89/9**

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

1 WATT TRANSISTOR AMPLIFIERS for 3-5 ohm loudspeakers. Miniature size. Brand new boxed. **39/11**

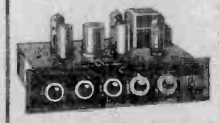
PRINTED CIRCUIT KITS for making printed circuits. Complete with 72 square ins. laminated board and necessary fluids. **14/11**

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

TAPE RECORD/PLAYBACK AMPLIFIERS 4 watts output. Magic Eye Recording level indicator. For 3 ohm L/S. All normal facilities but less Facia plate. (Normally 13 gns.). **£7.19.11**

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

STEREO/TEN HIGH QUALITY AMPLIFIER

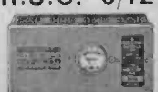


5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo cartridges. Ganged Bass and Treble Controls. Valves ECC83 (2), EL84 (2), EZ81. For 2-3 ohm speakers. Assembled with 12 months' guarantee Carr. 11/6 **£11.19.6**

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

VERDIK HIGH FIDELITY AMPLIFIERS with separate pre-amplifier. Mullard 510 circuit. Limited number to clear by mail order only. **12 Gns** Carr. 7/6

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



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

What has aluminium to do with sound?

The voice coil is the heart of a loudspeaker. This Peerless voice coil is wound around an aluminium former. It sounds so easy - but it is the result of years of experimenting and it represents a revolution within the field of tweeters.

The aluminium voice coil former enables the production of even more effective tweeters.

They can withstand 5 times greater input due to the Al-former conducting and giving off heat far better than the voice coil formers used until now.

They are far more reliable due to the Al-voice coil former retaining its form far better than the voice coil formers used until now, and due to the good thermal conductivity of aluminium which allows short great overloading without the coil annealing.

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It is emphazised that the new tweeters have an extraordinary flat frequency response, excellent spatial sound diffusion and low non-linear distortion.

The new 5 watts tweeters fully comply with the intensified demands of modern times for modern advanced reproduction of sound, both regarding quality and power capacity.

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Special versions of our P50 Series are now available for AF117 or OC45 Transistors. They can be used in the standard superhet circuit with slight changes in component values.

Oscillator Coil	P50/1AC (For OC45)	P50/1AC (For AF117)	5/4
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2nd I.F. Transformer	P50/2CC (For OC45)	P51/2 (For AF117)	5/7
3rd I.F. Transformer	P50/3CC (For OC45)	P50/3V (For AF117)	6/-

Rod Aerial	RA2W	12/6
Driver Transformer	LFDT4/1	9/6
Output Transformer	OPT1	10/6
Printed Circuit	PCA1	9/6

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Details of these and our other components are given in an illustrated folder which will be supplied on request with 4d. postage please.

WEYRAD (ELECTRONICS) LIMITED
SCHOOL STREET, WEYMOUTH, DORSET

AERIAL WIRE: Coils of 25 yds., solid 2/3, plus 1/- P. & P

TEST METERS: Still available ITI/2 20 K ohms per volt, at £3.6.9, plus 3/- P. & P. Also stocked Taylor AVO T.M.K.

TRANSFORMERS: Instrument, 250 volt primary 250 volt secondary 6:3 volt 19/6, plus 3/9 P. & P. Charger, 4 amp for 6 or 12 volt, £1.2.6, plus 3/9 P. & P. Mains 250:0:250 sec 6:3 volt 60mA. 18/9, plus 3/9 P. & P.

HIGH FREQUENCY HORNS: 1½ to 4½ volt, ideal for alarm circuits. 3/6, plus 1/- P. & P.

RELAYS: 12 volt suitable for car alarm, heavy duty contacts, £1.1.9, plus 1/6 P. & P. Small relays for electronic uses, 130 ohm coil, 4 change over contacts operate 6 to 18 volt. 19/6, plus 1/- P. & P. 1V–6V Relay, 1 NOC, 30 OHM, 5/-, plus 1/6 P. & P.

EAR PIECES: 3·5mm, 2·5mm magnetic, 2/6, plus 6d postage. 3·5mm, 2·5mm crystal, 5/6, plus 6d. postage

LOUDSPEAKERS: still available 8 ohm 2½in. 7/6, plus 1/- P. & P.

VALVE HOLDERS: B7g, B8a, B8g octal 6d., plus 6d. postage.

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PHONO PLUGS: 5/- doz, plus 1/- P. & P.

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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/-.

COMBINED BBC1 — ITV — BBC2 AERIALS 1+3+9, 70/-. 1+5+9, 80/-. 1+5+14, 90/-. 1+7+14, 100/-. Loft mounting only. Special leaflet available.
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LODGE HILL 2266

4-STATION INTERCOM

£7/15/0

Solve your communication problems with this **4-Station Transistor Intercom system (1 master and 3 Subs),** in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 7/6.

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No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control. Price 12 gns. P. & P. 9/6 extra.

INTERCOM/BABY ALARM

OUR PRICE ONLY **59/6**

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 2/6. P. & P. 4/6.

Transistor TELEPHONE AMPLIFIER

59/6

Why not boost business efficiency with this incredible De-luxe Telephone Amplifier. Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Battery 2/6 extra. P. & P. 3/6. Full price refunded if not satisfied in 7 days.

WEST LONDON DIRECT SUPPLIES (P/W1)
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HARVERSON'S EXCLUSIVE BARGAIN HI-FI GUITAR AMPLIFIERS

Refurbished units with a peak to peak output of approx. 20 watts. Brief spec: AC Mains 200/240v. EF86, ECC83, 2 x ECL82, Bridge Rect. Two inputs via standard jack sockets for 1 or 2 guitars or mikes controlled by single volume control. Separate bass and treble controls. Tremolo with variable speed control and standard jack socket for remote control of tremolo on/off by foot switch. Standard jack socket for speaker output (3 or 15 ohm). Completely self-contained unit in attractive portable case finished in dark rexine with gold trim and folding handle. Size approx. 14¾ x 11½ x 8in. Also capable of really Hi-Fi reproduction when used with a gram deck or radio tuner. Each amplifier is carefully tested and checked by us before despatch, and due to the fact that the cabinets are slightly store soiled we are offering them at the unrepeatable price of £12.12.0. Carr. 10/-. Standard Jack Plugs 2/6 each, if required. FOOT SWITCH for tremolo on/off control complete with lead and jack plug 27/6.

BRAND NEW 3 OHM LOUDSPEAKERS

5in. 14/; 6½in. 18/6; 8in. 27/-; 7 x 4in. 18/6; 10 x 6in. 27/6. E.M.I. 8 x 5in. with high flux magnet 21/-. E.M.I. 13½ x 8in. with high flux ceramic magnet 42/- (15 ohm 45/-). E.M.I. 13 x 8in. with two inbuilt tweeters and crossover network. 3 or 15 ohms 4 gns. P. & P. 5in. 2/-, 6½ & 8in. 2/6, 10 & 12in. 3/6 per speaker.

BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £5.10.0. P. & P. 5/-. Guitar models: 25w. £6.0.0 35w. £8.0.0.

E.M.I. 3½in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 ohms 15/- each; 15 ohms 18/6 each. P. & P. 2/6.

12in. "RA" TWIN CONE LOUDSPEAKER. 10 watts peak handling. 3 or 15 ohm, 35/-. P. & P. 3/6.

35 OHM SPEAKERS

3½in. 12/6; 7 x 4in. 21/-. P. & P. 2/- per speaker.

VYNAIR AND REXINE SPEAKERS AND CABINET FABRICS app. 54in. wide. Usually 35/- yd., our price 13/6 yd. length. P. & P. 2/6 (min. 1 yd.). S.A.E. for samples.

LATEST COLLARO MAGNAVOX 363 STEREO TAPE DECK. Three speeds 4 track, takes up to 7in. spools. Send S.A.E. for latest prices.

B.S.R. TD2, 4-TRACK STEREO TAPE DECK. Send S.A.E. for latest price.

QUALITY PORTABLE TAPE RECORDER CASE. Brand new. Beautifully made. Only 49/6. P. & P. 8/6.

Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser 35/-. P. & P. 3/-.

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

ACOS HIGH IMPEDANCE CRYSTAL STICK MIKES. Listed at 42/-. OUR PRICE 21/-. P. & P. 1/6.

SPECIAL OFFER! MOVING COIL STICK MIKE. Fitted on/off switch for remote control. High quality. High or low impedance. (State imp. required). BARGAIN PRICE 30/-. P. & P. 2/6.

NEW S.T.C. TYPE 25 MINIATURE RELAYS—12 volt. 4 s/p, c/o contacts. 1 amp rating. Coil resistance 185 ohms. Size approx. ⅞ x 1½ x 1¼in. high. 10/- each. P. & P. 1/6.

Also some similar to above but coil resistance 5,800 ohms 48 volt operation. 8/- each. P. & P. 1/6.

SPECIAL OFFER! PLESSEY TYPE 29 TWIN TUNING GANG. 400pF + 146pF. Fitted with trimmers and 5:1 integral slow motion. Suitable for nominal 470 kc/s I.F. Size approx. 2 x 1 x 1¼in. Only 8/6. P. & P. 2/6.

MAINS TRANSFORMER. Primary 200–240V two separate ½ wave secondaries giving approx. 16V at 1 amp and 20V at 1·2 amp; secs. can be connected in series for 36V at 1·5 amp. Ideal for transistor power supplies. Drop through mounting. Stack size 2½ x 3¼ x ⅞in. 15/-. P. & P. 6/-.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500 mA. 11/-. P. & P. 2/6. Pri. 200/240v. Sec. 12–0–12 at 1 amp. 14/6. P. & P. 2/6. Pri. 200/240v. Sec. 10–0–10 at 2 amp. 27/6. P. & P. 3/6.

MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1¼ x 1½ x ⅞in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/-. P. & P.

PARMEKO 7-10 watt OUTPUT TRANSFORMERS to match pair of ECL82's in push-pull. Sec. tapped 3·75, 7·5 and 15 ohm. Stack size 2½ x 1 x 2in. approx. ONLY 12/-. P. & P. 3/-.

7-10 watt OUTPUT TRANSFORMERS to match pair of ECL86's in push-pull to 3 ohm output. ONLY 11/-. P. & P. 2/6.

BRAND NEW MAINS TRANSFORMERS for Bridge Rectifier. Pri. 240v. AC. Sec. 240v. at 50mA and 6·3v. at 1·5 amp. Stack size 2½ x ¾ x 2½in. 10/6. P. & P. 3/6. (Special quotations for quantities).

HIGH GRADE COPPER LAMINATE BOARDS

8 x 6 x 1/16in. FIVE for 10/- P. & P. 2/-.

TRANSISTOR STEREO 8 + 8 MK II

Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W. mono). Integrated pre-amp. with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Freq. response ±3dB. 20–20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 25V at ·6 amp.

PRICES: AMPLIFIER KIT £10.10.0; POWER PACK KIT £3.0.0; CABINET £3.0.0. All Post Free.

Circuit diagram, construction details and parts list (free with kit) 1/6. (S.A.E.).

SPECIAL PURCHASE! E.M.I. 4-SPEED PLAYER

Heavy 8½in. metal turntable. Low flutter performance 200/250 v. shaded motor (90 v. tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. LIMITED NUMBER ONLY 63/-. P. & P. 6/6.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.
E.M.I. MODEL 999 Single Player with unit mounted pick-up arm and mono cartridge £5.5.0
B.S.R. UA25 with latest mono compatible cart... £6.19.6
All plus Carriage and Packing 6/6.

LATEST GARRARD MODELS. All types available 1000 SP25, 3000, AT60 etc. Send S.A.E. for latest Bargain Prices!

PLINTH UNITS cut out for Garrard Models 1000, 1025, 2000, 3000, AT60, SP25. With rigid perspex cover. OUR PRICE 5 gns. complete. P. & P. 8/6.

SONOTONE 9TAHC compatible Stereo Cartridge with diamond stylus 50/- P. & P. 2/-.

MONO T/O CARTRIDGE. Complete with LP & 78 sapphire stylii. Brand new 12/6. P. & P. 2/-.

FEW ONLY! ACOS GP69/1. For EP and LP 10/-. P. & P. 2/-.

QUALITY RECORD PLAYER AMPLIFIER

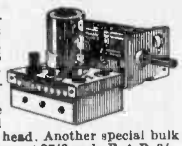
A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7" w. x 3" d. x 6" h. Ready built and tested. PRICE 75/-. P. & P. 6/-.

ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE 97/6. P. & P. 7/6.

DELUXE QUALITY PORTABLE R/P CABINET

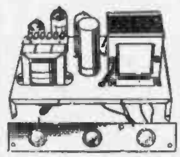
Uncut motor board size 14½ x 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD autochanger or Single Player Unit (except AT60 and SP25). Size 18 x 15 x 8in. PRICE £3.9.6. P. & P. 9/6.

FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer & Wadsworth Ltd. Supplied ready fitted with twin ·0005 tuning condenser for AM connection. Prealigned FM section covers 86–102 Mc/s. I.F output 10·7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-.

GORLER F.M. TUNER HEAD. 88–100 Mc/s. 10·7 Mc/s. I.F. 15/- plus 2/6 P. & P. (ECC85 valves, 8/6 extra)



3-VALVE AUDIO AMPLIFIER MODEL HA34

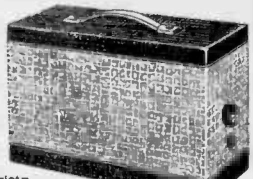
Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. x 4" d. x 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4.5.0. P. & P. 6/-.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. 79/6. P. & P. 6/-.

BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched Pair) 15/-; V15/10p, 10/-; OC71 5/-; OC76 6/-; AF117 7/6.

Set of Mullard 6 transistors OC44, 2—OC45, AC128D, matched pair AC128 25/-; Mullard LFH3 Audio Transistor Pack AC128D and matched pair AC128 12/6; ORP12 Cadmium Sulphide Cells 10/6. All post free.

SPECIAL OFFER!

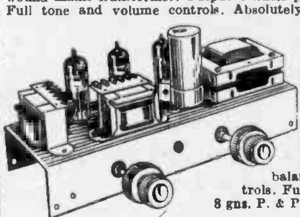


A great opportunity to purchase a first class GENERAL PURPOSE, HIGH GAIN, HIGH SENSITIVITY, PORTABLE AMPLIFIER. Completely self contained and can be used for a variety of purposes, i.e. Intercom, Baby Alarm, Booster unit for transistor radios etc., also ideal for classroom unit etc. Works perfectly with our special offer High Impedance Dynamic Microphone (30/-). Output 1000mw. Uses standard 9 volt battery. Smart two tone carrying case size 12 x 4 x 9in. fitted standard input jack socket, volume controls, 7 x 4in. speaker. Completely built and tested, brand new with full maker's guarantee.

Only 79/6 P. & P. 5/6

STEREO AMPLIFIER

Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



ONLY **£5.9.6** P. & P. 8/-.

Super De-luxe version with ECL86 valves, sep. bass, treble and balance controls. Full feedback. 8 gns. P. & P. 8/-.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT
Type TA1

- Peak output in excess of 1½ watts.
- All standard British components.
- Built on printed circuit panel size 6 x 3in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET114 or 81 Mullard AC128D and patched pair of AC128 o/p).
- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram 2/6 (Free with Kit). All parts sold separately.

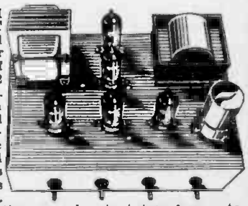
SPECIAL PRICE 45/-. P. & P. 3/-. Also ready built and tested, 52/6. P. & P. 3/-.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound mains transformer, EZ80 rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7" wide x 3" deep x 6" high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with valves and good quality output transformer. LIMITED NUMBER ONLY.

OUR ROCK BOTTOM BARGAIN PRICE **49/6** P. & P. 6/-

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 2/6 (Free with parts). All parts sold separately. ONLY £7.9.6. P. & P. 8/6. Also available ready built and tested complete with std. input sockets, £9.5.0. P. & P. 8/6.

Open all day Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station

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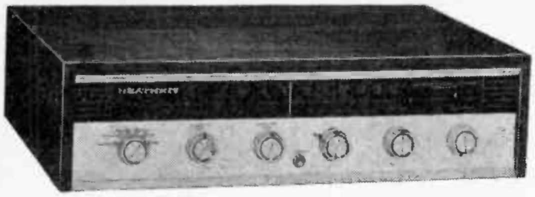
Here's What's NEW from HEATHKIT in SOLID STATE RECEIVERS

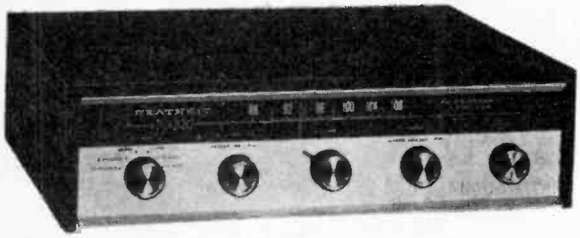
AVAILABLE AS EASY TO BUILD KITS OR READY-TO-USE MODELS



Kit K/AR-14
£54.0.0 P.P. 13/6

Ready to use A/AR-14
£75.0.0 P.P. 13/6

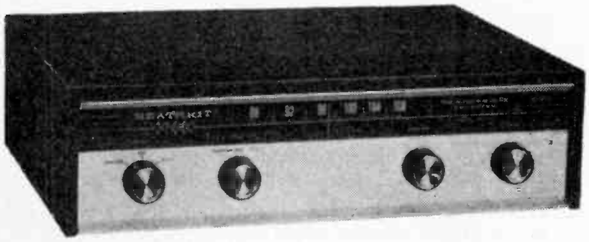
Cabinet £4.10.0. extra



Kit K/AR-17
£39.0.0 P.P. 10/6

Ready to use A/AR-17
£59.0.0 P.P. 10/6

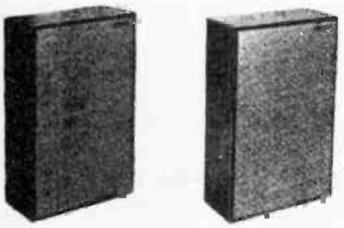
Cabinet £3.10.0. extra



Kit K/AR-27
£22.10.0 P.P. 10/6

Ready to use A/AR-27
£32.0.0 P.P. 10/6

Cabinet £3.10.0 extra



CHOOSE A QUALITY HEATHKIT LOUD-SPEAKER SYSTEM TO GET THE BEST FROM YOUR AUDIO SET-UP.

BERKELEY LOUDSPEAKER SYSTEM

Use two for stereo. Best performance from a slim-line cabinet. Uses less than 1 sq. ft. of floor space. Available in Teak or Walnut finish.

Kit
£21.4.0 P.P. 13/6

Ready to use
£24.0.0 P.P. 13/6

Top Value in a 30 Watt FM Stereo Receiver, AR-14

● 31 transistor, 10 diode circuit for cool, instant operation with the transparent, natural sound only transistors can deliver ● ±1dB, 15 to 50,000 Hz at 10 watts per channel continuous (20 watts total). 15 watts per channel IHF music power (30 watts total) ● Wide-band FM/FM stereo tuner plus two preamplifiers and two power amplifiers. ● Front panel stereo headphone jack. ● Compact—just $3\frac{7}{8}$" H x $15\frac{1}{4}$" W x 12" D. ● Custom install it in wall, your own cabinet, or use as a free standing unit. ● Build it in 20 hours.

Kit K/AR-14 (less cab.) .. kit £54.0.0. P.P. 13/6
A/AR-14 (less cab.) .. .. £75.0.0. P.P. 13/6
Cabinet extra: Teak or Walnut finish £4.10.0

Unbeatable Value in a 14 Watt FM Stereo Receiver, AR-17

● 28 transistor, 7 diode circuit for natural transparent sound, instant operation, long trouble-free life. ● 14 watts music power, 10 watts RMS from 25–35,000 Hz at ±1dB. ● Automatic stereo indicator light. ● Adjustable phase control for maximum separation. ● Complete front panel controls. ● Flywheel tuning. ● All critical circuits including FM "front-end" factory assembled and aligned. ● Circuit board assembly. ● Compact $10\frac{3}{8}$" D x 3" H x 12" W. ● Front panel stereo headphone jack.

Kit K/AR-14 (less cab.) .. kit £39.0.0. P.P. 13/6
A/AR-14 (less cab.) .. .. £59.0.0. P.P. 13/6
Cabinet extra: Teak or Walnut finish £3.10.0

A Quality Table Radio FM Mono Receiver, AR-27

● 13 transistor, 6 diode circuit for high-fidelity sound reproduction, long life, low heat, freedom from hum, and service-free operation. ● 7 watts music power. ● ±1dB, 25 to 60,000 Hz at 5 watts. ● Input connectors for phonograph and auxiliary signals. ● Complete front panel controls. ● Flywheel tuning. ● Preassembled and prealigned FM tuner, all other critical parts factory aligned. ● Easy, circuit board assembly. ● Compact bookshelf size. ● 3-way installation . . . wall, free standing or in a suitable cabinet. ● 117 v. A.C. or 210/240 v. A.C., 50 Hz operation.

Kit K/AR-27 (less cab.) .. kit £22.10.0. P.P. 10/6
A/AR-27 (less cab.) .. .. £32.0.0. P.P. 10/6
Cabinet extra: Teak or Walnut finish £3.10.0

See how easy it is to build any Heathkit model. Purchase a manual only. British manuals 10/- each. American manuals £1 each incl. P.P. Price of manual deductable from kit if you buy later.

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HEATHKIT Models for Family Entertainment

OFFERS THE BEST IN SPECIFICATION AT LOWEST COST

Latest STEREO TAPE RECORDER, STR-1

Fully portable—own speakers

Kit K/STR-1
£58.0.0. P.P. 10/6

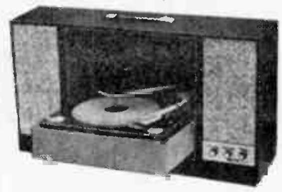
Ready-to-Use A/STR-1
£72.0.0. P.P. 10/6

FOR THIS SPECIFICATION

$\frac{1}{4}$ track stereo or mono record and playback at $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ips. Sound-on-sound and sound-with-sound capabilities. Stereo record, stereo playback, mono record and playback on either channel. 18 transistor circuit for cool, instant and dependable operation. Moving coil record level indicator. Digital counter with thumbwheel zero reset. Stereo microphone and auxiliary inputs and controls, speaker/headphone and external amplifier outputs . . . front panel mounted for easy access. Push-button controls for operational modes. Built-in stereo power amplifier giving 4 watts rms per channel. Two high efficiency 8 x 5in. speakers. Operates on 230V a.c. supply.

Versatile recording facilities. So easy to build—so easy to use.

Latest Portable Stereo Record Player, SRP-1

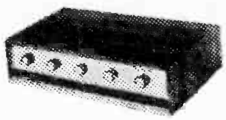


Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250V ac mains operation. Overall cabinet size $15\frac{7}{16}$ x $3\frac{7}{8}$ x $10\frac{1}{4}$in.

Compact, economical stereo and mono record playing for the whole family—plays anything from the Beatles to Bartok. All solid-state circuitry gives room filling volume.

Kit K/SRP-1 £28.6.0 incl. P.T. **Ready-to-Use A/SRP-1 £35.4.0. P.P. 10/6**

Latest STEREO AMPLIFIER, TSA-12



12 x 12 watts output.

Kit K/TSA-12
£32.16.0. *less cabinet.* P.P. 10/6
Cabinet £3.16.0. extra

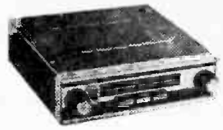
Ready-to-Use A/TSA-12
£39.10.0. P.P. 10/6

FOR THIS SPECIFICATION

17 transistors, 6 diode ± circuit. 1dB, 16 to 50,000 Hz at 12 watts per channel into 8 ohms. Output suitable for 8 or 15 ohm loudspeakers. 3 stereo inputs for Gram, Radio and Aux. Modern low silhouette styling. Attractive aluminium, golden anodised front panel. Handsome assembled and finished walnut veneered cabinet available. Matches Heathkit models TFM-1 and AFM-2 transistor tuners.

Full range power . . . over extremely wide frequency range. Special transformerless output circuitry. Adequately heat-sinked power transistors for cool operation—long life, 6 position source switch.

High-performance CAR RADIO, CR-1



Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

8 Latest semi-conductors (6 transistors, 2 diodes). For 12 volt positive or 12 volt negative earth systems. Powerful output (4 watts). Pre-assembled and aligned tuning unit. Push-button tone and wave change controls. Positive manual tuning. Easy circuit board assembly.

Instant operation, no warm-up time. Tastefully styled to harmonise with any car colour scheme. High quality output stage will operate two loudspeakers if desired. Can be built for a total price.

Kit K/CR-1 (incl. speaker) £14.12.0. incl. P.T. P.P. 4/6
Ready-to-Use A/CR-1 (incl. speaker) £19.12.0. incl. P.T. P.P. 4/6

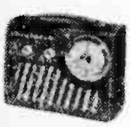
RADIOS for Luxury Listening

Oxford

"OXFORD" PORTABLE UXR-2

This De-Luxe, 7 transistor, 3 diode portable radio covers long and medium wave-bands with an easy-tune dial and uses battery-saving circuitry to ensure longer life and more hours of listening pleasure. Choice of Brown or Black real leather case.

Kit K/UXR-2 £15.10.0. P.P. 6/–
Ready-to-Use A/UXR-2 £17.10.0. P.P. 6/–



UXR-1

PORTABLE UXR-1

This luxury 6-transistor, 1 diode receiver covers long and medium wavebands. Its robust case is now available in real brown leather or choice of colours: Navy blue, coral pink, lime green (please state second choice).

Kit K/UXR-1 £12.8.0. colour case. P.P. 4/6
Ready-to-Use A/UXR-1 £14.8.0. P.P. 4/6
Kit K/UXR-1 £13.8.0. real leather. P.P. 4/6
Ready-to-Use A/UXR-1 £15.10.0. P.P. 4/6

'Mohican' General Coverage Receiver, GC-1U

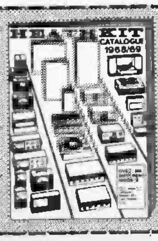
Powerful 10 transistor, 5 diode circuit. Tunes 580 to 1550 kHz and 1·69 to 30 MHz in five bands. Bandspread on all bands. Fixed-aligned ceramic IF trans-filters for best selectivity. Pre-assembled and aligned 'front-end' for fast, easy assembly. Built-in 6 x 4in. speaker. Tuning meter for pin-point tuning. Completely self-contained for portability—can be operated on 230 volt AC with Model K/UBE-1. Kit £2.17.6. extra.

Kit K/GC-1U **£38.8.0.**

Ready-to-Use A/GC-1U **£46.8.0.** P.P. 10/6

OTHER MODELS FOR SW LISTENERS

Gen. Cov. Receiver RG-1 Kit	£39.16.0. P.P. 9/-
SW Receiver GR-64 Kit	£22.8.0. P.P. 9/-
SW Receiver GR-54 Kit	£50.2.0. P.P. 9/-



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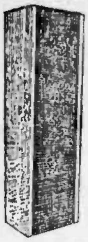
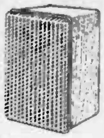
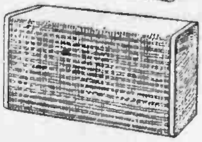


THE CAXTON COLUMN This is a column cabinet. Size 22¼ x 5 x 6¾in., fitted with 3 speakers. This will handle 10 watts and will improve the quality of any tape recorder, or record player. Finished in wood grain cloth and sandstone Vynair. A real bargain at **59/6**. P. & P. 10/6.

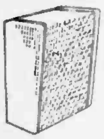
THE MILTON. A Hi-Fi Bookcase Cabinet. Size 9 x 5 x 6in., with 5in. speaker. Finished in Teak cloth with gold silk front **30/-**. P. & P. 4/6.





THE IMP. Extension Speaker Cabinet. Wedge shaped. size 7½ x 6¾in. fitted 7 x 4in. speaker. Covered with attractive walnut with fawn Vynair front. Keyhole slot in back. Only **25/6**. P. & P. 4/6

THE STEREO. A superior extension speaker cabinet fitted with two 7 x 4in. speakers. Size 16 x 9 x 8¾in. Finished in fawn Vynair with natural/teak ends. **£3.** P. & P. 5/-.



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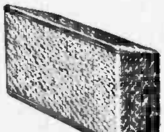
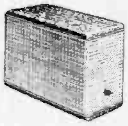


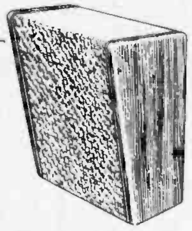


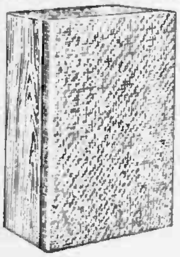
CLARENCE. Extension Speaker Cabinet fitted 8 x 5in. speaker. (3 ohms imp.) and volume control. Size 10¼ x 8½ x 4¾in. Finished in black and grey Vynair. **45/-.** P. & P. 4/6.

THE SCOTT. Table top or wall mounting Speaker. Size 16¼ x 10¼ x 5¾in., tapered as illustrated. Fitted 13¼ x 8in. Speaker with volume control. Finished in teak cloth and contrasting Vynair. (Please state 3 or 15 ohm imp.) **£4.5.0. P. & P.** 7/6.

All cabinets are new and speakers are mounted on ½in. chipboard baffles. All speakers ex TV reconditioned hi flux magnet. All carefully tested before despatch.

SPEAKER ENCLOSURES





The Baker. Size 8 x 15¾ x 23¼in. Teak veneered top and sides. Fawn Vynair covered front. Cut out for 12in. speaker and 3in. tweeter with port and internal bass reflex board. Fitted rubber feet. **£6.15.0.** P. & P. 10/6.

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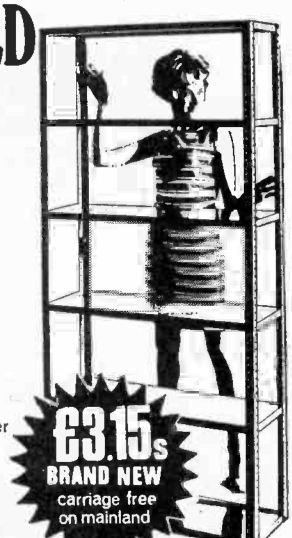

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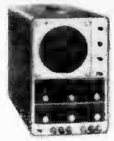
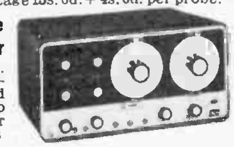


KG635 5-inch Oscilloscope Kit
For Colour TV Servicing and General Wideband Testing. D.C. to 5.2-MHz Bandwidth. 5 Linear time base ranges. Response: ± 1.5dB, DC to 5.2 MHz (vertical), ± 1.5dB, 1 Hz to 400 kHz (horizontal). Complete kit: £62.19.6. Postage 15s. 0d. + 4s. 0d. per probe.

KG687 Solid State Sweep/Marker Generator
Silicon transistors. Covers all colour/monochrome TV, FM, IF and VHF frequencies. Sweep oscillator covers 3 to 220 MHz on 5 fundamental bands. Marker oscillator covers 2 to 225 MHz on four bands. Complete kit: £54.2.6. Postage 15s. 0d.



KG663 Regulated 0–40 Volt Solid State DC Power Supply Kit
Compact. 6 silicon transistors. 12 diodes. Output voltage and current 0–40V DC, 0–1.5 A, continuously variable. Complete kit: £40.19.6. Postage 10s. 0d.

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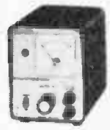
Compact and rugged. 4 silicon transistors. 7 diodes. Voltage output 0–25 volts DC, at 0–0·5 amp. Complete kit: £15.6.6. Postage 10s. 0d.



KG686 Lab. Quality RF Signal Generator
100 kHz/1 MHz Crystal Calibrator. 10 silicon transistors. 6 diodes. Frequency coverage 100 kHz to 54 MHz. Accuracy ± 1.5% on 5 fundamental bands. Complete kit: £39.13.6. Postage 15s. 0d.

KG688 Solid-State Sine/Square Wave Generator Kit
Sine Wave: 20Hz to 2 MHz in 5 ranges. Square Wave: 20 Hz to 200 kHz in 4 ranges. Precision Sulzer oscillator circuit. All silicon transistors: Complete kit: £36.5.6. Postage 10s. 0d.

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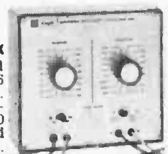
Covers all frequencies from 1.5 to 300 MHz in 6 overlapping ranges. Extremely compact. Supplied with 6 coils in plastic case. Complete kit: £12.15.6. Postage 4s. 0d.

KG675 R & C Substitution Box
Eliminates need for soldering and resoldering when substituting. 36 switch-selected Resistance Ranges. 19 Switch-selected Capacitance Ranges. 750 mA 800 PIV Silicon Diode. 40 mfd 450V Capacitor. Complete kit: £7.19.6. Postage 7s. 6d.



KG650 RF Signal Generator Kit
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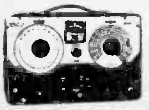
TE-20RF SIGNAL GENERATOR

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.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

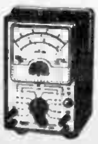
2 pF–2,000 mFd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. **Brand New £17.10.0** Carr. 7/6.

ARF-100 COMBINED AF-RF SIGNAL GENERATOR



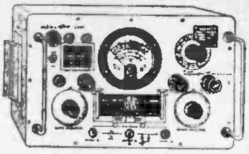
A.F. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P **HIGH IMP. 21V.** P/P600 Ω 3·8V. P/P. TF 100 Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C. £30.0.0. Carr. 7/6.

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



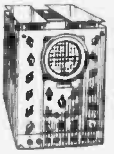
10 meg. input 10 ranges: .01/·003/·1/·3/1/3/10/30/100/300V. R.M.S. 4cps.–1·2 Mc/s. Decibels —40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0 Carr. 5/-.

AVO CT.38 ELECTRONIC MULTIMETERS



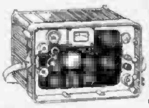
High quality 97 range instrument which measures A.C. and D.C. voltage. Current. Resistance and Power Output. Ranges D.C. volts 250mV–10,000V. (10 megΩ–110 megΩ input). D.C. current 10μA 25 amps. Ohms: 0–1,000 megΩ. A.C. volt 100mV–250V (with R.F. measuring head up to 250 Mc/s) A.C. current 10μA–25 amps.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

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



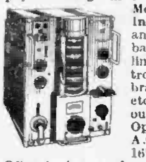
An excellent general purpose D/B oscilloscope. T.B. 2 cps.–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £15. Carriage 30/-.

AM/FM SIGNAL GENERATORS



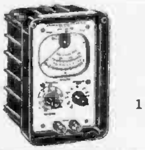
Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM/CW/Fm Incorporates precision dial, level meter, precision attenuator 1μV–100mV. Operation from 12 volt D.C. or 0/110/200 250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new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

ADMIRALTY B.40 RECEIVERS



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

MARCONI CT44/TF956



AF Absorption Wattmeter

1 μ/watt to 6 watts. £20 Carr. 10/-.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions. Model 47A £9 19 6. P. & P. 7/6.

CLASS D WAVEMETERS

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

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0/115/230v. Step up or step down. Fully shrouded.

150 W.	£1 12.6.	P. & P. 3/-.
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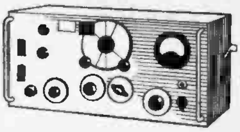
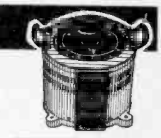
1,000 W.	£5.10.0.	P. & P. 7/6.
1,500 W.	£6.10.0.	P. & P. 8/6.
3,000 W.	£7.10.0.	P. & P. 12/6.
7,500 W.	£15.10.0.	P. & P. 20/-.

MARCONI TEST EQUIPMENT



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

Variable Voltage TRANSFORMERS



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

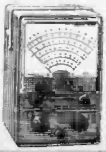
ADVANCE D.1 SIGNAL GENERATORS

A high quality U.H.F. signal generator covering 10–310 Mc/s. Operates on 200/250 volt A.C. Supplied in excellent condition complete with calibration charts. £15. Carr. 15/-.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

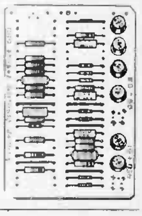
Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads, £16.10.0. Carr. 7/6.

TE-65 VALVE VOLTMETER



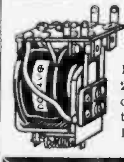
High quality instrument with 28 ranges. D.C. volts 1·5–1,500v. A.C. volts 1·5–1,500v. Resistance up to 1,000 megohms. 220/240v. A.C. operation. Complete with probe and instructions £17.10.0. P. & P. 6/-. Additional probes available: R.F. 35/-. H.V. 42/6.

PRINTED CIRCUITS



Five asstd. boards with transistors, diodes, resistors, condensers, etc. Guaranteed min. 20 transistors. Ideal experimenters. 5 for 10/-. P. & P. 2/-.

OMRON MK2 RELAYS

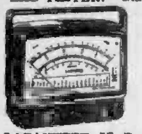


Brand New and Boxed. 24V. D.C. coils. 2 Pole changeover. 5 amp. contacts. 7/6 each. P. & P. 1/6.

G. W. SMITH & CO (RADIO) LTD
3-34 Lisle Street. W.C.2
Also see opposite page

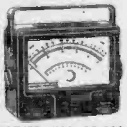
MULTIMETERS *for EVERY purpose!*

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

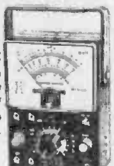


TE-900 20,000 Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0. 2·5/10/250/1,000/5,000v. A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C. 0/50μA/110/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. £15. P. & P. 5/–.

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

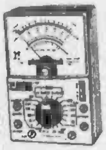


MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10μA/6/60/300mA/12 amp. 0/2K/200K/2M/200M Ω. —20 to +17dB. £12.10.0. P. & P. 3/6.

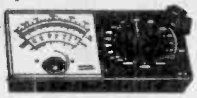


NEW MODEL 500 30,000 O.P.V. with overload protection, mirror scale. 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg./60 Meg Ω. £8.17.6. Post paid.

MODEL AF-105. 50K Ω/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/100M Ω. —20 to +17dB. £8.10.0. P. & P. 3/6.



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

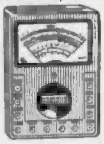


MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6 Meg./60 Meg. Ω 50pF. 0·2 mFd. £5.19.6. P. & P. 3/6.

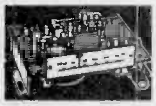
MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 Meg Ω. £5.10.0. P. & P. 3/–.

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

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



★ 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 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiplex adaptors 5 gns.

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VM.76 VALVE VOLTMETER R.F. measurements in excess of 100 Mc/s and D.C. measurements up to 1000V. with accuracy of ±2%. D.C. range 300 MV to 1 KV. A.C. range 300 MV to 300 V RMS. Resistance ·02–500 M Ω. Price £72.

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

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

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

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

TT1S TRANSISTOR TESTER £37 10.0

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Z12 12 watt amplifier, 89/6
PZ4 Power Supply Unit 89/6
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
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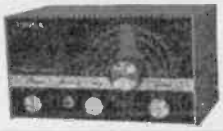
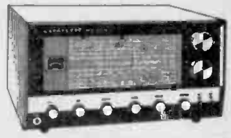
UNR-30 4-BAND COMMUNICATION RECEIVER



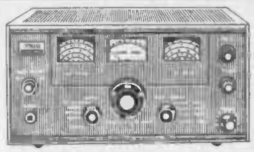
Covering 550 Kc/s–30 Mc/s. Incorporates variable BFO for CW/SS/B reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

LAFAYETTE SOLID STATE HA600 RECEIVER



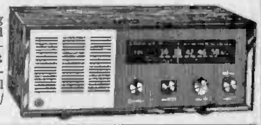
5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE. 150 Kc/s–400 Kc/s and 550 Kc/s–30 Mc/s. F.E.T. front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limiter ● S meter ● 24 in. Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8½in. Weight 18 lbs. **EXCEPTIONAL VALUE.** £45. Carr. 10/–. S.A.E. for full details.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



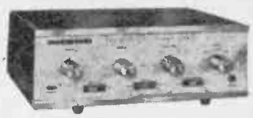
4 band receiver covering 550 Kc/s to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7×15×10in. With instruction manual and service data. £39.15.0, carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally £5.19.6. **OUR PRICE £3.15.0** if purchased with above receiver.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER



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

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



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

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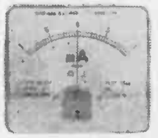

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100μA	35/-	1-0-1mA	25/-	150mA	25/-	500V. D.C.	25/-
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200μA	31/6	5mA	25/-	300mA	25/-	15V. A.C.	25/-
500μA	37/6	10mA	25/-	500mA	25/-	50V. A.C.	25/-
		750mA	25/-	3V. D.C.	25/-	150V. A.C.	25/-
		1 amp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

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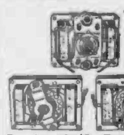
GARRARD TAPE MOTORS



Brand new stock as used by famous manufacturer. 200/250V. A.C. Capstan motor 15/–. Fast Forward 10/6. Fast Rewind 10/6. P. & P. 3/–. Set of three motors 32/6. P. & P. 5/–.

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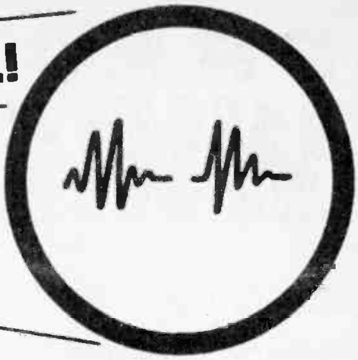

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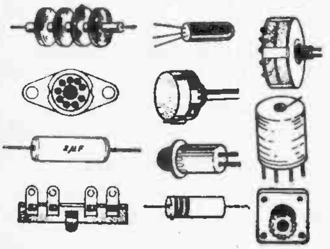

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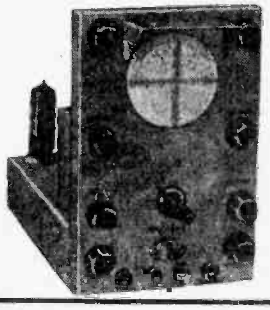
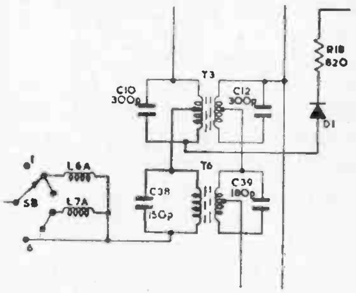


3 READ and DRAW and UNDERSTAND CIRCUIT DIAGRAMS



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PRACTICAL WIRELESS

VOL 44 No 9

Issue 743

JANUARY 1969

TOPIC OF THE MONTH

State-of-the-Art

SEMICONDUCTORS personify the modern image of radio and electronics, even for the home constructor, yet on looking back over the years some quite surprising facts emerge. We can, in fact, go back to Munk Af. Rosenshold who in 1835 discovered that certain solid substances possessed rectifying properties. As is so often the case, he was in advance of his times and the idea lay dormant until rediscovered by F. Braun in 1874.

A year before this, a checker working on underwater telegraph cables noticed that the resistance of a certain material varied according to the light falling on it. The material was selenium and three years later it was discovered that this material possessed the property of rectification.

These facts lay virtually untapped until the turn of the century when, strangely enough, thermionic valves and what we now call semiconductors vied with each other for popularity. For many years, however, it was the semiconductor which reigned supreme and it is interesting to note that in 1906 Pickard invented a silicon detector for use in wireless equipment, a device which was in fact a point-contact rectifier. Three years later Eccles devised a crystal diode oscillator. Later, in 1924, Lossev achieved oscillations with semiconductor diodes.

During the late 1920's and the 1930's the thermionic valve ousted semiconductors but during World War II crystal detectors were widely used in radar equipment. Then in 1941 came another landmark—the invention of the junction diode—and the way lay open for a remarkable comeback of semiconductors.

In December 1947, Bardeen and Brattain produced in the Bell Telephone Laboratories a crude prototype of a crystal triode and this device, named the transistor, was the one which can be said to have administered the *coup de grace* to the future of thermionic valves. From this starting point sprang the junction transistors and other modern semiconductor devices, leading to the integrated circuits now beginning to become a vital factor in the progress of radio an electronics.

The age of the solid state can, therefore, be said to have really begin 21 years ago, and in saluting the many pioneers who have made this possible we celebrate the occasion with a special feature starting on page 664.

W. N. STEVENS—*Editor*.

NEWS AND COMMENT

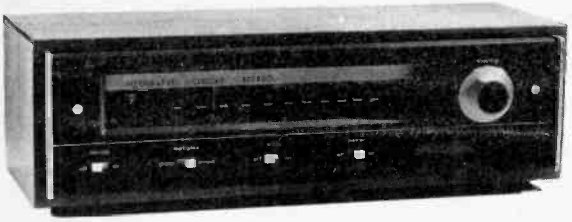
CONSTRUCTIONAL

OTHER FEATURES

FEBRUARY ISSUE WILL BE PUBLISHED ON JANUARY 10th

NEWS AND COMMENT...

TRUVOX INTEGRATED CIRCUIT STEREO TUNER



The first British f.m. stereo tuner using integrated circuits and field-effect transistors has been introduced by Truvox Ltd. (of Hythe, Southampton).

Designed from the outset specifically for stereo reception (mono reception is of course automatic when stereo is not being received), the new model is designated the Truvox Series 200 IC Stereo Tuner. It joins the recently introduced Truvox Series 200 range; hi-fi amplifier, tuner, loudspeakers, mono and stereo tape recorders.

Sensitivity is 2·0/μV for 30dB quieting IHFM, 1·5/μV for -3dB limiting, 5·0/μV for 200kc/s bandwidth. Frequency response is: 20c/s to 15kc/s$\pm$1dB before de-emphasis and steep notch filters. Price is £59 10s. 0d.

ISWC ANNIVERSARY 1929–1968

Surely something to celebrate. The existence of the ISWC for 40 years. The ISWC image was created on 4th October, 1929, by a little band of short wave enthusiasts in the USA, among them Arthur J. Green, Jacob Kleimans, Joseph B. Session, Charles Schroder and George F. Brooks. To form a medium for the exchange of short wave station information and a contact among those who were interested. Short wave radio was a new thing. There were only a few experimental stations on the air. No one had ever thought to publish news on short wave stations. It was essential for the listeners who were interested to have some information on the stations that were to be heard if they were to have an equal chance of hearing them, for there was no other guide. No other short wave clubs. No World Radio Handbooks. No Sweden Calling DX-ers or the like. No DX Parliament or European DX Council. ISWC were publishing International Short Wave Radio and membership was spreading across the world, bringing with it a greater exchange of information and the fostering of international friendship through short wave radio and the ISWC. ISWC is a non-commercial organisation end for those who work for it, it is a labour of love.

RODING BOYS' SOCIETY: HOLLOWAY BRANCH

The active boys' Radio/Science Club based in Walthamstow, and known as the R.B.S. has a group going in the Holloway area now. Any keen young people in this area who would like to join in helping to build up the club room and facilities, are very welcome to contact us. Please write or call: David Huntly, 262 Hornsey Road, N.7.

Any boys in the other area (Waltham Forest) are, of course, very welcome to visit the Club there. Any enquiries concerning the Society can be sent to: Ken Smith, G3JIX (Leader), 82 Granville Road, Walthamstow, E.17.

RADIO 2 COVERAGE IN SCOTLAND

On 1st October the BBC opened two additional transmitters, at Dundee and Redmoss (Aberdeen) transmitting Radio 2 on 202 metres (1484kc/s). The cities of Dundee and Aberdeen, and their environs, are served by the new transmissions.

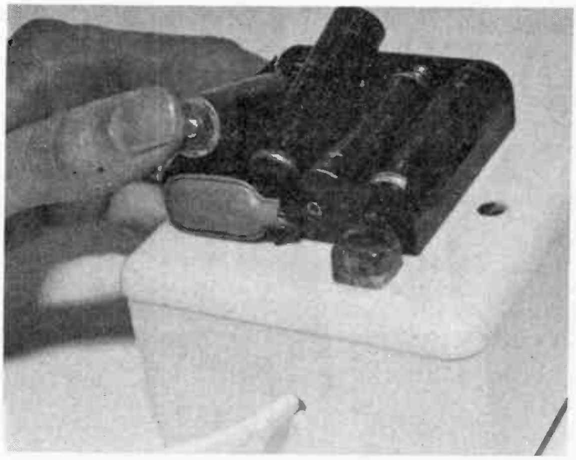
On the same date the wavelength of the existing Radio 3 transmitter at Dundee will change from 194 metres (1546kc/s) to 188 metres (1594kc/s).

The new transmitters at Dundee and Redmoss will join the existing stations at Edinburgh and Glasgow on 202 metres in augmenting the medium-wave coverage of Radio 2 in Scotland. The Edinburgh and Glasgow transmitters were recently increased in power to provide further improvements in the service. These four stations offer good reception of Radio 2 to many listeners who have difficulty in receiving the long-wave transmissions on 1500 metres (200kc/s) from Droitwich.

NEW RADIO 1 TRANSMITTER

On 3rd November the BBC opened a new Radio 1 transmitter to serve the Bournemouth area, on 202 metres (1484kc/s). This transmitter extends the coverage of Radio 1 to Bournemouth and Poole and their environs bringing the number of Radio 1 transmitters to seventeen.

PUT ON A CHARGE!



A low-priced battery charging system called "Pencel" is announced by DCB Instrument & Lighting Company of Austin House, Croft Road, Crowborough, Sussex.

Recent field tests have demonstrated that the MN 1500, the popular battery in the transistor radio and photographic fields, can be recharged between ten and thirty times (depending upon operation conditions) by the "Pencel" Battery Charger.

As a replacement set of alkaline manganese 1500 type cells costs 11s. and has a limited life in a transistor radio, it is apparent that the initial outlay of 79s. 6d. which includes four alkaline manganese 1500 type cells, is soon recovered. For further details contact DCB Instrument and Lighting Company, Austin House, Croft Road, Crowborough, Sussex.

NEWS AND COMMENT...

HOME ELECTRICIANS KIT

The new Bib Home Electricians Kit comprises of the new Model 5 self-opening wire stripper and cutter, a reel of insulating tape, 5 and 15 amp fuse wire, Ersin Multicore match melting tape solder (no soldering iron required), two Bib flex shorteners, for shortening leads and cables without cutting, and plug size screwdriver to suit all types of domestic plugs. Price is 14s. 6d.

GET IT TAPED LADS!

Philips Electrical have invited Britain's half-a-million Scouts to take part in a £1,000 tape recording contest.

Trips to Holland, tape recorders and accessories and special tours of recording studios are among the prizes offered. Cub Scouts (8–10 years), Scouts (11–15 years), Venture Scouts (16–20 years), adult leaders and regular supporters are all catered for in the various sections of the contest.

Typical recording assignments asked for by the organisers are: a tape-recorded report of an expedition, a dramatic or musical item including pop and folk music, a series of sound effects, a message for Scouts overseas and interviews with local personalities.

Entries have to be between three and five minutes' duration and recorded at $1\frac{7}{8}$ or $3\frac{3}{4}$ inches per second. Closing date is 1st March, 1969. Entry forms are available from all major Philips agents and Gilwell Park International Adult Leader Training Centre, Chingford, London, E.4.

CONCRETE-TRANSISTOR??

A "concrete-transistor" developed at the USSR Institute for Industrial Concrete Structure and Goods Prefabrication is employed at leading Soviet enterprises for reinforced-concrete element prefabrication. It is designed for controlling the strength and homogeneity of steel-concrete elements and structures and can be used for the defectoscopy of wood, ceramics and other building materials.

The instrument measures the rate of the diffusion of longitudinal ultrasonic waves in the material under investigation; quality can also be appraised by the magnitude of these waves. Errors in determining the strength of concrete lie within a narrow range, as compared with the results of compression tests by mechanical methods.

The measuring principle employed in the circuit does not require the use of an electron-beam oscillograph which is essential for measuring the time of supersonic diffusion. The system of discrete time count makes lower demands on the operator and precludes objective errors.

MW-DXers PLEASE NOTE

If you are interested in medium wave DX, please note that the fifteenth series of Medium Wave News is now being published. Issued to subscribers monthly from November to April, plus an extra one in June, this newsletter is packed with comprehensive and up-to-date news of medium wave DX happenings. It includes as regular features, the monthly DX log, World of Radio and Verification Section, together with such articles as Antenna Forum, Reception Analysis and other information features. This publication is essential for the keen MW-DX fan. Details from K. Brownless, 7 The Avenue, Clifton, York, YO3 6AS. Please enclose a s.a.e. Please note that we are starting our MW Column on page 710.

GERMAN STEREO

Two new mains operated stereo record players are announced by Bruns of Hamburg, Germany. They are model SH 41 St with a manual 4-speed deck and model WH 50 St with 4-speed autochange deck (see photograph). Double wide frequency response transistorised amplifiers feed separate $6\frac{1}{2}$in. speakers through individual gain and tone controls. Output is 2×2 watts. The speakers are neatly housed in the twin cabinet lids. Dimensions: $17\frac{1}{4} \times 10 \times 5\frac{1}{2}$in. Finish is dark walnut. Recommended retail prices: SH 41 St 30gns. (inc. P.T.); WH 50 St 40gns. (inc. P.T.)

OTLEY RADIO SOCIETY

Meetings are held every Tuesday evening at our own premises in Otley. The Society has its own call sign —G3XNO—which is on 160 metres every Tuesday evening. Four members recently passed the Radio Amateurs' Examination and are now learning morse while another nine members are running an RAE course for next year's examination.

On 10th September we held an open evening welcoming wives and friends of members, forty people in all being present. Members had been making radio and electronic equipment for several months to enter the Construction Competition which was judged by three visitors during the evening. The winner of the senior section was K. Pickard with an Electronic Time Switch with Binary readout, and in the junior section P. Fox with a Transistor Stereo Amplifier.

Further details about the Society are available from the Publicity Officer, M. T. George-Powell, G3NNO, 82 Forest Avenue, Starbeck, Harrogate.

THE SOLID STATE

by I. R. SINCLAIR

PART 1

IT is now almost exactly twenty-one years since William Shockley, working at the Bell Telephone Laboratories, announced that he had constructed the first working transistor. In the intervening years that primitive point-contact laboratory curiosity has grown into a precision device produced in millions, and has bred a host of newer devices, including f.e.t.s, thyristors, tunnel diodes and diode lasers all of which were undreamt of only twenty-one years ago.

That discovery did more than produce a new device, a new technology and a new industry: it brought to the attention of everyone the remarkable advances in a branch of physics which had up till then been the province of a few researchers—the physics of the solid state. Those of us who had been familiar with the ideas of vacuum physics and their application in thermionic valves suddenly had to accustom ourselves to talking of holes, lattice defects, impurity conductivity, traps, tunnelling and all the rest of the language which solid state electronics developed. Since then it has been as much as electronics engineers could do to keep up with the circuit behaviour of new devices without having to cope with their theory of operation.

The time has come, however, when it is more and more difficult to understand the newer devices without at least a smattering of such understanding. The physics which we learned at school is of little use to us in this connection: even at "A" level it deals with very little which was not known in 1850. We must now learn the physics which has developed in this century, containing ideas which seem so strange as to be almost unbelievable but whose proof is all around us.

Electronics may be said to have started with the discovery that atoms, the basic units from which all substances are made, can be split into *nuclei*, which are heavy and positively charged, and *electrons*, which are light and negatively charged. Before the end of the nineteenth century it had been shown that electrons were the same as the "cathode rays" which had been observed in gas discharge tubes, and their important properties, attraction to a positive plate and repulsion by a negative one, deflection by a magnet, heating a substance struck by them and fluorescence in certain minerals, were all well known.

At that time the atom was thought to consist of a core, the nucleus, with the electrons clinging to it tightly, but the work of Rutherford and others (including Geiger, of Geiger-Müller counter fame) showed that the structure behaved much more like a very small positive core, the nucleus, surrounded by electrons at a distance very large compared with the diameter of the nucleus (about 100,000 times). The nucleus was positively charged and the number of negatively charged electrons was just enough to balance the positive charge on the nucleus.

The problem which next arose was why the atom did not collapse due to the attraction of the positive nucleus and the negative electrons. The most obvious answer was that the electrons were spinning round the nucleus at such a speed that the centrifugal force exactly balanced the electrical forces, but this still did not explain why the electrons should not gradually spiral into the nucleus, just as a weight tied to a string and revolving round a pole gradually loses energy and moves in "ever decreasing circles" in the manner of the legendary oozlem bird.

This puzzle was solved by a series of guesses. Anyone can guess, but it takes a genius to guess correctly in matters of this sort, and the guessers in this case were called Planck, Bohr and Sommerfield. In 1900 Planck had put forward his Quantum Theory which implied that *everything* was atomic, and that there were atoms of light, electrical and mechanical energy, and all radiated waves. These "atoms" of light and radiation he called "quanta". One quantum, he thought, was the least amount of energy change which could take place. At first sight this did not seem reasonable; it was like saying to an electrical engineer "You may have supplies of 200V, 220V, 240V etc., but never 210V, 230V etc." Nowadays we are accustomed to the idea of quantities varying in steps: we have tapped transformers, wire wound potentiometers, preferred value resistors, and although these are large steps the idea is there. The quantum is a *very* small amount of energy ($6{\cdot}6 \times 10^{-27}$ erg/sec.) and our senses could hardly distinguish such small steps of energy from a smooth change. When we are dealing with atoms, however, the difference is important, and we must use the quantum theory. The quantum theory was extremely successful: it explained exactly the relation between the energy of radiation and the temperature of the radiating object, and was used by Einstein

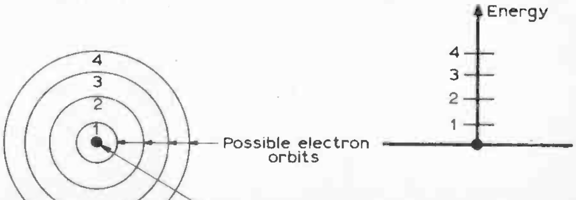


Fig. 1: Possible orbits and energies of an electron.

to explain photoemission—the idea being that one quantum could eject only one electron from a substance.

When Bohr and Sommerfield applied quantum theory to the atom (Fig. 1) they used the principle that the energy of an electron could only be one of a series of energies or energy states which were each a quantum of energy apart. This idea, dating from 1915, is one of the most important principles in physics. In its later form of Quantum Mechanics it has explained and led to the construction of such devices as masers, lasers and transistors in the field of electronics alone.

One more point remains before we can move on to the problems of solid state physics. Experiments in 1927 showed that beams of electrons could behave exactly like beams of short-wave light, and that there was a direct connection between the energy of the electron beam and its apparent wavelength. Mathematicians later showed that the same equations which were used to describe light and other forms of radiation could also be used to describe electrons, and this approach, founded by de Broglie and Schrodinger, has been immensely useful in work on the theory of solids.

PROBLEMS OF SOLIDS

To any physicist of the last century the structure of solids seemed to be one of the most difficult of all problems and one least likely to be solved. It was generally agreed that the difference between solids, liquids and gases was one of the spacing between the atoms, the atoms in liquids being rather farther apart than in solids, and the atoms in gases much farther (ten times) apart. This was sufficient to explain such matters as boiling and freezing and latent heat but many others could not be explained.

Among the inexplicable problems was electrical conductivity. If we compare the electrical conductivity of different solids, the most striking fact is the huge range of values. The conductivity of the best conductor at room temperature (silver) is about 10^{30} (a short way of writing the figure 1 followed by 30 zeroes) times the conductivity of the poorest (p.t.f.e.), yet both these substances are solids, made of atoms which are constructed of nuclei and electrons. If, as we believe, electrons are the means of carrying electric current in solids—and they certainly are in gases (at low pressure)—why is there this difference, which is the greatest span of difference in all measurable quantities?

Solids also differ greatly in their ability to conduct heat. Schoolboys used to be taught that a good electrical insulator was a good heat insulator, but experiments on the conduction of heat at low temperatures showed that sapphire crystals were better conductors of heat than any metals, though they were electrical insulators.

These questions were difficult enough, but there were many other curiosities to explain. Why should certain metals and alloys be strongly magnetic though the remainder of solids were only very weakly magnetic? What was so special about the arrangement of atoms which decided whether a substance was a metal or a non-metal? Why did some crystals (such as quartz) vibrate in an alternating electric field? These and scores of other questions had to be explained by any theory of the solid state.

BAND THEORY OF SOLIDS

The simplest possible case of atomic structure is the structure of hydrogen gas, whose atom consists of a nucleus with one electron. Simple here is a comparative term; neither the physics nor the mathematics of the problem is simple, but the basic ideas can be simply described. The electron belonging to one nucleus can have various possible values of energy but *no intermediate values* (Fig. 2). At room temperature most of the electrons are in the

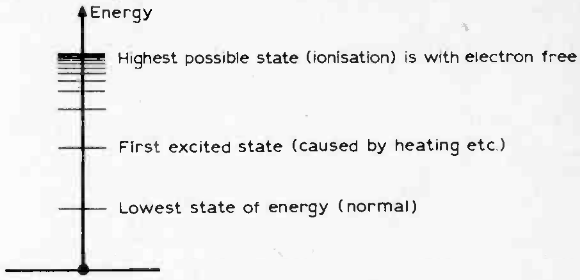


Fig. 2: Energy diagram for one electron in an atom. Note how the levels become crowded together until separate levels become indistinguishable when the electron is free (atom ionised).

lowest state of energy, but by very great heating or by the effect of light or electric current electrons can be made to have higher energies. Note particularly that they must change instantly from one energy value to another without ever having any intermediate value, and the amount of energy used to cause this change must be exactly the difference in energy between the two states. When electrons return to the normal low state, this energy is given out; in most cases this appears as light of a definite wavelength.

When we examine more complex atoms we find the same type of structure—a nucleus surrounded by electrons—but it turns out that there is a special restriction on the way electrons can be arranged. If we take a given energy level, which for convenience is described by a set of "quantum numbers" which act as map references, we find that only two electrons can occupy a level, and even these two are not identical in energy because they spin around their own axis in opposite directions. We may imagine the system as a ladder with the nucleus at the foot and two electrons on each rung (though the laws about the spacings of the rungs are rather more complex) so that electrons can climb up the ladder when a suitable amount of energy is put into the atom, and fall to the lowest unoccupied rungs when left alone, releasing energy in this process.

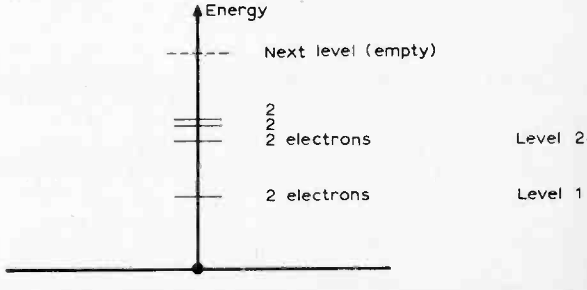


Fig. 3: Energy diagram for a nucleus with eight electrons (oxygen). Note that level 2 is split into three sub-levels each containing the maximum two electrons allowed.

This picture of the structure of a substance (Fig. 3) works well for gases, where the atoms are so far apart that each nucleus affects only its own electrons. In a solid, however, the atoms are so close that there is a considerable amount of interaction between one nucleus and the electrons belonging to the neighbouring nuclei, and this interaction holds the clue to the differences in the behaviour of solids. To deal accurately with the interactions of just two atoms is a problem in mathematical analysis of the greatest difficulty; to describe accurately the behaviour of millions of atoms is impossible, but a combination of experiment and theory has enabled us to arrive at ideas of solid structure which have fulfilled the most important test—that they work. The theory is called the *Band Theory of Solids.*

If we take two atoms at a considerable distance, each with its electrons arranged in their appropriate energy levels, and then force the atoms together, the energy levels do not remain unchanged. Instead the attraction of each nucleus for the other's electrons causes the levels to be displaced in such a way that a range of energies is possible for the electrons which formerly occupied the various levels in the two atoms (Fig. 4). When this happens, we refer to each range of energies as a *band.*

When a large number of atoms is arranged in a regular way in a crystal of a solid the bands of energy are fairly wide and contain a large number of electrons. If the energy levels of each atom which has contributed to the band are completely occupied by electrons then the band also will be completely occupied.

However, if the energy levels are *not* filled either because the atom naturally had these levels unfilled or because the electrons have moved to a higher level because of energy changes, then the band formed by the atoms coming together will also not be filled. In general if a band is formed from a given number of atoms then it will be full if it is occupied by exactly twice that number of electrons.

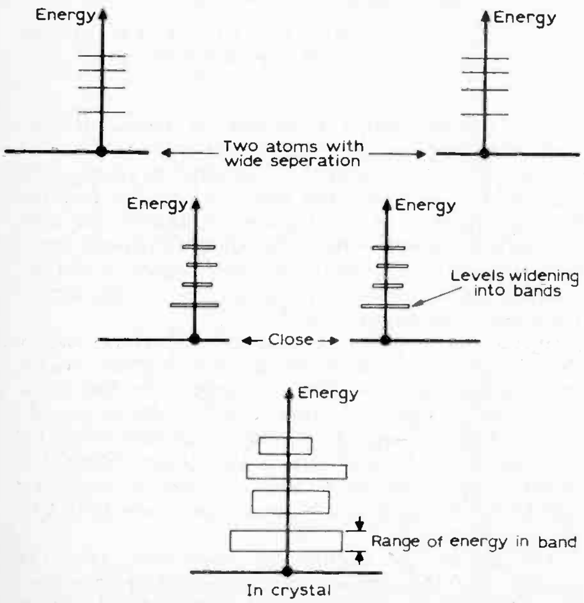


Fig. 4: How the energy levels broaden into energy bands as atoms approach.

There is a vitally important difference between a filled band and an unfilled band. When a band is filled, there is no possibility of electrons moving from one nucleus to another. A full band is like a road completely jammed with cars; unless some gap occurs, no movement is possible except some shunting. In a band which is not filled, however, there is no restriction on electron movement. There is no change needed in energy for an electron to move from one nucleus to another, providing that there is not another electron of the same energy there, and in an unfilled band there need not be. When this occurs, then the solid is a *conductor* of electricity. A metal could, in fact, be defined as a substance containing unfilled energy bands. Conversely a substance with its energy bands completely filled is an *insulator.* If we heat such a substance sufficiently we can give the electrons sufficient energy to move to a new band which is unfilled, so causing the insulator to conduct, a fact which is known and used.

ENERGY GAPS, OVERLAPS, HOLES

The theory that the energy levels of single atoms merge with each other to form bands does not ignore the differences in energy between different levels in the same atom. When atoms come together, the energy bands may still be separated from each other—our ladder rungs may have become sloping platforms—but there may still be a jump from the top end of one platform to the bottom end of another. In some substances, however, the bands may overlap, allowing electrons which had been at the lowest level in one atom to reach a higher level of another with no jump. There may on the other hand be large gaps between the bands, and no electron can ever have an amount of energy corresponding to an amount in a gap, just as no one can stand on a rung which is missing! If the gap between bands is large a large amount of energy (heat, light etc.) must be put into the substance to move electrons from one band to another; if the gap is small, very little energy is needed.

This then is the difference between insulators and semiconductors. Both have filled energy bands, but higher energy bands exist which are empty. In an insulator the gap between the top filled band and the empty band is large; in a semiconductor this gap is small and even at room temperature a few electrons can make the crossing to the unfilled band to cause some degree of conductivity.

This is not the whole story, however, as it turns out that electrons in the unfilled band do not form the only contributor to conductivity. Since the electrons have come from a filled band they have caused vacancies in this formerly filled band allowing some movement in that band; i.e. gaps have appeared in our traffic jam. Since it is easier to think of one gap moving in a band rather than millions of electrons shuffling around, we talk of this gap or *hole* as if it were an object with mass and a positive charge, and in fact it behaves as if it were just this (Fig. 5).

The contributions of holes to conductivity were discovered by measurement of the Hall effect, which was predicted in the last century. If current is

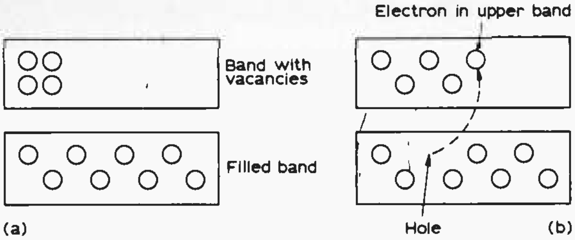


Fig. 5: How a hole is formed in semiconductor material.

passed through a slab of material to which a magnetic field is applied at right angles to the direction of current, the electrons moving in the material are deflected in exactly the same way as the electrons in a cathode-ray tube are deflected by a deflection coil (Fig. 6). This deflection causes one side of the slab to be more negative than the opposite side because of the deflection of electrons to that side. The voltage difference is extremely small so that *accurate* measurements of Hall effect were not possible until comparatively recently, but it is detectable and the predicted negative voltage can be found in several metals. In other metals, however, the voltage is *positive*, indicating that the charge carriers are either positive or moving in the opposite direction.

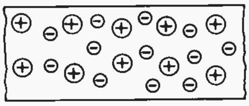
It is sometimes argued that holes are not real particles having mass and charge and that it is misleading to write as if they were. Such fictions are often desirable, however. Electrons in semiconductors often respond to voltages as if they had less mass (even negative mass, if such a thing can be imagined) or charge than normal free electrons and it is easier to keep the usual equations of movement and use the effective mass or charge of the electron as if it were real. In the same way, the hole is a convenient way of treating a problem and for practical purposes it is no less of an experimental reality than is the electron.

SEMICONDUCTORS

In a pure specimen of semiconductor crystal there is a vacant energy band which is only slightly separated from a full band. The gap between these bands varies from one material to another (and is less in germanium than in silicon) but is small enough to allow some electrons to be kicked into the vacant band even at room temperature. Increasing the temperature of the crystals causes very many more electrons to cross over so increasing the conductivity rapidly as temperature rises. It is for this reason that all semiconductor devices are sensitive to temperature changes (as would be valves if they had to work in an atmosphere which was at the same temperature as their cathodes), germanium being more sensitive than silicon because of its smaller energy gap.

Heating a semiconductor increases the number of electrons contributing to conduction and also increases the number of holes since each electron leaves a hole in the otherwise full band. This type of conductivity in pure or "intrinsic" semiconductor crystals is called electron-hole pair production and is not caused by heat only. Electron-hole pairs can also be produced by light (photoconductors) or by radioactive bombardment (radiation detectors). It should be noted incidentally that electrons and holes do not contribute equally to conductivity; the electrons move faster than the holes and so carry a greater share of the current.

What transformed the study of semiconductors into a technology which has changed the whole of electronics is the effect of impurities on the semiconductor crystal. Each germanium or silicon atom in a crystal of germanium or silicon has four electrons in its highest energy level. If we introduce as an impurity among a set of germanium or silicon atoms a material which has *five* electrons in its highest energy level, this causes an excess of electrons in the crystal and so makes for a great increase in conductivity by electrons. The amount of impurity required is very small; one atom of impurity in every hundred million of semiconductor causes the conductivity to increase by a hundred thousand times. In this case we say that the conductivity is *n-type*, because the main or *majority carriers* of the current are *n*egative electrons (Fig. 7).



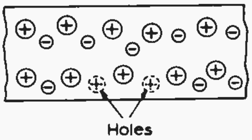
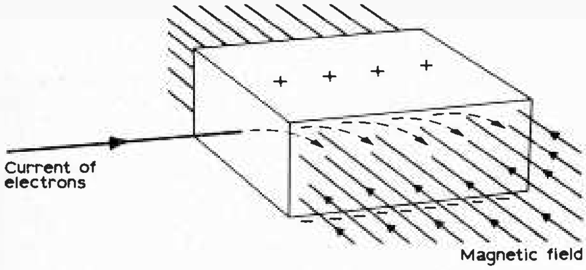


Fig. 7 (left): N-type material has more free electrons than nuclei; a surplus of negative carriers.

Fig. 8 (right): P-type material has fewer free electrons than nuclei—the "holes" will act as carriers (positive).

In the same way the addition of atoms which have only three electrons in the highest energy levels causes gaps—holes—to appear in the semiconductor crystal structure and so increases the conductivity, though by a lesser amount since the majority carriers are now holes. Such material is called *p-type* (Fig. 8) because the majority carriers are the holes which behave as if they were *p*ositively charged particles.

The action of adding the impurities is called doping, and the amount of doping which has been carried out can be measured most accurately by measuring the electrical resistance of the doped material in comparison with an undoped sample.



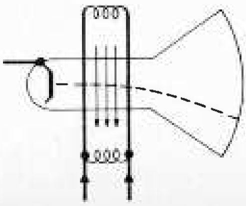


Fig. 6: The Hall effect. A magnetic field (above) causes the path of current in a material to be deflected just as electrons in a c.r.t. (right) are deflected, causing a difference in voltage between opposite sides of the material.

THE DIODE

We are now in a position to understand how a semiconductor diode works. Imagine a single crystal in which one half has been doped to p-type material and the other half to n-type material. This constitutes what is called a p-n junction and may be made by a variety of methods; in fact the main developments in transistors during the last fifteen years have been better methods of creating such junctions. The normal state of such a junction when no bias is applied is shown in Fig. 9, with an excess

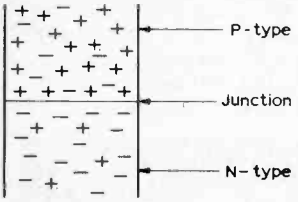


Fig. 9: An unbiased p-n junction. The + and — symbols denote holes and electrons only: nuclei are not shown since they do not transfer but are fixed in the crystal.

of electrons on the n side and an excess of holes on the p side. When a negative bias is applied on the p side and a positive bias on the n side (Fig. 10) the positive holes are attracted towards the negative bias and the negative electrons to the positive bias and the result is that there are practically no carriers left near the junction. This lack of carriers means that there cannot be any movement of carriers across the junction and hence the diode does not conduct; it is said to be *reverse biased*.

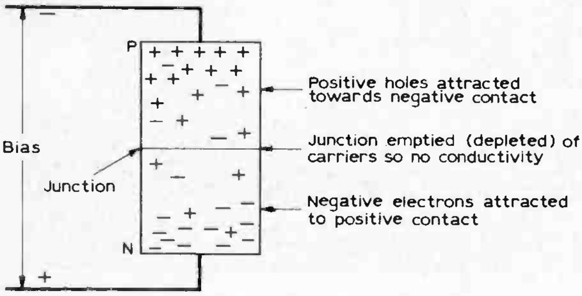


Fig. 10: When a diode is reverse biased as shown here it does not conduct.

As the reverse bias is increased a voltage is reached at which holes from the n region and electrons from the p region can be attracted across the junction and the movements of these carriers causes collisions allowing other pairs of electrons and holes to move. This is the *breakdown* of reverse-biased junctions called the *avalanche* effect; a similar *zener effect* occurs at a sharply defined voltage which is utilised as a stabilised voltage in the zener diode.

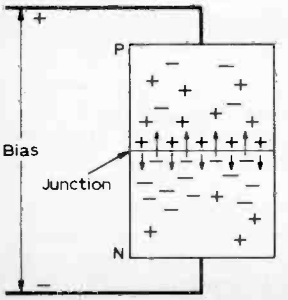


Fig. 11: When a diode is forward biased as shown here current carriers flow across the junction.

When the diode is *forward biased* (Fig. 11) so that the p side is positive and the n side negative both types of carriers move over the junction carrying their charge with them and so producing conductivity. It is important to note that both the p-type and n-type regions must be formed in a single piece of crystal; it is impossible to form an effective diode by putting separate pieces of n and p type material in contact since the atoms can never be made to approach the close spacing which they have in a crystal, and without this spacing the energy bands of the material are quite different.

THE JUNCTION TRANSISTOR

The first transistors made were not junction transistors, nor are all diodes junction diodes. A point contact made with wire of a suitable composition on to a semiconductor crystal can produce a rectifying contact when a large current is passed in what later becomes the forward direction. It is thought that the action is that of transforming some of the metal from the wire into the semiconductor, so producing a doped region around the point contact. Although point-contact diodes behave in essentially the same way as junction diodes, the long-obsolete point-contact transistor differed from the junction transistor in one very important respect; it had current gains of more than unity when operated in the common-base connection, and was extremely unstable in the common-emitter connection. For these reasons and because the commercial production and development of junction transistors was more promising, the point-contact transistor is today a museum piece—a good reminder of the rate of scientific progress.

A junction transistor has three separate and

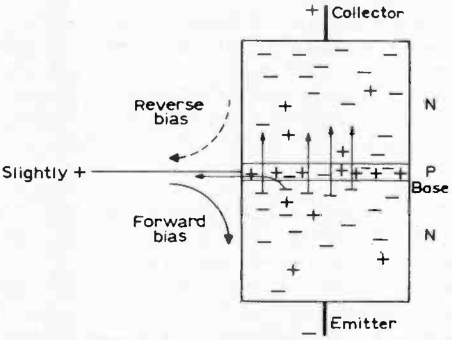


Fig. 12: A junction transistor consists of two p-n junctions back-to-back as shown. When biased as shown here current flows through the transistor.

distinct regions in its crystal. Two regions of similar doping form the bread of a "sandwich" whose meat is a region of opposite doping. The sandwiched region is very lightly doped, compared to the other two regions, and is also very thin, with widths measured in millionths of an inch.

In Fig. 12 the principle of the n-p-n transistor is shown. One n region is designated the emitter and the other the collector, while the middle p region is the base. The emitter and collector could be interchanged for low current work, but commercial transistors are usually built so that the n region designated as collector is better able to dissipate the power of operation.

—continued on page 701

1968 INTERNATIONAL

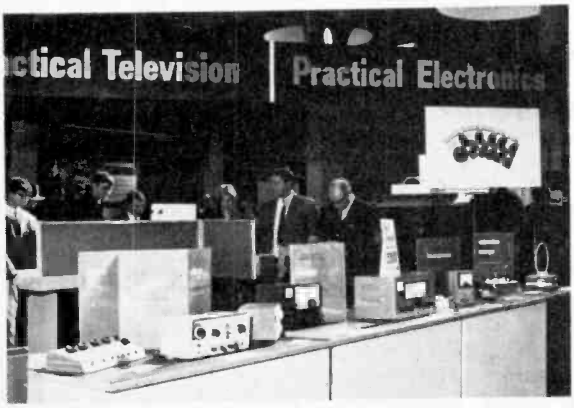
Radio Engineering and Communications Exhibition

THE organisers, sponsors and exhibitors were all pleased at the support given to the 1968 RSGB exhibition at the Horticultural New Hall, London, which ran from 2nd to 5th October. Although attendance figures were some 400 down on last year, more than 8,000 enthusiasts passed through the turnstiles, many of them from overseas. As usual, the exhibition provided a good opportunity to meet fellow enthusiasts and judging by the many groups of amateurs gathered around the stands or chatting over a coffee or glass of beer it still retains the atmosphere of an annual reunion. There was also a series of lectures this year, which were fairly well attended.

The exhibition was formally opened on 2nd October at noon by W. J. Sharpe, CBE, the Director of Communications, Diplomatic Wireless Service, Foreign Office, standing in for the Postmaster-General who was unable to attend due to pressure of business. Mr. Sharpe commented on the very important role that Amateurs can still play in the field of radio communications. We were all more than a little disappointed that the expected announcement on the proposed new Beginners' Licence did not materialise and could get no satisfaction from the GPO.

Exhibitors occupied 38 stands, ranging from component and equipment manufacturers, publishers, associations and Services. The RSGB had the largest-ever display and featured the latest edition of the *Radio Communication Handbook*, a fine new publication which will shortly be reviewed in these pages.

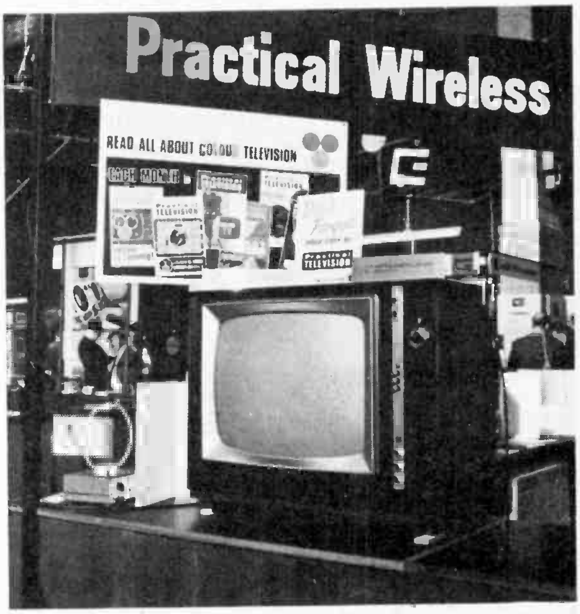
The three *Practicals—Wireless, Electronics* and *Television*—shared a large stand, displaying equipment and providing an opportunity for readers to meet members of the staff. On the P.W. section were previews of various constructional projects scheduled for publication in the near future. These included a new f.m. tuner (to be published in February), a progressive superhet receiver (March), a calibration oscillator (April), a comprehensive audio mixer and a transistor tester. Look out for these on our future-announcement notices.



Here can be seen some of the constructional projects that will be featured in Practical Wireless *in the near future.*

The theme of the *Practical Television* display was "colour television" and this was backed up by an operational GEC 2029A colour receiver, which gave excellent results under often adverse viewing conditions. It was running from an 18-element J-Beam aerial mounted on the roof of the exhibition hall and it was a matter of some surprise that the signals being radiated from the forest of aerials on the roof from the various amateur stations operating throughout the exhibition caused virtually no interference.

Another regular feature of the exhibition was the presentation of awards for various pieces of home constructed equipment in different categories. Those awarded this year were:



Part of the Practical Television *display showing the GEC 2029A colour television receiver.*

The Exhibition Organisers Award (G4KD Plaque), awarded for the best piece of equipment on display went to B. C. Seedle, G3UIT/G6ACJ/T for his four metre a.m./c.w. transmitter and 28Mc/s s.s.b. transverter.

The Horace Freeman Trophy, awarded for the most original piece of equipment went to S. Weber, G8ACC for his solid state 432Mc/s transmitter.

Merit prizes were awarded as follows:

For the best transistorised equipment; C. Sharpe, G2HIF (144Mc/s solid state linear amplifier).

For the best valved equipment; G. R. Jessop, G6JP (The 2-50 transmitter).

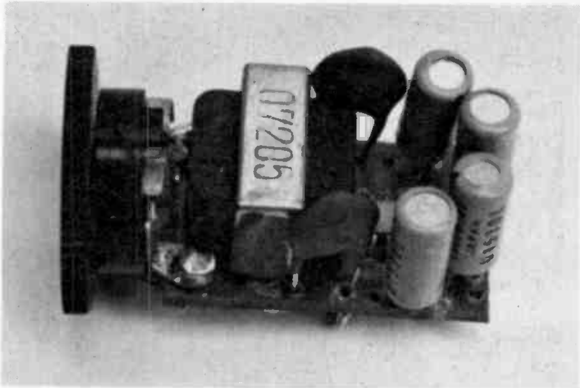
For the best ancillary equipment; C. F. Dorey, BRS16468 (Filter response curve, display unit).

Special Merit Prize for the "Amateur-Amateur"; R. C. Arnold, BRS29738 (All band communications receiver).

We very much enjoyed the show, not only as exhibitors but as an opportunity to meet old friends and make new ones. Thank you, RSGB, and we look forward to another successful exhibition next year.

miniature i. c. hearing aid amplifier

L. Mc Namara B. Sc.



THE use of integrated circuits in amateur equipment is becoming more popular especially since their prices have come more into line with their discrete counterparts. The amateur can now decide to use them on their own merits. Their small physical size, durability and ruggedness make them ideal in applications where they are liable to get rough handling. The present article describes the construction of a miniature hearing aid amplifier which compares in performance and cost with commercial units more than double its size.

CIRCUIT DESCRIPTION

The prototype amplifier was built around a Westinghouse type WC183 integrated circuit. The circuit as shown in Fig. 1 consists of an eight transistor balanced amplifier whose operation can best be understood by considering it as two independent four transistor amplifiers fabricated on a single silicon chip. The input signal is fed to Tr1 which acts as a common-emitter amplifier stage whose output is directly coupled to Tr2 which also operates in the common-emitter mode. Biasing for Tr1 is provided by the d.c. feedback loop from the collector of Tr3 which in turn also provides a certain amount of degeneration or negative feedback since the output of Tr3 is opposite in phase to the input signal applied to Tr1. The emitter of Tr3 will usually be decoupled to earth in a practical amplifier circuit. Direct coupling is also provided between Tr3 and the output transistor Tr4 which in the present design operates in conjunction with Tr8 as a class AB output stage. Tr5, Tr6 and Tr7 operate in a similar fashion and since the whole unit is direct coupled throughout there are no frequency limiting components and the unit can operate well above the audio range of frequencies.

Figure 3 shows the circuit diagram of the complete amplifier. The input from the microphone is fed to pins 3 and 7 of the i.c. via two isolating capacitors C1 and C2. As the input impedance of Tr1 and Tr5 is fairly low the use of a magnetic microphone with an impedance in the range of 10-50kΩ is recommended for really satisfactory operation. If a crystal microphone is to be used an external emitter-follower stage would be needed to provide proper matching.

OUTPUT TRANSFORMER

The primary winding of transformer T1 forms the load for the output pair Tr4 and Tr8, each terminal being bypassed by an 0·01μF capacitor. These help to stabilise the circuit by preventing spurious high frequency oscillations. Choice of output transformer is not critical and any surplus transformer with a primary coil resistance between 100—500Ω will suffice. Its output impedance should match the type of earphone used to ensure maximum efficiency and a crystal earphone was found to work quite satisfactorily with a high output impedance transformer. The transformer specified

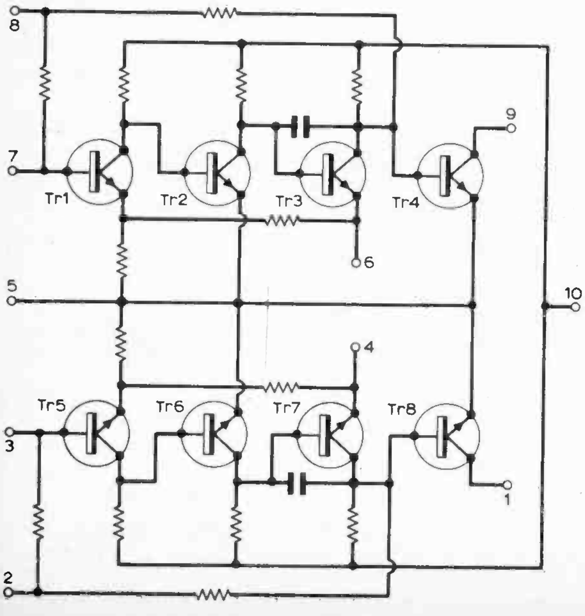


Fig. 1 (left): Complete circuit of the Westinghouse WC183 integrated circuit.

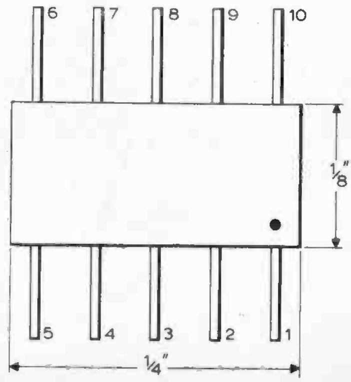


Fig. 2 (right): Physical dimensions and outline of the i.c.—top view of the unit. Lead 1 is identified by the spot of paint adjacent to it.

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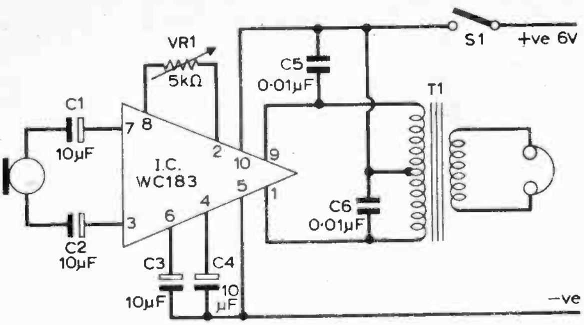


Fig. 3: Circuit diagram of the miniature hearing aid amplifier incorporating the WC183 i.c.

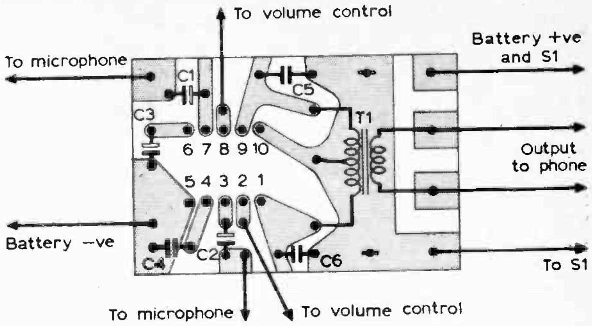


Fig. 4: The printed circuit pattern of the copper laminate board used in the prototype. Actual board size 1 x $\frac{3}{4}$ in.

is a driver transformer used in reverse, i.e. with its primary winding feeding the earphones and its centre-tapped secondary being the load for Tr4 and Tr8.

CONSTRUCTION

The layout for the printed circuit board is shown in Fig. 4. The design should be carefully painted on a piece of copper laminate board 1 x $\frac{3}{4}$in. and then dry etched in the usual manner in a solution of ferric chloride.

As the WC183 i.c. in the flat pack version measures a mere $\frac{1}{4}$ x $\frac{1}{8}$in. great care should be taken in bending its leads to enable them to fit through the mounting holes, and of course these holes must be reasonably accurately drilled to prevent straining the leads.

Some constructors may wish to dispense with the volume control and operate the unit by inserting a fixed value resistor with a modified jack socket acting as an on-off switch. The value of this resistor will depend on the sensitivity of the microphone but its optimum value can easily be found by connecting a 5kΩ variable resistor between pins 2 and 8 and finding the value which just prevents positive feedback. In the prototype the volume control was soldered directly to the copper board through the terminals of the on-off switch.

The unit is quite versatile in its operation and will give very satisfactory results from power supplies between 4·5 and 9V. On a 6V supply it drew 5mA and so small batteries will give a reasonably long operating life. The manufacturers claim for the unit an efficiency in excess of 55% with an overall gain of 90dB.

★ components list

Capacitors:	
C1	10μF 6V miniature electrolytic
C2	10μF 6V miniature electrolytic
C3	10μF 6V miniature electrolytic
C4	10μF 6V miniature electrolytic
C5	0·01μF miniature
C6	0·01μF miniature
Others:	
VR1	5kΩ miniature pot with switch
T1	Type LT44 transformer (Henry's Radio) or any suitable alternative with 100-500Ω primary winding
WC183	Westinghouse linear integrated circuit

The amplifier could also be used as a miniature audio preamplifier and if the two channels are considered as completely separate amplifiers and suitable load resistors are inserted between pins 1 and 9 and the positive supply it could provide a very neat stereo preamplifier. ■

LETTERS...

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

The Beginner's Licence

I read the letter by Mr. Curtiss with a great deal of interest. May I be permitted to add a few comments to redress the balance?

There are a great many people who aspire to holding an Amateur Radio Licence and who would be prepared to study hard to achieve this. At the same time, the conditions under which they live and work may make this aim virtually impossible. For example, people whose work entails shifts or a great deal of travelling precludes their attendance at night classes or even severely curtails the working of a Postal Study Course.

Are we all to be singled out as lazy and illiterate as Mr. Curtiss (whose opinion I respect) would have us believe?

An "easy" licence would do nothing but harm to the Amateur Radio Movement. On the other hand a "Beginner's" licence could do a great deal of good by raising the standard of the RAE and therefore of the Movement as a whole.

Such a licence could be based quite simply on the following terms and conditions:

1. A written examination comprising: (a) The compulsory Section One of the RAE as it exists at present.

(b) Part Two based entirely on (i) Frequency control and measurement. (ii) Interference, types of interference, the causes and the suppression thereof. (iii) Operating Procedure. (Which by the way, may help relieve Mr. Meacham from long dissertations on warts etc!!)

2. The GPO Morse Test.

3. (a) The Licensee to be restricted to a very small part of one of the Amateur Bands. (b) Very low Power Emission (not more than say 2 watts). (c) c.w. telegraphy only. (d) The allocation of a Beginner's Prefix.

4. Closer supervision by the GPO to be paid for by

5. A £3 Licence Fee.

The conditions of such a licence would, by their very nature, urge the willing and genuine Amateur to climb from what could be regarded as a sort of Limbo to the Elysian Fields that the Full Licence permits, while the lazy, the incompetent and the less enthusiastic would fall by the wayside or get sent off the air or just go QRT, rather than scrape up the licence fee for another year.

I could weep tears of caustic soda for poor Mr. Curtiss who, after such a fantastic achievement, does not append either his call sign or the number of his Amateur Radio Certificate! — **"Aspiring GW3"** (*Llanberis*).

Keep the morse test

I must disagree with Mr. Wright's suggestion that the morse test be abolished (November issue). If this came about the result would be hundreds of Amateurs using 'phone only and, as 'phone takes up broader bandwidth, a MORE overcrowded band. Does Mr. Wright want to kill Amateur morse? If he does the result will be chaos with people using c.w. at two words a minute.

I see no reason why the "B" licence should not be extended to cover all bands. Those with the "A" licence would still have the advantage of c.w. operation which is the best form of emission when conditions are bad or bands overcrowded.—**R. A. Dixon** (*Glasgow W.*4).

Anti-loudness

Congratulations on your interesting "Audio Supplement" in the October 1968 issue. Quite correctly you caution readers on the use of loudness controls. I would like to go one step further if I may and ask enthusiasts to avoid them altogether.

Some manufacturers include them on cheaper amplifiers as a sales gimmick but other manufacturers of high quality equipment include a loudness control out of a sincere belief in a misconceived theory. This theory states that because the sensitivity of the ear falls in the lower frequency range, some compensation should be provided which boosts the low frequencies when the volume is reduced.

The misconception is this. If one were at a live concert and moved from a front seat to a back seat in the concert hall the sound intensity would appear to fall with a more noticeable loss in the lower frequencies. Therefore to produce a natural sound a system should give the impression of being at a greater distance from the source when the volume is turned down, without frequency compensation!

With a loudness control one gets the impression of low register instruments being near while the rest of the orchestra is in the distance, which is hardly natural! And the murky obscure sound which results from the use of a loudness control can hardly be called hi-fi. To give a natural sound, which is what is required, the system must give a *natural* tonal balance.

Why then use tone controls at all you might argue? Fair comment, but I would say that tone controls should really be set flat. Any adjustment to compensate for a system deficiency should not cause a deviation from a flat response. Once set for a particular condition they should remain at that setting regardless of the sound level used.—**Iain Smith** (*Rugby*).

Thank you Scotland

Thank you for printing my request for information on converting TVs to oscilloscopes in your "CQ" column in the November 1968 issue. Would you please extend my thanks to an anonymous Scottish reader who sent me some information on how he did it. If he has any further hints or anyone else has any advice I would be glad to hear from them.—**G. Johnson** (3 *Bixley Road, Ipswich, Suffolk*).

I agree

May I fully endorse the views of Jonathan Wates (November issue) regarding the Beginner's Licence.

I too am a keen s.w.l. who is also tied up with "O" level studies, making it very difficult for me to allot enough time to study for the RAE.

I feel that it would be a great help for Jonathan and I, and a great many others, to be given the opportunity to transmit on the Amateur bands, as this would be a *very* good grounding for when we get our full licence.

So, you licensed experts, spare a thought for the volume of our school work before you heartily condemn the Beginner's Licence and all s.w.l.s—**C. Williams, A5376** (*Brierly Hill, Staffs.*).

LETTERS...

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

Modifying V.H.F. portables

My attention has been drawn to the article "Modifying V.H.F. Portables" in your October issue.

British Standard 905 quotes limits for oscillator radiation from such receivers and manufacturers make considerable efforts to keep radiation down to acceptable levels. Modifications such as those described are liable to increase the levels of radiation. Any spurious oscillations and the extension of the tuning range would increase the number of services liable to suffer interference.

This is a practical matter: some of your readers will no doubt be aware that we have been investigating complaints of serious interference in the v.h.f. range caused by excessive radiation from certain receivers. Measurements have shown that this sort of interference can occur at surprisingly large distances and that a variety of radio services may be affected, including those concerned with safety of life.

I should also point out that in this country unlicensed use of radio receivers is an offence. Broadcast receiving licences are valid only for reception of transmissions from authorised broadcasting stations and licensed amateur stations, and we do not issue licences to overhear private services such as those your writer describes (not entirely correctly) as "Commercial".

I should be grateful if you would make these facts known to your readers in the next issue.—T. **Dawson, Director of Public Relations, GPO** (*London, E.C.1*).

* * *

The Author Replies:

I can quite understand how excessive oscillator radiation from a set modified as shown in my article could possibly occur, due to the increased coupling between the oscillator and aerial tuned circuits. If, however, the home-made capacitors are replaced by conventional components of similar values, it does seem unlikely that the limits quoted in British Standard 905 would be exceeded.

The question of extending the tuning range, to cover say 75 to 90Mc/s, causing interference does seem rather strange to me. With the modified set the oscillator will now cover a range of 86 to 101Mc/s approximately. If we examine the oscillator frequencies used in a standard television receiver covering Band I we find that they cover a range of 89 to 111Mc/s and to my mind would be of greater amplitude than those emitted from a transistor portable utilising a simple rod aerial at ground level.

As Mr. Dawson states my broadcast receiving licence allows me to tune into authorised Broadcasting stations and licensed Amateur stations. Does this then mean that it is illegal to tune into the aircraft, satellite, USA "CB" and Short Wave commercial bands? If this is so it seems strange that receivers are openly on sale covering one or more of these frequency segments.

In the past, articles have appeared, from time to time in the popular radio publications making direct reference to such reception, and I can personally recall articles in the national press stating that a particular person or persons have monitored a pilot's last words before an aircrash, and of groups of school-children tracking Russian satellites.

I believe that further clarification concerning illegal reception of stations is badly needed and may have been overshadowed in recent years by the excellent publicity given to the illegal use of imported transceivers. **L. Case** (*Widnes, Lancashire*).

Top band echo

I was very interested to read, amongst your readers' letters in the November issue of P.W., about the use of "one man bands" and "echoes" on Amateur frequencies.

Being a little tired of the "old man—Rig here is—Antenna here is—best 73s and BCNU" routine, I fixed an extra replay head to my tape recorder and produced a very pleasing 3-time delay and variable intensity echo.

I had been on the air for only 25 minutes, the station worked saying that the echo was like "a breath of fresh air", when I was visited by a Wireless Telegraphy Officer from the GPO, who advised me that I was almost certainly violating the licence conditions and I should return to normal "plain" speech rather than use echo, which he said was unpleasant to listen to.

It appears that, as the echo is not "plain" language and as amateurs are not supposed to play recordings of their *own* voices on the air (though some do this for CQ's), the echo is not permitted.

It seems rather sad that, when amateur radio is supposed to encourage experiment and ingenuity, such audio experiments as echo and, presumably, tremolo, and phase, should not be allowed.—**John R. Green, B.Sc., G3WVR** (*Brentwood, Essex*).

Anyone help?

In the September 1963 edition of PRACTICAL WIRELESS, there is a constructional article on a simple stroboscope.

The circuit is built round a NSP1 or NSP2 which I cannot obtain. I would be very grateful if any readers could inform me where I might get one from, and the price.—**N. Lord** (53 *Keepers Drive, Norden, Rochdale, Lancs.*).

Merry Christmas and a Happy New Year

from the staff of Practical Wireless

W. N. STEVENS

L. E. Howes, G3AYA T. R. Preece, G3TRP J. A. Reddihough C. R. Riches H. W. Moorshead

A SIMPLE CAPACITANCE BRIDGE

P. CASSIDY

THE instrument to be described is very simple in design and construction but is nevertheless a very useful addition to the workshop especially when one is confronted with variable capacitors whose values are not known.

The Circuit

The circuit is based on the Wheatstone Bridge Circuit and in fact compares the a.c. resistance of the unknown capacitor with that of a capacitor whose value is known. Since the a.c. resistance of a capacitor is proportional to its capacitance then by comparing the a.c. resistances we are effectively

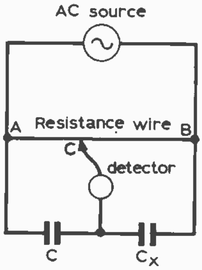


Fig. 1: The basic principle of the unit which is based on the Wheatstone Bridge. The a.c. resistance of the unknown capacitor Cx is compared with that of a capacitor C of known a.c. resistance. The bridge is completed by the resistance wire ACB. The value of Cx is found from the formula

$$Cx = C\frac{AC}{CB}$$

comparing the capacitances. The theoretical circuit is as follows (Fig. 1).

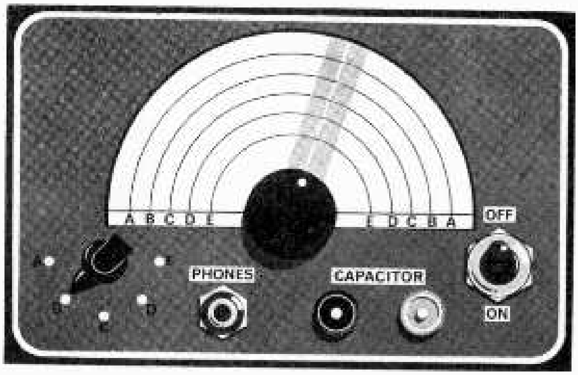
The capacitor C represents the known capacitance and Cx represents the unknown one. The pointer is moved along the resistance wire until a null point is reached. At this point the a.c. resistance and therefore the capacitance of C and Cx are in the ratio:

$$\frac{C}{Cx}=\frac{CB}{AC}$$

For a standard capacitance C the ratio $\frac{CB}{AC}$ will change with the value of Cx i.e. the null point will move along the resistance wire. Hence the instrument may be calibrated against a standard capacitance using different known values of Cx.

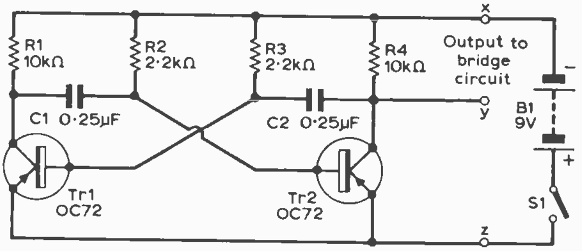
The instrument, then, consists of two separate parts, the a.c. source and the bridge circuit. Let us first consider the a.c. source. This simply consists of a free running multivibrator about which little need be said. The transistors used were OC72 and the circuit was built on Veroboard.

In this circuit the resistance wire of the theoretical circuit is replaced by a 100Ω linear pot. The detector is replaced by a set of headphones and the standard capacitance is replaced by the switched arrangement which allows the standard capacitance to be varied from 10pF to 0·1μF in five switched ranges. The range may be extended to about 10μF if desired without altering the circuit. The multivibrator is connected across the potentiometer and capacitances in parallel as shown and the unknown capacitance is connected across the terminals T1 and T2.



Construction

The instrument was mounted in a small wooden case with a *paxolin* front panel. The potentiometer, range switch, terminals T1 and T2, jack socket for headphones and on/off switch were mounted on the front panel. The capacitances C3 to C7 were wired directly to the range switch. The circuit board for the multivibrator and battery were then mounted inside the case. A cursor and scale were then prepared as follows. The scale consisted of a semicircular piece of stiff white paper with five semicircles shown on it marked A to E. This was pasted on to the front panel in the appropriate position. The cursor consisted of a piece of clean plastic with a line drawn along it with a sharp tool. Small holes



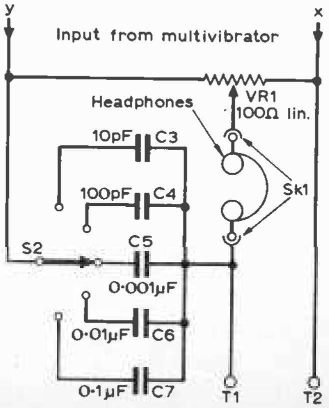


Fig. 2: In the practical circuit used in this equipment the free-running multivibrator circuit Tr1, Tr2 provides the a.c. source for the bridge whilst a pair of headphones (preferably high impedance) is used as the detector.

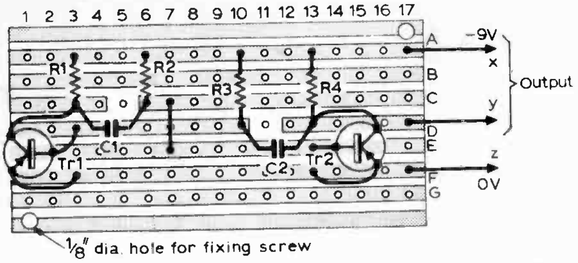


Fig. 3: Veroboard layout and wiring details of the multivibrator circuit.

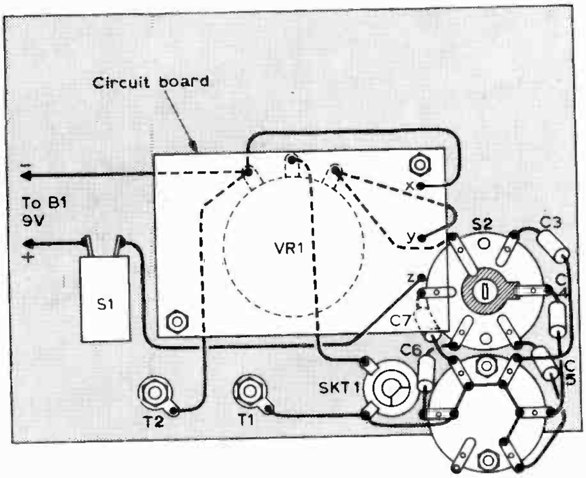


Fig. 4: Layout of the components mounted on the front panel and wiring of S2. For convenience a two-wafer switch is used in position S2.

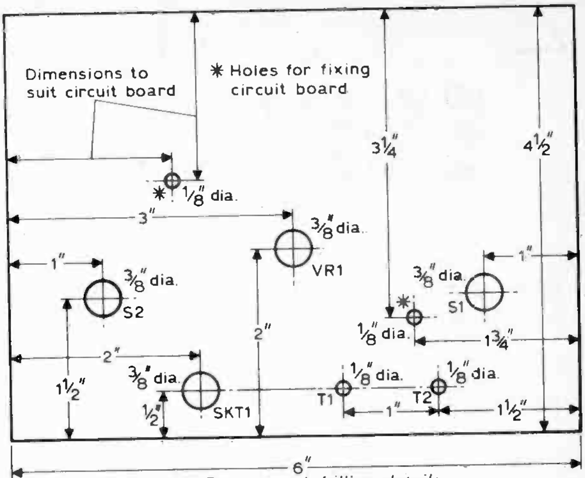


Fig. 5: Front panel drilling details.

★ components list

A—MULTIVIBRATOR CIRCUIT

Resistors:

R1	10kΩ	R3	2·2kΩ
R2	2·2kΩ	R4	10kΩ

all 10% ½W miniature.

Capacitors:

C1	0·25μF	C2	0·25μF

Transistors:

TR1	OC72	TR2	OC72

Miscellaneous:
Single pole on/off switch, Veroboard, PP9 battery.

B—BRIDGE CIRCUIT

Potentiometer:
VR1 100Ω linear w/w potentiometer

Capacitors:

C3	10pF	C6	0·01μF
C4	100pF	C7	0·1μF
C5	0·001μF		all close tolerance

Miscellaneous:
T1 and T2 post terminals; jack socket for head phones; S2 single-pole 5-way switch (two-wafer type used by author for convenience); headphones; cabinet.

were drilled along it to coincide with the semicircles on the scale. The cursor was then glued to an instrument knob and fixed on the spindle of the potentiometer.

If a metal front panel is used it will be necessary to insulate the components mounted on the front panel.

Calibration

The instrument was then calibrated as follows. The range switch was set to its lowest position—10pF and the instrument switched on. A known small capacitance (about 20pF) was placed across the terminals T1 and T2. The knob of the potentiometer was then moved until a null point was heard in the headphones. The point was marked on the scale by inserting a sharp-pointed pencil in the small hole in the cursor. This process is then repeated using different known values of capacitors until all five ranges have been calibrated. It may seem that quite a number of capacitors are needed for the calibration but this can be avoided. If a capacitance substitution box is available this will prove invaluable. Failing this, placing capacitors in parallel and in series will greatly reduce the number of capacitors required for calibration purposes. ■

CORRIGENDA
NOVEMBER ISSUE

UNIJUNCTION TRANSISTOR CIRCUITS

The connections to the base of the 2N2646 unijunction transistor used in the circuits in this article were not shown. These are as shown in Fig. 1 below.

In Fig. 2 in the article a positive-going instead of a negative-going pulse output was shown at the base 2 connection of the unijunction transistor.

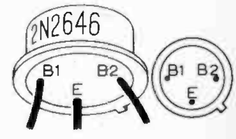
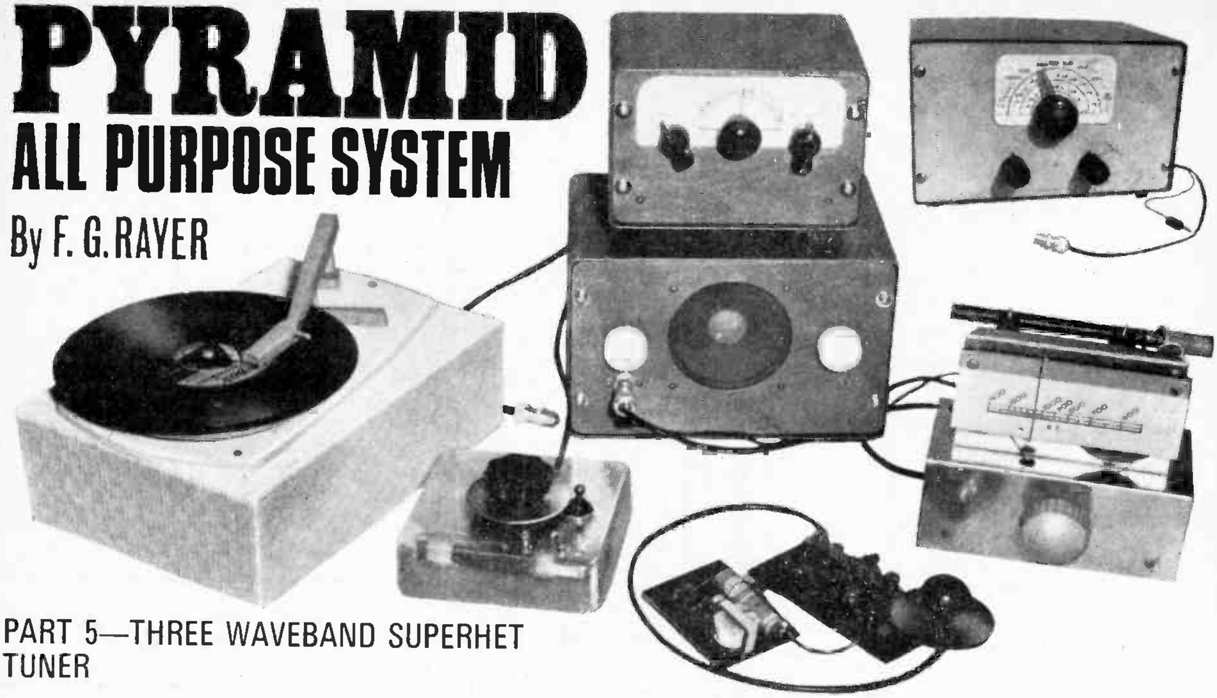


Fig. 1: 2N2646 base connections.

TRANSISTORISED SIGNAL GENERATOR

VC1 referred to in the text and components list is shown on the diagrams as C8. R6 referred to in Fig. 6 is VR1.

PYRAMID
ALL PURPOSE SYSTEM
By F. G. RAYER



PART 5—THREE WAVEBAND SUPERHET TUNER

THIS tuner covers approximately 20-580 metres in three switch-selected bands 5-15Mc/s (60-20 metres); 1·67-5·3Mc/s (180-57 metres): 515-1,545kc/s (580-194 metres).

The 515-154kc/s range is the usual "medium wave" band, while the other bands include the more useful short wave frequencies 80. 160 metres, shipping transmissions, etc.

The tuner is designed to operate in conjunction with the "Pyramid" amplifier, but could be used with almost any other amplifier.

Mixer Circuit

This is shown in Fig. 1. L1, L2 and L3 are the aerial coils, and selected by means of a three-way switch. One switch pole transfers the aerial to the required coil, another pole switches the tuning capacitor VC1, while the third pole selects the coupling winding for the OC170 mixer base.

To avoid the need for several pre-set trimmers, a panel trimmer VC3 allows peaking up the aerial circuit on each band throughout the tuning range. This allows maximum efficiency with any aerial, and simplifies trimming.

L4, L5 and L6 are the oscillator coils, tuned by VC2. The emitter, collector and VC2 circuits are switched to the required coil by a second wafer of the switch (also three-pole three-way). TC1 is the oscillator circuit trimmer.

Each oscillator coil has its own padder, Cp1, Cp2 and CP3. Each of these capacitors is of different value, and is connected to a different coil pin, as shown.

The mixer section is assembled on an aluminium chassis, and the i.f. amplifier strip is wired on a paxolin panel and fitted to the chassis at a later stage.

I.F. Strip

Figure 2 shows the circuit using two AF117 transistors with double-tuned intermediate frequency transformers, i.f.t.1 and i.f.t.2. I.f.t.3 is single-tuned, and incorporates the detector diode and by-pass capacitor. Using these transistors, and five tuned circuits, high gain and selectivity are achieved.

Automatic volume control bias is applied to the first AF117, through R9, in the usual way. When the tuner is plugged into the "Pyramid" amplifier, the 5kΩ audio gain control is present in circuit from pin 5 of i.f.t.3 to the chassis. If the tuner is employed with a different amplifier, and the amplifier input circuit is not as used in the "Pyramid" equipment, a fixed resistor of similar value (around 5kΩ) must be wired from i.f.t.3 pin 5 to chassis.

Mixer Wiring

Layout of components under the chassis appears in Fig. 3. Six ¼in. holes are drilled for the coils L1 to L6.

The ganged capacitor must have an efficient reduction drive. This may be a ball drive, be integral in the capacitor, behind the panel, or of any other usual type; the ball drive is the least expensive. The capacitor is also given as 365pF each section, but may be 315pF each section, or of similar value. This merely alters the tuning range slightly but this is of no importance as there is some overlap at the band ends.

The ganged capacitor is bolted to the chassis. Leads from front and rear sections pass down through holes to the nearest switch tags, Fig. 3. TC1 is soldered in parallel with VC2, above the chassis.

Wiring is most easily undertaken by placing the coils so that the pins all come in the same relative positions, Fig. 3. Each coil is then wired to the

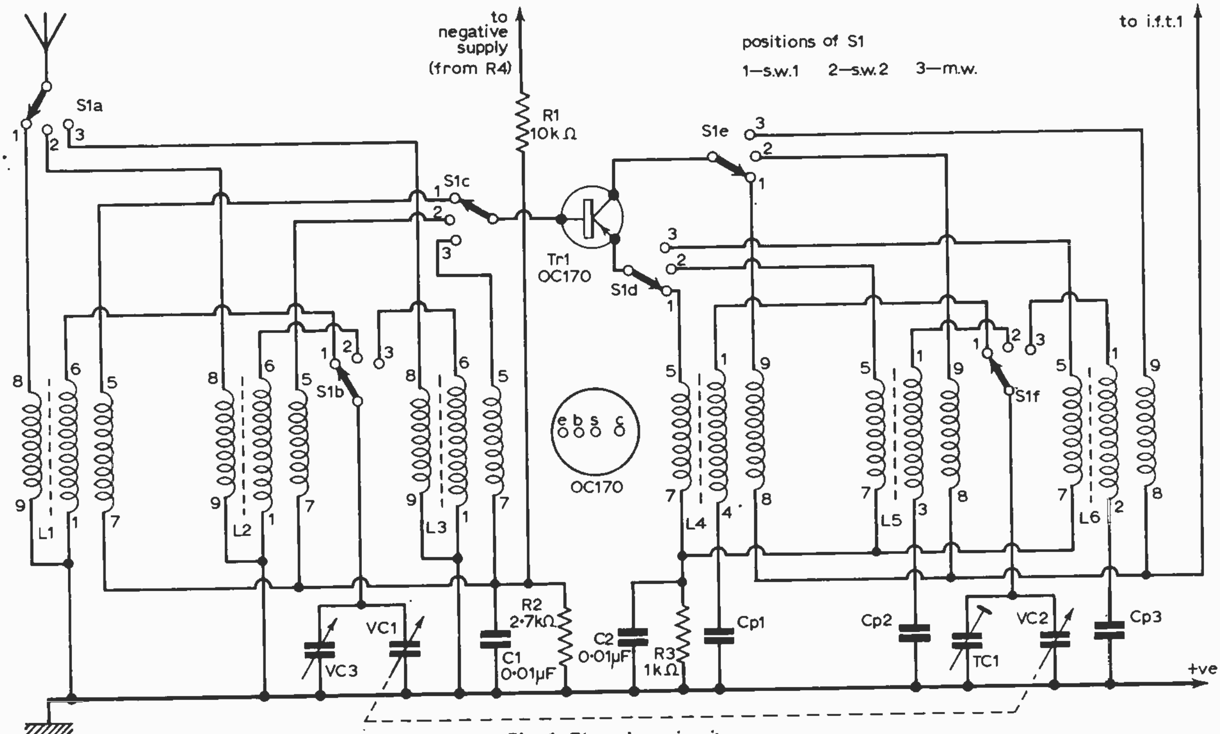


Fig. 1: The mixer circuit.

switch, following Fig. 4. Leads should be short and direct, especially to the short-wave coils,

If this wiring is done systematically, and with care, no error should arise. If preferred, the chances of making a mistake can be reduced by placing only L3 and L6 in, and wiring these first. With the switch in the appropriate position, medium-wave reception should then be obtained. L2 and L5 can then be added and tested. Finally, L1 and L4 may be connected.

Figure 3 shows transistor and other coil connections. Padders Cp1, Cp2 and Cp3 go directly from the correct coil pins to chassis, a lead running between the MC connections for this purpose. The transistor leads, and wires from C1 and C2 should be quite short. Other connections from L1, L2 and L3 (Fig. 4) run to the front wafer of the switch and are clear of wires to L4, L5 and L6 which go to the rear wafer.

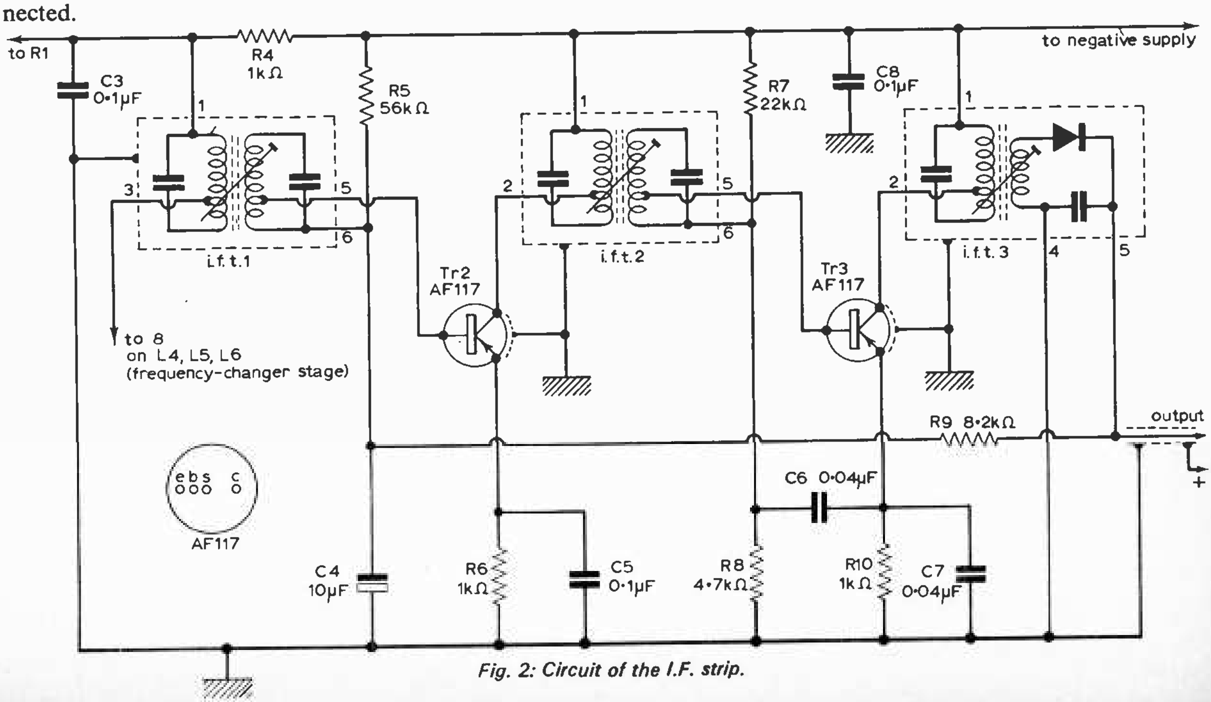


Fig. 2: Circuit of the I.F. strip.

I.F. Amplifier Construction

This section is wired completely on a piece of $\frac{1}{16}$in. thick paxolin, 4 × 2¼in. Small holes are drilled so that the resistor leads and other parts may be fitted as in Fig. 3.

The paxolin panel is turned over and wired as in Fig. 5. One can tag of each i.f.t. is earthed to the positive line, which is in turn soldered to a tag. When the strip is completed, it is held in the chassis by two bolts, each with extra nuts to allow clearance for wiring. The i.f. strip positive line is thus common to the metal chassis, Fig. 3.

External Connections

These are shown in Fig. 3. For the "Pyramid" amplifier, the negative supply is drawn from a socket on the panel. The negative lead, Figs. 3 and 5, shows a plug to insert in this socket. If the tuner is used with other equipment a supply of about 6V is required.

Audio signals go from pin 5 of i.f.t.3 to the amplifier input (volume control). The outer braiding of the screened or coaxial lead forms the positive or "earth" return between tuner and amplifier. This is provided automatically when plugging into the "Pyramid" amplifier.

If an earth is available, this can be connected to the chassis via a socket or terminal. The aerial goes to a socket or terminal insulated from the chassis, Fig. 3.

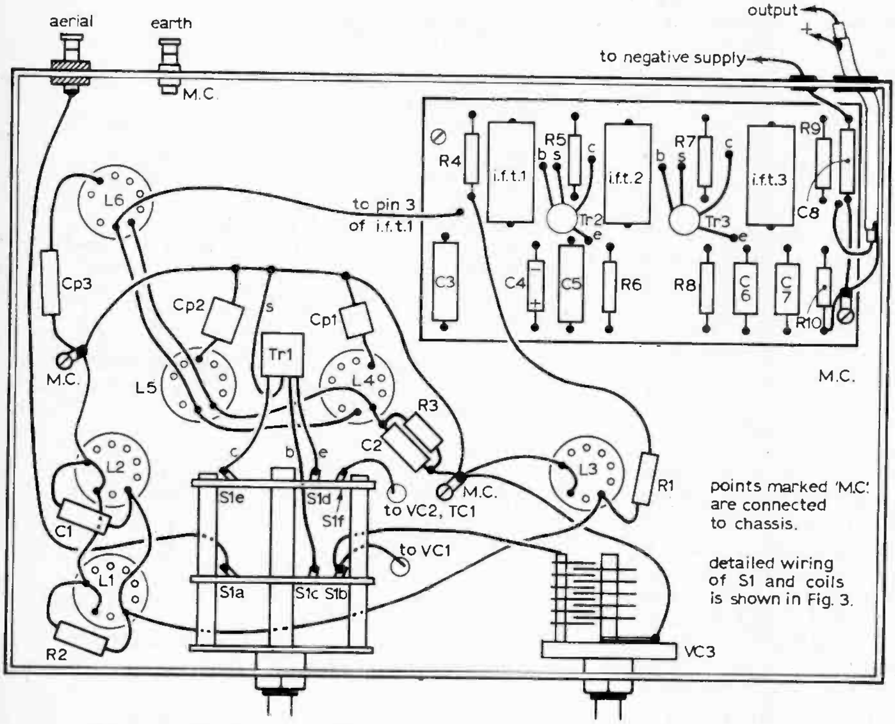
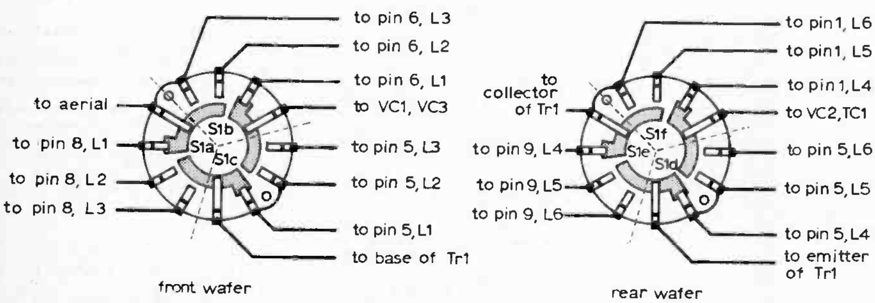


Fig. 3 (above): Under chassis wiring. Note that leads should be short and direct.

Fig. 4 (below): Wiring to the wave change switch.



Sleeving should be put on the transistor wires to avoid short-circuits. It is helpful to use different colours for identification, e.g. red for collectors, green for emitters, yellow for bases, with shield wires left bare. It is then much easier to check connections when the transistors are in position. Their leads should be quite short, and must be soldered rapidly in the usual way to avoid overheating.

Aligning the I.F.T.s

If a signal generator is available, set it to provide a modulated output on about 470kc/s. Connect the output to pin 5 of i.f.t.2, and adjust the core of i.t.f.3 for best results. Then transfer the generator lead to pin 5 of i.f.t.1, and adjust both cores of i.f.t.2. Finally, inject at the mixer base and adjust i.f.t.1 cores.

The input level should be kept down to avoid overloading. Output can be shown by a meter in one battery lead to the amplifier, but when trimming for maximum current, reduce audio gain so that this is not unnecessarily heavy (say not usually over 30mA).

If the i.f.t.s are prealigned, and are not badly off frequency, a signal will be obtained at once through the whole amplifier, by injecting at the mixer base, and aligning all cores. However, if some cores are much out of position, this may result in no signals being obtained and the procedure previously described should then be taken.

If no generator is available, it is necessary to tune into a transmission, and adjust the cores for best results, each core should tune quite sharply. A properly shaped and fully insulated trimming tool is necessary. Cores should be touched up finally, with a weak signal, when the strip is fixed in the chassis.

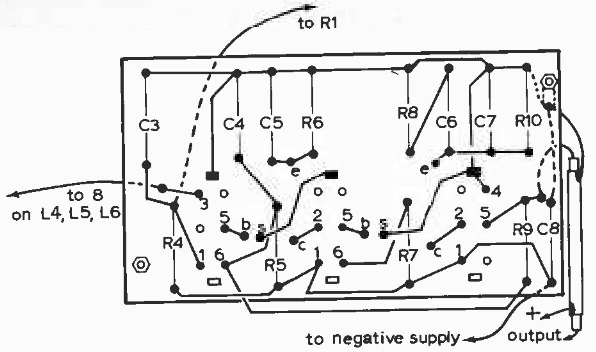


Fig. 5: I.F. board wiring (underside).

Mixer Alignment

Screw TC1 about half-way down. With the switch in the medium wave position, adjust the core of L6 for suitable band coverage. At the high-frequency end of the band (VC1/2 nearly open) VC3 should peak for best sensitivity around one-third to one-half closed. Tune towards the LF end of the band, and adjust the core of L3 for best results, and to make necessary the least re-adjustment of VC3.

The 1·67-5·3Mc/s range should be dealt with next by adjusting the cores of L2 and L5. Finally, switch to the highest frequency range, and adjust the cores of L1 and L4.

The actual coverage of each band depends on the settings of the oscillator coil cores, L4, L5 and L6, but if VC3 can be peaked up for maximum results, and is not fully open or fully closed, satisfactory efficiency will be obtained. A signal generator is most convenient for aligning the mixer coils, and obtaining suitable frequency coverage for each band.

With the highest frequencies it is possible to tune L1 to the wrong side of the oscillator coil frequency, this is usual with a superhet. Where L1 can be peaked to *two* frequencies, each giving maximum performance, the correct setting is the lower frequency of the two, so that the oscillator is working at a higher frequency than that of the aerial circuit.

It may be noted that the coil manufacturer specifies 3,000pF for P1, and 1,100pF for P2. Should these values be available, they furnish the same results in this circuit as the 2,700pF and 1,000pF capacitors listed.

Should it be found during alignment that VC3 always needs to be nearly open, at the h.f. ends of all bands, then screw down TC1 a little.

If the aerial is at all long, results are improved by placing a small capacitor between aerial lead and receiver, a 50pF pre-set should usually be suitable. ■

★ components list

Mixer Section:

R1	10kΩ	C2	0·01μF
R2	2·7kΩ	Cp1	2,700pF
R3	1kΩ	Cp2	1,000pF
C1	0·01μF	Cp3	350pF

VC1/VC2 2-gang 365pF or similar.
VC3 50pF variable. TC1 30pF beehive pre-set.

Denco Coils:	"Blue"	"Red"
	L1 Range 4T	L4 Range 4T
	L2 „ 3T	L5 „ 3T
	L3 „ 2T	L6 „ 6T

Chassis 8×5½×2in. OC170. Two-wafer switch, three-pole three-way each wafer. Drive, Knobs, etc. "Dinki-case" 10×6×6in. (Electroniques).

IF Strip:

R4	1kΩ	C3	0·1μF
R5	56kΩ	C4	10μF 6V
R6	1kΩ	C5	0·1μF
R7	22kΩ	C6	0·04μF
R8	4·7kΩ	C7	0·04μF
R9	8·2kΩ	C8	0·1μF
R10	1kΩ		

Paxolin 4×2¼in. Repanco i.f.t.s: i.f.t.1 XT50/1, i.f.t.2 XT50/2, i.f.t.3 XT50/3. Two AF117s. Screened lead, etc.

CQ! CQ! CQ! CQ! CQ! CQ!

ISSUES WANTED

. . . *Practical Wireless* 1963 to 1967. State prices. All letters answered. — M. D. Ellse 86 Bennetthorpe, Doncaster.

. . . February 1967 issue of *Practical Wireless*.—H. S. Clark, "Cromford", 24 Broadmoor Lane, Upper Weston, Bath, Somerset.

. . . Sell or loan the September 1967 issue of *Practical Wireless*, also the issue, containing mods. to the 19 set (issued in one of the last issues of 1967).—B. M. Oddy, 27 Gimble Way, Pembury, Kent.

. . . Sell or loan May 1963 issue of *Practical Wireless*.—K. Portman, 23 Fell Wilson Street, Warsop, Mansfield, Nottinghamshire.

. . . Copies of 1961 August and September *Practical Wireless*. All expenses met. —J. Watson, 20 Watson Road, Sheffield 10.

. . . November and December 1964 issues of *Practical Wireless*. Also, will anyone sell or give me any of the i.f.t.'s and coils for the "Ten-Five" receiver, contained in these issues.—P. Hudson, 338 Bennett Street, Long Eaton, Nottingham NG10 4JD.

. . . January 1967 issue of *Practical Wireless* containing details of the "Explorer" v.h.f. receiver.—S. Kendall, "Handsel", Peel Crescent, Ashton, Chester.

. . . March and April 1966 issues of *Practical Wireless* containing mods to the 19 set.—A. M. Laird, The Tower, Patra Road, Kirkmichael, Ayrshire.

. . . Copies of *Practical Wireless* from October 1953 to July 1954, containing the P.W. Electronic Organ.—A. D. Varley, "Belfairs", 252 Liverpool Road, Penwortham, Lancashire, PR1 OLY.

. . . June 1967 issue of *Practical Wireless*. Buy or loan.—C. M. Davos, 1 Willesden Road, Hughesdale 3166, Victoria, Australia.

. . . Any issues of *Practical Wireless* containing circuits, constructional articles on electron musical instruments, particularly P.W. Electronic Organ, published in the 1950s.—D. E. Bray, 104 Fulmerston Road, Thetford, Norfolk.

. . . October 1966, November 1966, and all issues of 1964 and 1965 which had information on the R.A.E.—C. J. Bourne, 11 Woodhouse Lane, Bishop Auckland, Co. Durham.

. . . October 1962 issue of *Practical Wireless* containing the "Tudor" 4-valve battery portable.—M. J. Darby, 266 Canley Road, Coventry, Warwickshire, CV5 6AP.

. . . January-December 1964, January-August 1965, November-December 1965, January-June 1966 (all inclusive) and August 1966 issues of *Practical Wireless*, preferably including any blueprints.—D. L. Edwards, 18 Parkdale Crescent, Worcester Park, Surrey.

. . . January 1967 issue of *Practical Wireless* containing "Explorer" v.h.f/ f.m.-a.m. receiver and any other issues with same details.—S. Marklew, 4a George Street, Wombwell, Nr. Barnsley, Yorkshire.

. . . Does any reader remember the periodical in which an article about the conversion of W.S.38 to top band appears? If so, please let me have issue number.—A. Carter, "Rosemary", Shakespeare Avenue, Langdon Hills, Basildon, Essex.

. . . June 1965 issue of *Practical Wireless* or descriptive text of Hawaiian Guitar.—N. Taylor, 21 Tower Mill Road, Millfield Estate, Bungay, Suffolk.

. . . Anyone sell or loan April 1966 issue of *Practical Wireless* dealing with the second part mods. to the 19 set.—T. R. Smith, 50B Aldershot Road, Guildford, Surrey.

. . . Issues of *Practical Wireless* from 1961 to 1967 on exchange basis of Indian novelties and curios of equivalent amount.—K. B. Tendulkar, 94/3 Jaiprakash-Nagar, Goregaon (East), Bombay 63(NB), India.

. . . I would be very grateful if any reader could sell me the July 1963 issue of *Practical Wireless* and the September 1967 issue of *Wireless World*.—S. Saethern, Box 336, N-3101 Tonsberg, Norway.

. . . the issue of P.W. with the article on a domestic "colour organ".—4269206 S.A.C. Swift D.G., "B" (S.C.S.), R.A.F. Stanbridge, Leighton Buzzard, Bedfordshire.

. . . the issue of P.W. containing E. J. Wooton's T.R.F. receiver.—V. Reed, 25 Arlington, Ashford, Kent.

ISSUES FOR DISPOSAL

. . . *Practical Wireless*, from December 1963 to February 1966. Most blueprints included. Sell or exchange for components suitable for transistorised circuits.—A. Beveridge, The Schoolhouse, Tiffermore, Perth.

. . . *Practical Wireless* 1951–1966 for disposal.—L. W. Levell, Popes Hill, Newnham, Gloucestershire.

. . . 57 issues of *Practical Wireless* from 1961 to 1966 in excellent condition, and 47 copies before 1961 (reasonable). Any reader wanting these please send 25s. and stamped addressed envelope (for return of money).—M. Pardoe, 3 Dunwell Avenue, Newby, Scarborough, Yorkshire.

. . . Quantity of *Practical Wireless* and *Television* for sale.—J. Foy, 101 Sandringham Road, Birmingham 22B.

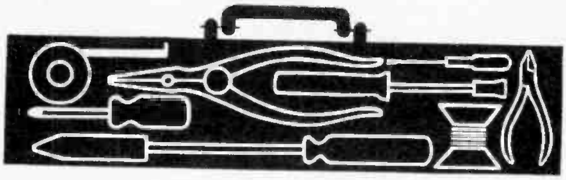
. . . *Practical Wireless* from January 1956 to April 1968 inclusive and would sell or swap for anything interesting electronic or otherwise.—I. R. W. Bram, 38 Muirfield, Perth.

Items in this section are included free of charge.

repairing radio sets

PART 1 (Third Series)

The first series ran from April-September 1967 and dealt with repairing sets with valve circuits. The second series, running from April-September 1968, dealt with transistor sets. We now present a short third series covering the repair of sets with unknown circuits.



Gordon J King

OWING to requests by readers of this series for a final, two-part article dealing with the non-theoretical and practical approaches of servicing valve and transistor sets of unknown circuit, it has been decided to extend the series by two articles adopting the same pattern as the previous ones. That is, one by my pen on the circuit and fault-diagnosing side and the other by my colleague H. W. Hellyer on practical matters.

DETERMINING THE CATEGORY

Starting first with the valve models, these can be divided into four primary categories: (i) the a.c.-only model, (ii) the a.c./d.c. model, (iii) the battery (all-dry) model and (iv) the mains/battery model. Thus, the first thing to do when an unknown species comes into our hands is to put it into one of the above classifications.

The true a.c.-only set is easy to identify because it possesses a rather hefty mains transformer, often carrying on its top metal cover some means of adjusting the mains input voltage requirement. This, of course, must always be adjusted to correspond as closely as possible to the household mains voltage on which the set is to be operated. As this still tends to vary about the 240-volt "standard" from district to district the correct tapping must be selected at the place where the servicing is to be undertaken.

This type of set is generally the least "lethal" from the servicing point of view because the mains supply is fully isolated from the circuits and metal chassis by a primary winding on the mains transformer. Secondary windings deliver power for the h.t. rectifier (usually a valve in older models and a metal or semiconductor unit in more recent ones) and for the heaters of the valves. This sort of set, therefore, can be worked on quite safely without taking undue precautions against electric shock, though it is desirable to connect a good earth to the earth terminal or socket, so that a mains supply short to chassis will blow a fuse rather than encouraging the flow of current through the body of the repairer touching the metal chassis while being "earthed".

SAFETY PRECAUTIONS

At this juncture it must be stressed that there is a variety of a.c.-only set which employs a mains tranformer arranged rather in the form of an auto-transformer for the h.t. supply—having isolated windings only for the heaters of the valves. Here the primary winding, which is connected via the on/off switch to the mains supply, is tapped to give the necessary voltage for the h.t. rectifier, and one side is connected to h.t. negative and/or the metal chassis of the set. In other words, one side of the mains supply is connected to chassis, and if this happens to be the "live" side the repairer is likely to receive a nasty shock on touching it while being in circuit with earth.

The a.c./d.c. set is completely devoid of a mains transformer, for such a device can only work on a.c. If d.c. is connected across the primary of a mains transformer, there would be no transformer action and the supply current would be limited only by the resistance of the winding. The transformer would almost certainly blow up! The mains current is reduced to a value suitable for the heaters of the valves—series-connected heaters being used here instead of the parallel-connected heaters of a.c.-only models—by a large, wire-bound resistance unit, called a "mains dropper". The "anode" of the h.t. rectifier is connected to the mains supply either direct or more usually through a low value, wire-wound resistor, called the "surge limiter" (as it limits the initial switch-on current through the h.t. circuits), and is often a part of the mains dropper. This sort of set, of course, can be lethal to work on when it is connected to the mains supply so that the "live" side is in termination with h.t. negative or chassis.

The battery-only set is perfectly safe to work on since the h.t. supply rarely exceeds 90 volts. Such sets of the last two decades have employed small low-consumption valves with 1·4-volt filaments, and they run either with their filaments connected in series or in parallel, and a l.t. battery corresponding to the mode of connection is then employed.

The battery/mains model is basically the same as the battery-only set but with additions for working the valves—h.t. and l.t.—from the mains supply. The usual plan is for the filaments of the valves to be switched to series-connection on mains and then to be connected across the h.t. supply via a series resistor. The h.t. supply is derived either via a small mains transformer or, more usually, from a mains dropper, with a valve or metal rectifier. As the latest all-dry valves require only 25mA of filament current, the load the series-chain presents to the h.t. supply can easily be catered for, bearing in mind that the total h.t. current is little more than 20mA, anyway.

In the mains mode, therefore, this sort of set can also have a chassis which is "live" with respect to earth; but possibly the biggest servicing problem lies in protecting the very delicate 25mA filaments of the valves while servicing, for one false move with a meter test prod can often result in a substantial rise in filament current—especially with the set switched to mains—either straining the valves so they no longer work with the correct current or burning out their filaments altogether.

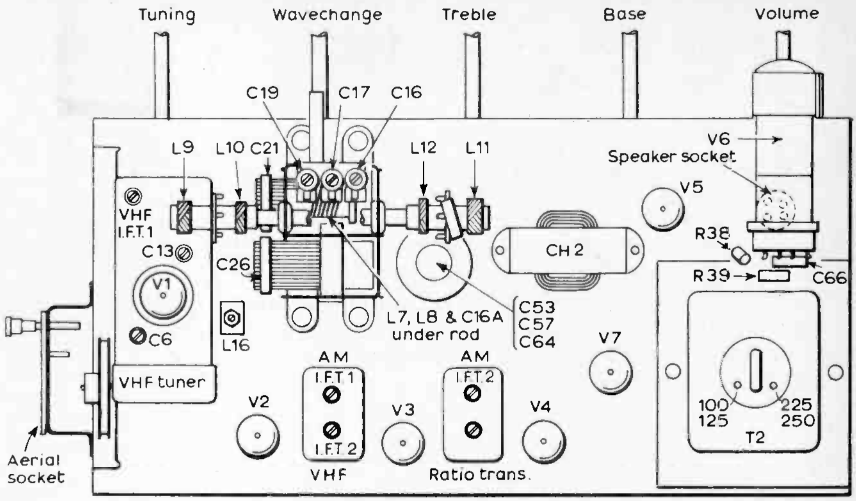


Fig. 2: Typical layout for an a.m./f.m. valve receiver. Note the placing of the a.m. and f.m. tuning components, the i.f. sections, the mains and output transformers and the smoothing choke.

POINTS OF DETAIL

Mains sets—both a.c.-only and a.c./d.c.—mostly have long and medium wavebands, while many also incorporate one or several short wave bands. This sort of detail is revealed by the tuning scale. Sets within the last two decades have also tended to cater for the v.h.f. f.m. transmissions in Band II as well as for the ordinary a.m. transmissions in the long, medium and short wavebands. A.m./f.m. sets are basically the same as their a.m.-only counterparts, but carrying a v.h.f. tuner, a f.m. detector of some kind (usually a ratio detector—a pair of diodes in series) and i.f. stages which can be switched between 470kc/s for a.m. and 10·7Mc/s for f.m.

The switching in this variety of set is somewhat complex because several parts of the set as a whole have to be switched simultaneously. A long, slider type of switch—with switching sections along its length—is often arranged along the length of the chassis, thereby allowing local switching of the v.h.f. tuner, the a.m. frequency changer to an additional i.f. stage on f.m., the a.m. local oscillator, the i.f. transformers and the a.m. and f.m. detectors.

The majority of the battery-only and battery/mains models cater only for the long and medium wavebands, with a few carrying a short waveband in addition There were very. very few models of this kind with facilities for f.m. as well as a.m.

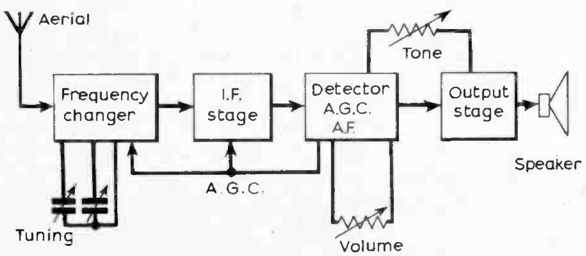


Fig. 1: Block diagram of typical valve a.m. receiver.

Typical mains sets. as well as most of the battery and battery/mains models. have four main "receiving" valves plus either a valve or metal rectifier, as shown by the block diagram in Fig. 1. If there is a "magic-eye" tuning indicator, this represents an extra valve, but which if missing or faulty will not usually cause the set to cease working. There is also an extra valve in those models which cater for f.m. as well as a.m., this being in the v.h.f. tuner.

COMPONENT IDENTIFICATION

A typical example layout of an a.m./f.m. a.c.-only model is given in Fig. 2. V1 is a double-triode in the v.h.f. tuner (ECC85), one section working as the v.h.f. amplifier and the other as the self-oscillating frequency changer. V2 is the a.m. frequency-changer (ECH81), a triode-heptode, with the heptode as mixer and the triode as local oscillator. On f.m. the triode is muted and the heptode is arranged to work as an extra 10·7Mc/s i.f. stage. V3 is the i.f. amplifier (EF89) working in conjunction with a.m. and f.m. i.f. transformers, as already mentioned. V4 is the a.m. and f.m. detector, one diode for the former and two for the latter (the norm in this sort of set-up), combined with the a.f. triode amplifier, the valve thus being a triple-diode-triode (EABC80). V5 is the output valve (EL84), invariably a pentode. V6 is the tuning indicator (EM34)—not directly concerned with the operation of the set. And, finally, V7 is the h.t. rectifier (EZ80).

Points to note are (i) the location of the two-gang tuning (a.m.) capacitor in relation to the frequency-changer valve, (ii) the siting of the v.h.f. tuner and the way that its mechanical tuning is often ganged to the two-gang a.m. capacitor, (iii) the position of the i.f. transformers between the frequency-changer and i.f. valves and between the i.f. and detector valves, (iv) the mains transformer (T2) as far as possible removed from the front-end of the set, (v) the position of the output (or speaker) transformer (T1, but below the chassis) adjacent to the output valves, (vi) the smoothing choke (CH2) close to the h.t. rectifier, (vii) the tuning indicator arranged to show at the front of the set and (viii) the relative positions of the controls. The tuning and wavechange controls are always towards the front-end, while the volume is as close as possible to the a.f. amplifier. Not all models feature both bass and treble controls, but most have one "tone control" which, at least, provides a variable degree of treble cut!

A.c./d.c. sets follow closely in layout, but using a mains dropper instead of transformer, while battery-only models are that much less complicated to service—the vulnerability of the filaments apart—due to the lack of power supply components. The top-view of a typical a.c./d.c. model is depicted in Fig. 3, where V1, V2, V3, V4 and V5 respectively are the frequency-changer, i.f. amplifier, detector/a.f., output and rectifier valves. The mains dropper is R10, shown also in inset. The overall mains dropping resistance appears between tags 1 and 4, while the two taps along the resistance, given at 2 and 3, produce a volts drop suitable for lighting a small dial bulb; tag 3 also connects to the anode of the h.t. rectifier, thereby making the top two resistance sections the surge limiter.

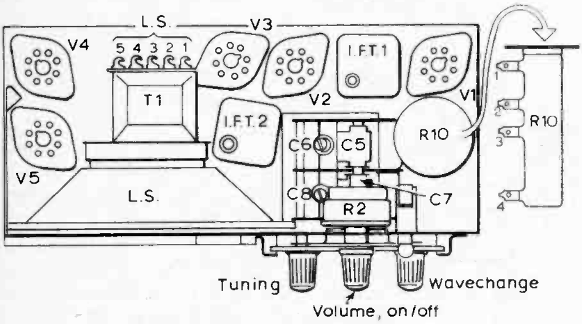


Fig. 3: Layout of a typical a.c./d.c. radio.

A battery-only portable top-of-chassis layout is given in Fig. 4, with V1, V2, V3 and V4 representing the frequency-changer, i.f. amplifier, detector/a.f. and output valves—respectively DK96, DF96, DAF96 and DL96. Notice again the location of the wavechange switch close to the front-end (frequency-changer), with the volume control at the far end, close to the a.f. stage. OP1 is the speaker transformer in this diagram, with the primary and secondary windings represented by L9 and L10.

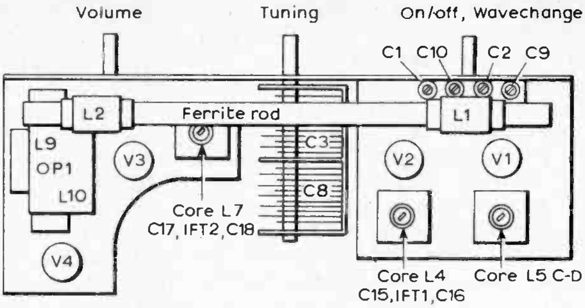


Fig. 4: Common layout of a valve battery portable radio.

As with battery/mains versions and some a.c.-only and a.c./d.c. table models, the battery portable now always uses a ferrite rod aerial (for a.m. and medium-frequency signals) in place of the former frame aerial. The ferrite rod aerial in Fig. 2 is shown above the a.m. tuning-gang, carrying windings L9, L10, L11 and L12. This works, of course, on a.m. only (not f.m.). The aerial in Fig. 4 runs the whole length of the chassis—the longer, the greater the signal pick-up—and carries m.w. winding L1, which is connected in series with winding L2 for l.w. reception. The wavechange switch performs the connection changes, while also changing over the local oscillator coil or adding parallel capacitance to a single coil for l.w. working, depending on the actual design.

ALL-DRY PORTABLE CIRCUIT

The circuit of a battery-only set, corresponding to the chassis layout in Fig. 4, is given in Fig. 5. This set has all the filaments in parallel, thereby requiring 1·5 volts l.t. Notice that the output valve, V4, has a tapped filament, and that the tap is connected to l.t. negative, while the two outer connections are joined. This puts the two half-sections in parallel. In series-connected filament circuits, the two half-sections, of course, remain in series to give the correct filament current balance.

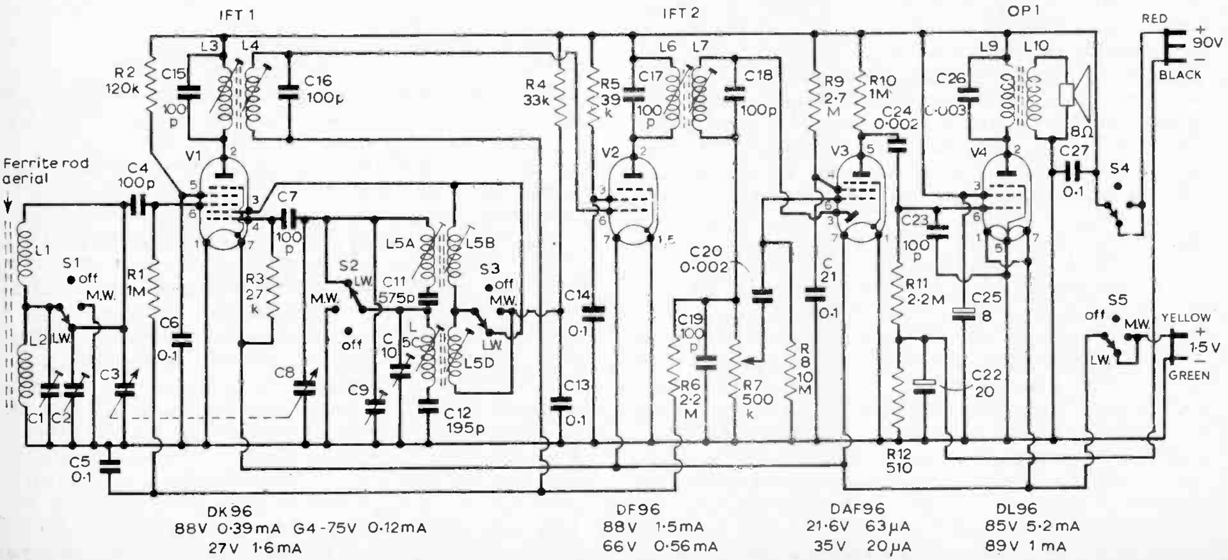


Fig. 5: Typical circuit of a two waveband battery portable; note the arrangement of filament wiring.

A characteristic fault in this scheme is lack of oscillation brought about by (a) low l.t. battery and (b) low emission or strained V1 or both. Another defect is low sensitivity often caused by increase in value of R9 or R10. Distortion is invariably caused by a leaky C24 or a low emission V4, while severe microphony usually means either that V3 is in need of replacement or that the l.t. battery is nearing the end of its useful life.

An even older battery/mains model (Decca), using a frame aerial, is shown circuit-wise in Fig. 6. On mains the small metal rectifier feeds d.c. to the anodes and screen grids of the valves, while also feeding a small filament current to the series-connected chain via Rx. Sets of this kind suffer badly during the winter months with muted local oscillators due to mains power cuts, for even a small reduction in mains voltage is often sufficient to drop the filament current sufficiently to prevent the local oscillator from working.

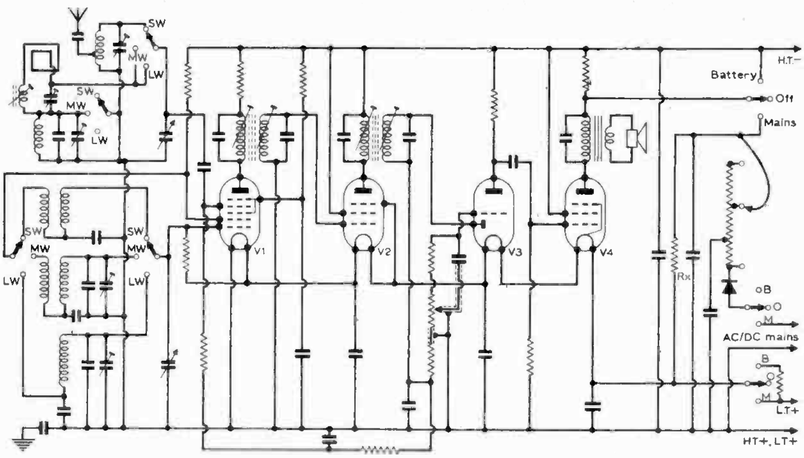


Fig. 6: Circuit of an older type battery/mains model.

The trouble is aggravated by a worn V1 *and* metal rectifier or by attempting to run the set with the mains tapping adjusted to a value above the input mains voltage. Sadly, if the tapping voltage is reduced, the filaments will be likely to suffer permanent damage on upward surges of mains voltage. Fortunately, sets like this have long since been superseded by the economic transistor model. Even so, there are still many thousands in use, repaired yearly by the amateur, so no excuses are offered for their brief inclusion in this text!

SERVICING HINTS AND TIPS

To summarise on valve models: one, check in which category it falls; two, make absolutely sure that it is safe to handle, especially when of the a.c./d.c. kind—make sure that the chassis is in connection with the *neutral* side of the mains and check with a neon tester, which will glow when the chassis —or anything else pertaining to the set—is "live"; and avoid becoming "earthed"—wear rubber-soled shoes; three, locate the primary components and valves so that the circuits around them can also be identified, and then proceed with the servicing exercise along the line expounded in the previous articles.

The following hints and tips will also be useful to keep in mind when handling an unknown valve model for the first time. When the set is a.c.-only make sure that all the heaters are lit. If one (or more) is out the valve will almost certainly be in need of replacement. Look out for overheating of a valve when first switching on. If the h.t. rectifier glows red hot and the set is dead a h.t. short—electrolytic capacitor failure—will almost certainly be responsible, though, sometimes, a short in the rectifier itself causes this symptom.

If the components are suffering no apparent discomfort after the set has been powered for several minutes, check the temperature of the valve envelopes with a finger; a barely warm h.t. rectifier could indicate open-circuit of that valve, even though the heater is lit, while a cool output valve could mean lack of screen grid or anode voltage. The latter trouble, invariably caused by open-circuit of the speaker transformer primary, results in the screen grid of the output valve glowing red hot. This is a good point to check on a dead set.

With a.c./d.c. sets, one open-circuit valve heater will remove power from all the other heaters, so no valves will be alight. Check each valve in turn with an ohmmeter or, with the set switched on, check with an a.c. voltmeter from the heater connected to the mains dropper relative to chassis along the heater chain back to chassis. A.c. volts will be indicated at the start of the chain and fall to zero at the far side of the valve whose heater is open-circuit. Of course, the same symptom will result with an open-circuit mains dropper, on/off switch, fuse, thermistor (if used) and so forth, but the use of an a.c. voltmeter will soon bring this sort of trouble to light.

UNKNOWN TRANSISTOR SET

So much, then, for valve models, now let us glance at the unknown transistor set. The typical transistor set follows similar lines to the basic valve set. There is one transistor working as a self-oscillating frequency-changer, one or more operating as the i.f. amplifier, a semiconductor diode for detection followed by an audio section comprising either a single driver transistor transformer—coupled to a push-pull pair or two pre-push-pull transistors *without* transformer coupling. There are numerous variations of these two themes, especially in the a.f. stages, whose details just cannot be given within the compass of a single article. However, up to the a.f. sections or detector most sets have a great deal in common. Earlier models, employing OC45 transistors, generally have two i.f. stages, while more recent designs, using the AF117 transistors, can secure virtually the same overall gain with just one i.f. transistor. The majority of models have six transistors and two semiconductor diodes in total, the second diode working in a signal overload protection circuit, coming into action with the a.g.c. and damping down the signal at the output of the frequency-changer.

General layout is not at all "standardised" as it is with valve sets. This is because printed-circuit boards are invariably adopted, as distinct from the wired-circuits of valve designs. The trend now is towards the employment of circuit board "modules" or sub-sections, and these are sited in the cabinet more to suit the mechanics of the situation rather than the electronics. Fortunately, great liberties can be taken over well-designed circuit boards, so the earlier problems of instability and the like now rarely occur.

The predominant feature of all transistor sets is the ferrite rod aerial, which takes pride of place. The coils on this constitute the aerial tuned circuits, and one section of the two-gang tuning capacitor resonates these over the l.w. and m.w. bands. The frequency-changer transistor will always be found close to the aerial side of the tuning gang. In sets with two i.f. stages there are three i.f. transformers—much smaller than those of valve sets—and two transformers when only one i.f. stage is employed. The local oscillator coil or transformer is connected between the collector and emitter of the frequency-changer transistor, and one isolated winding on the assembly serves to swing the oscillator frequency in conjunction with the oscillator section of the tuning gang. The oscillator coil then usually taps into the primary of the first i.f. transformer, thereby coupling the i.f. signal to the base of the first i.f. transistor. Earlier models feature some kind of neutralisation in the i.f. stages to prevent them from oscillating, but this is no longer necessary with the latest, high-gain, low-capacitance transistors.

The detector diode is sometimes hidden within the screening can of the final i.f. transformer, and the d.c. voltage that this yields after rectification of the signal constitutes the a.g.c. bias. This is fed back to the base of the i.f. transistor as an increasing (with increasing signal strength) positive voltage when the controlled transistor is a p-n-p type. The a.g.c. bias pulls down the emitter current, thereby reducing the gain of the stage. This, called "forward a.g.c.", requires a negative voltage when the controlled transistor is an n-p-n type. Some transistors, however, are designed for so-called "reverse a.g.c.", where the bias causes an increase in emitter/collector current and, sometimes, an increasing volts drop across a resistor, suitably decoupled, and connected in series with the collector circuit. The

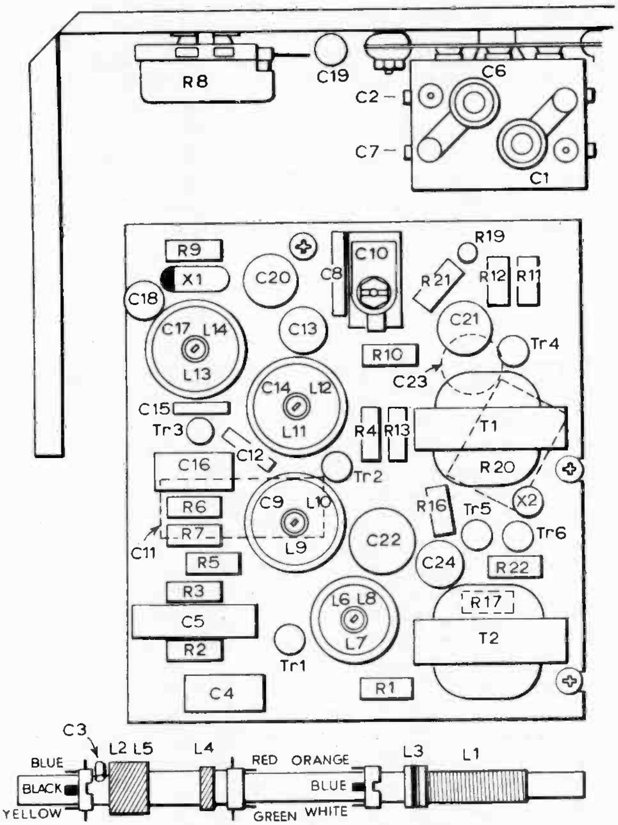
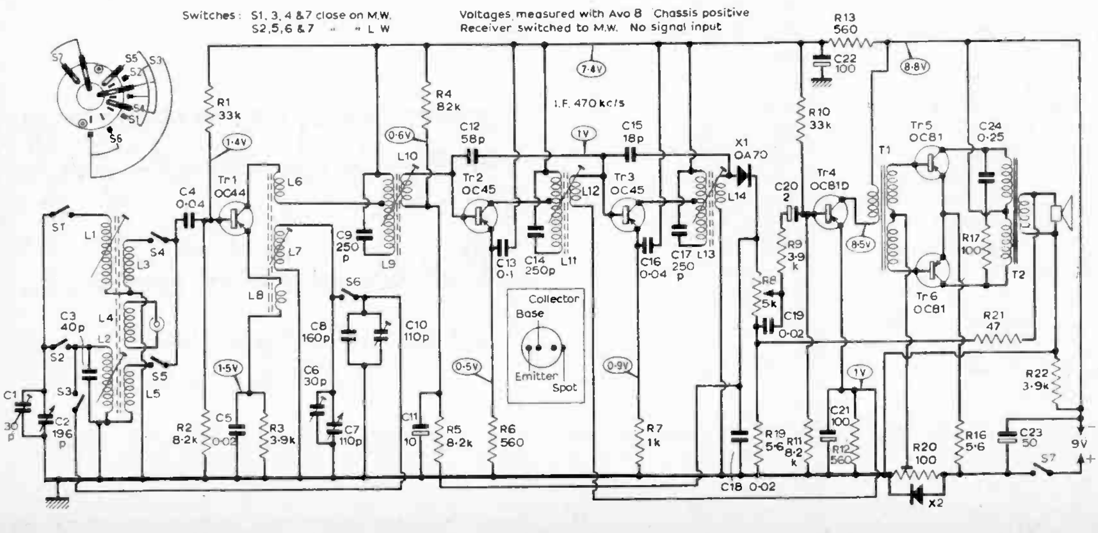


Fig. 7: Showing the circuit (a) and the layout (b) of a six transistor super radio.



stage gain in this case is reduced by the effectively falling collector voltage.

Audio from the detector is developed across the volume control—which is only about 5k, compared with the 500k of valved circuits—and the slider, ganged to the spindle, taps off the required level of signal to the audio amplifier.

One transistor set design is shown in Fig. 7, the circuit at (a) and the board layout at (b). This adopts a three-transistor audio section, with TR4 driver transistor coupled to the push-pull pair (TR5 and TR6) through transformer T1. the output transistors are biased towards class B working—with a vestige of quiescent current to minimise crossover distortion—by the preset potentiometer R20. The diode across it serves to stabilise the selected working point. In this circuit the speaker, too, is tranformer-coupled to the collectors of the output transistors by T2. Negative feedback is applied to the base of the driver transistor TR4 from the secondary of T2.

TIPS FOR TRANSISTOR SERVICING

The theme of this particular article implies that we have no circuit of the defective set and that we have not come across the model before. What, then, do we do when we are presented with a "dead" set of this kind? The best plan first of all is to get some idea where the various stages are located on the printed-circuit board or modules.

We can easily locate the major components and then identify the transistors on terms of stages from these. We can trace the wiring from the ferrite rod aerial to the frequency-changer transistor and next locate the oscillator coil and its trimmers relative to the collector circuit of the frequency-changer transistor. It will not be very difficult then to trace through to the i.f. stage or stages, thence to the detector diode, remembering that it may be hidden in a can, and on to the volume control. After that we come to the audio stages and, as already mentioned, this could take a variety of forms, but they all end up with the speaker, either transformer-coupled as in Fig. 7(a) or coupled capacitively through a fairly large value electrolytic.

Keep in mind that complete failure following the dropping of a transistor set—and this is not particularly uncommon!—will almost certainly be caused by a fracture of the printed-circuit board somewhere, but with the knowledge that we have now acquired this should not take long to locate. Distortion creeps on as the battery gradually falls in power; but excessive distortion at normal battery voltage with abnormally high total, quiescent current should immediately lead to a check of the output stage biasing preset—such as R20 in Fig. 7(a). Conversely, too little quiescent current will emphasise crossover distortion, which would also point to maladjustment of the biasing preset. A fair value for the output transistors of an ordinary transistor portable is 5mA quiescent at normal room temperature—about 18° C.

Well, then, that takes care of the circuit and general theory side of the unknown set.

Next month Mr. H. W. Hellyer will be dealing with the practical aspects of the unknown. ■

5-15Mc/s* CONVERTER

R. F. GRAHAM

THE output of this converter is inductively coupled to the aerial circuit of any ordinary transistor receiver having only medium wave or medium and long wave coverage, giving short wave reception over a band of approximately 5-15Mc/s (60-20 metres). Though it has primarily been used with the "Experimenters' 6" it will operate perfectly with similar receivers.

Figure 1 shows the circuit; the OC170 frequency changer provides an output in the order of 1·6-1·4Mc/s, the broadcast receiver being permanently tuned to the output frequency near the high end of the medium wave band. The overall circuit becomes that of a double superhet. First conversion is by the OC170 to the receiver frequency; second conversion is by the receiver frequency changer, generally to about 470kc/s. The detector, audio and output stages of the receiver operate in the usual way, with reproduction from the receiver speaker, or headphones if there is provision for these.

Freedom from second channel interference is greater than with the popular all-wave receivers using a 470kc/s i.f. Sensitivity, selectivity and results generally are very good.

Construction of the single OC170 stage is simple and straightforward, but a few points should be noted.

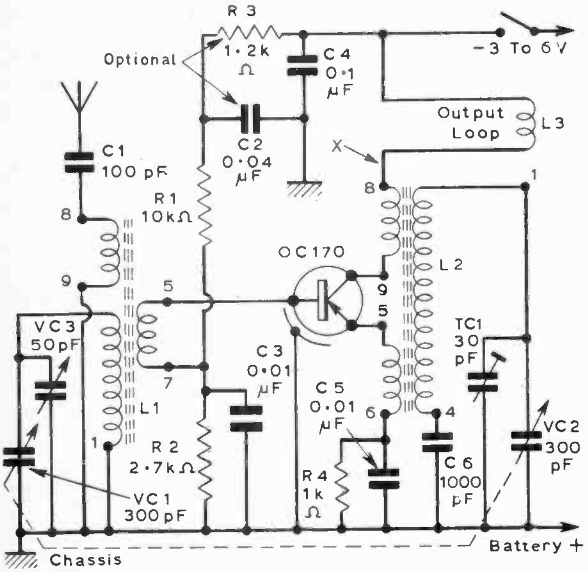


Fig. 1: Circuit of the converter.

VC1/VC2 is a ganged capacitor for tuning, and though a double 300pF or similar component is recommended, larger values give the same results except for some extending of coverage towards the low frequency end of the band. VC3 allows aerial circuit trimming, so the actual converter output frequency (and the frequency to which the receiver is set) is not critical. L1 is the aerial coil and L2 the oscillator coil, C6 being the padder. For 1·6Mc/s with the listed coils, a 960pF padder is specified, but in the present circuit either 960pF or 1,000pF may be fitted.

It was found that the inexpensive surplus type of OC170 varied somewhat, and C2 and R3 are optional, these items being required to avoid excess oscillation. One OC170 tried also operated best with a 470 ohm resistor at X. It is also worth trying 3V, 4·5V and 6V as a supply voltage, though 4·5V was generally best.

It is probably best to wire the converter without C2 and R3, and no changes need be made if excess oscillation does not spoil reception.

CHASSIS AND CONSTRUCTION

Figure 2 shows layout of components and wiring, only the battery, ganged capacitor and coils being on top of the chassis; the capacitor is bolted directly to the chassis.

An efficient reduction drive is necessary; the capacitor fitted had such a drive incorporated. A separate drive, behind the panel or fitting the capacitor spindle on the front of the panel, would be equally satisfactory.

In Fig. 2, C2 and R3 are omitted, for the reason explained. TC1 is soldered to a tag bolted to the chassis. Insulated leads pass through holes to VC1 and VC2.

L3 is 25 turns of thin insulated wire (about 32 s.w.g.) wound on a ½in. diameter former, afterwards removed. Turns were bound with thin tape. Two pieces of thin flex, about 6 to 8in. long, are soldered to the coil ends, joints being covered with sleeving.

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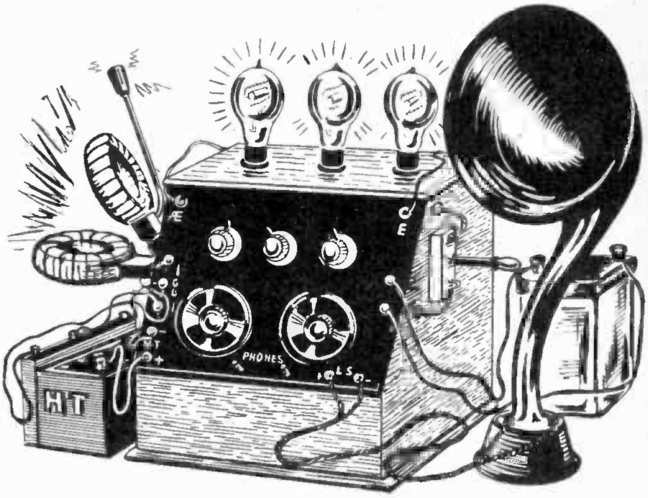

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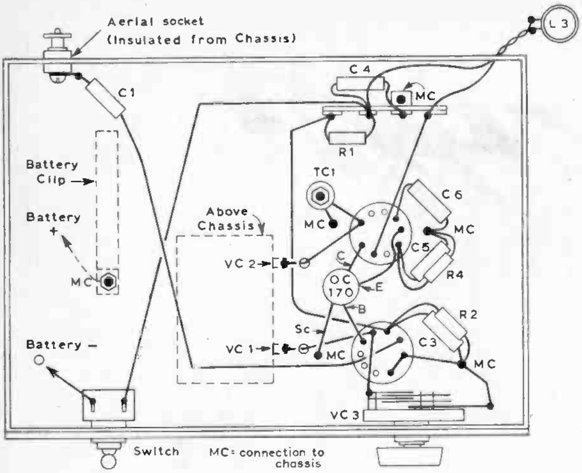


Fig. 2: Under chassis wiring.

The flex is twisted together, to pass through a hole and connect as in Fig. 2.

COUPLING

This is from L3 to the transistor receiver ferrite rod aerial winding, achieved by slipping L3 onto the ferrite rod. Coupling was sufficient with L3 on the end of the rod opposite to that bearing the medium wave winding.

Some receivers have a coupling winding, for external aerial. This generally has roughly ten turns, and can be used as L3. It is then possible to arrange that the converter can be plugged into the receiver aerial socket. A *long* flexible or screened lead should not be used between converter and receiver.

With a miniature and enclosed receiver, coupling can be obtained by situating L3 near the end of the ferrite rod, adjacent to the m.w. winding, but outside the case. It is also possible to put a ferrite rod or core in L3, and situate this near the receiver aerial rod.

The "Experimenters 6" receiver has variable aerial trimming, so no loss of sensitivity results from misalignment. But with other receivers coupling needs to be fairly loose, or alignment of aerial and oscillator circuits will be upset.

NOTES ON USE

The receiver is tuned to a point near the high frequency (low wavelength) end of the m.w. band where no station is heard. This will generally be around 1·6 to 1·4Mc/s (188-210 metres).

All tuning is then done on the converter. VC3 should be adjusted to peak for best volume throughout the band. Incorrect adjustment of TC1 or L1 and L2 cores will not normally cause lack of efficiency *provided* VC3 peaks up for best volume and is not fully open or fully closed.

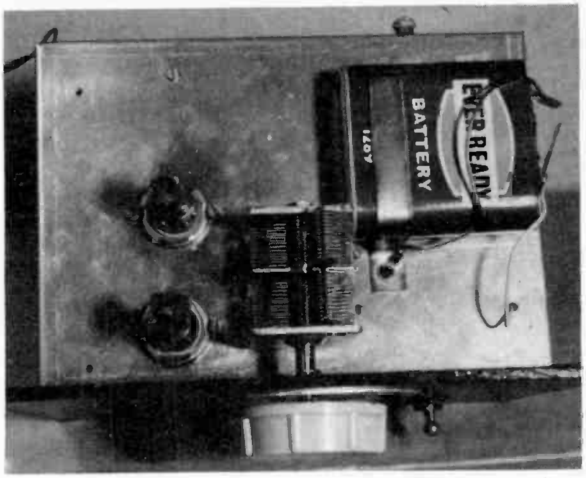
For correct alignment and band coverage, adjust L1 and L2 cores near the l.f. end of the band, and TC1 near the h.f. end, until little adjustment of VC3 is needed.

If a medium wave transmission is received when the converter is switched *off*, output from the converter will beat with this signal when the converter is in use, causing whistles on all signals. This is avoided by tuning the receiver carefully to avoid any signal when the converter is off.

The high i.f. gives reasonable freedom from second channel whistles, but some always become apparent on high frequency short wave ranges. Generally, they are not particularly troublesome.

Should any form of continuous oscillation be experienced, keep the converter aerial lead away from the broadcast receiver. If this continues it is worth trying an earth on the converter. Also place the receiver to avoid unnecessary coupling between its coils etc. and the converter. With a receiver close to the converter chassis and coils, it was found helpful to use the coil cans and lids as screens for the coils. With the same receiver clear of the coils, screening the latter was unnecessary.

As mentioned previously some receiver circuits require a resistor at X, see Fig. 1. If soldered directly to tag 8 of the coil holder, this can greatly help reduce whistles from excess oscillation.



Top view of completed converter.

★ components list

Resistors:

R1	10kΩ	R3	1·2kΩ
R2	2·7kΩ	R4	1kΩ

All 10% ½ watt miniature

Capacitors:

C1	100pF	C4	0·1μF
C2	0·04μF	C5	0·01μF
C3	0·01μF	C6	1000pF

VC1/VC2 Twin gang air-spaced variable 300pF or similar
VC3 50pF small air-spaced variable
TC1 30pF beehive trimmer

Coils:

L1 Denco Blue Range 4
L2 Denco White Range 4
L3 See text

Miscellaneous:

Reduction drive, two B9A valveholders, OC170 transistor, chassis (about 7 x 5 x 2½in.), on/off toggle switch, knobs, tagstrip etc.

practically wireless commentary by HENRY

No. 52

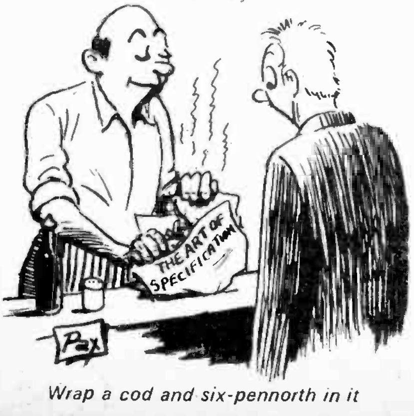
Up to Spec.

TEARING up some back copies of *Electronics Weekly* for the local chip-shop, Henry came across an article previously overlooked.

It seemed a pity to wrap a cod fillet and six-pennorth in anything as tantalising as *'The art of specification'*. The use of the word 'art' again proved the value of serendipity, and Charles Gunner of GEC-AEI certainly made this scribe think twice about what he had always taken to be a science.

As a Member of the Institute of Measurement and Control, Mr. G. may be excused for saying, provocatively: *'Electronic engineers are perfectly familiar with specifications, but the individual engineer probably has never stopped to consider either why specifications are necessary or what they really expect a specification to tell them.'*

Overlooking his own lack of control over the tensing of that statement, we must ask what the top lad of Inspection requires a specification to tell *him*. And we find that even a simple resistor amasses a dossier as involved as a *holly roth* plot. When Joe calls: *'Chuck us over a forty-seven-K, mate,'* you can make him feel it would be easier to go and fetch it himself by simply querying all of the fourteen different limiting tolerances one by one. No wonder the Stanmore Laboratories report that test time for a 'simple item' like a resistor costs more than the bill for making it!



Wrap a cod and six-pennorth in it

Now, please—before you descend on Henry for belittling the need for specifications, let's see what else Mr. Gunner had to say about the gentle art. Specifications are necessary, he says, for quality control, reliability assessment and economy of effort. All concerned with production should try to convince laboratory and design staff that specs are not just a tool for the convenience of production staff. They are as much a part of production as a set of drawings . . . *a good laboratory engineer will consider the specification to be as much an end product of his work as the unit or component which he has designed.*

Those are my italics, not Mr. Gunner's. They make one realise, if one discounts the slight whiff of sour grapes, that the airy world of upper-echelon electronics is as much beset by inter-departmental war as the factory floor. As one who did his stint in the inspection department of a couple of radio factories, as well as the cosier regulated world of the Services, Henry can speak with some feeling on the bending of specifications to suit the Production Manager's bonus chart.

A small hint of this is gleaned from a later example quoted in the article which is currently giving us a subject to chew over. Component engineers, while admitting that a sales sheet for their product states it *'complies with an American MIL specification'*, go on to tell you that *'in that particular case'*, whole sections of this very comprehensive specification have *'been conceded'*.

Lovely term—conceded. Can you not see it on the brochure of a 'High Fidelity System'? *The equipment conforms with British Standard XYZ:1969:47Q, sections 3a to 45 conceded.* Mr.

The slight whiff of sour grapes

Gunner would probably wave a deprecatory hand toward such unimportant gear as our domestic music-boxes, but the consumer industry needs someone as dedicated as he, especially in the field of so-called high fidelity.

Let us conclude with one beautiful example, from M. Horowitz' book: *'Measuring Hi-Fi Amplifiers'*. By means of juggling the output power ratings, he tells us, it can almost be proved that no low-power amplifiers exist! Take a modest 12-watt stereo amplifier. Two 12 watts r.m.s. can be said, tongue-in-cheek, to equal a total of 36 watts IHFM 'Music Power'. Now the specifications of music power assume no power supply voltage change with signal change and define test conditions. Sinewave power at a predetermined distortion level is measured. But *peak* IHFM power is twice the sinewave power, so the copy-writer can fairly legitimately double his figures, to get a 72-watt 'Peak-IHFM Amplifier'.

What about the distortion level? Well, if we come back along the roll-off curve, and carefully forget to state that the frequency response figure was measured at a different power level, you can get away with calling this modest amplifier an 80-watt job. Look carefully at those 'specifications' before buying!

P.W. GUIDE TO COMPONENTS

PART 2

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

CAPACITORS are essential components in electronic circuits. They function as tuning, smoothing, timing and d.c. blocking components. The basic unit of capacitance is the farad, though microfarads (μF or m.f.d.) and picofarads (pF) are in practice used: they are farads divided by 10^{+6} and 10^{+12} respectively. Nanofarads and kilopicofarads are also in use: 1nF=1kpF=1,000pF=0·001μF.

Values and Tolerances

Capacitors are frequently marked numerically with their capacitance value, usually together with the voltage rating and polarity if any. However microminiaturisation has resulted in an increase in the use of colour coding. Due to the diversity of shapes and sizes of capacitors colour coding is not standardised and the manufacturer's data should be consulted. As a general rule the value is given as for the resistor coding but with the capacitance in picofarads. Tolerance and voltage ratings are given special colours by the manufacturer.

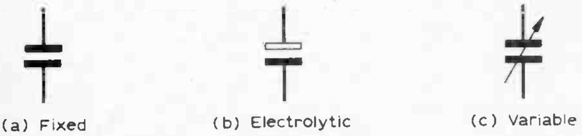
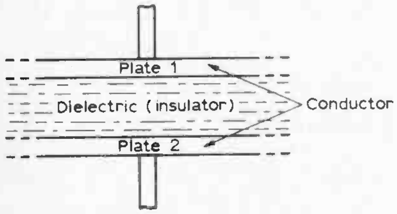


Fig. 1: Capacitor circuit symbols.



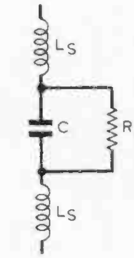


Fig. 2: Basic capacitor construction.

Fig. 3 (right): Capacitor equivalent circuit: the inductance of the leads and resistance of the dielectric affect the performance of a capacitor in practice.

Capacitors are available in the capacitance range 0·5pF to 500,000μF and with tolerance ratings of better than $\pm\frac{1}{2}$% to +100% −20%. Tolerance generally increases with the larger values of capacitance. Cost increases for miniature styles, high capacitance values, and very high voltage working.

Commonly low value capacitors are available in the values given in Table 1. This cannot be regarded as a definite standard as in the case of resistors, and for the higher values of capacitance above approximately 1,000pF many non-standard values appear. Most manufacturers follow the values of Table 2 for the higher values of capacitance.

Notable exceptions are values such as 200pF and 500pF which appear in the various ranges up to 0·5μF. For electrolytic capacitors above 0·1μF many non-standard values appear. As electrolytics are mainly used for smoothing or coupling and their tolerance is often +50% −10% these variations are insignificant as the absolute value is rarely important.

Ideal Capacitor Characteristics

Ideally a capacitor is constructed as shown in Fig. 2, with two conducting plates separated by a perfect insulator or dielectric. As the plates are isolated they effectively block the passage of direct currents and the resistance of the dielectric determines the usefulness of the capacitor for this purpose. Capacitors do however transmit alternating currents. This is because of the large area of the plates which require a large increase of charge to give a change of voltage across them. Thus the voltage across a capacitor cannot change instantly,

Table 1: Generally Available Capacitors 2·2pF—1000pF

Common Values	*Other Values*	*Common Values*	*Other Values*
10	—	39	—
15	—	47	50
18	20	56	—
22	25	68	75
27	30	82	—
33	—	100	—

Table 2: Generally Available Capacitors—High Values
(values in microfarads—μF)

Non-Electrolytic		*Electrolytic*		*Electrolytic*	
Common Values	*Other Values*	*Common Values*	*Other Values*	*Common Values*	*Other Values*
0·001	0·0015	1	1·5	500	—
0·0022	0·002	2	4	1000	1250
0·0033	—	5	6	2000	1500
0·0047	0·005	10	8	2500	—
0·0068	—	15	16	5000	—
0·01	—	25	32	10,000	12,500
Up	Up	50	60	25,000	20,000
to	to	100	—	50,000	—
10	5	150	200	100,000	—
		250	—	500,000	—

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EMI Junior Mains	£2.19.6	Garrard AT60	£12.19.6
Garrard SRP22 ..	£6.19.6	BSR Transcription Stereo/Mono	UA70 £12.19.6

All fitted LP/78 stylii mono pickup crystal complete.

Stereo/mono 20/- extra except UA70

GARRARD TEAKWOOD BASE WB.1. Ready cut out for mounting 1000, 2000, 3000, SP25, AT60. **GARRARD PERSPEX COVER SPC.1 for WB.1** **65/-** EACH

PICK-UP ARM Complete with ACOS LP-78 Turnover GP67 and Stylii 29/6; GP67 17/6; Stereo Ceramic 35/-.

CRYSTAL MIKE INSERTS

1½ × ¾in. 6/6; ACOS 1¾ × ¾in. 8/6. BM3, 1" dia. 9/6
MOVING COIL MIKE with Remote Control Switch 19/6

PORTABLE TRANSISTOR AMPLIFIER

Many uses. Intercoms, Baby Alarms, Guitar Practice, Telephone or Record Player Amplifier. **ONE WATT OUTPUT** Wooden cabinet 12 × 9 × 4in. Rexine covered two tone grey. Four transistors. 7 × 4in. speaker. Volume control. Jack socket. Uses PP9 battery. **WORTH DOUBLE OUR PRICE** **79/6** Post 5/6.

COLLARO BATTERY RECORD DECKS

4 speed model 9v. operated. Complete with pick-up fitted crystal cartridge. Plays 7, 10, 12in. records. Fitted auto, stop and start. Ideal for use with above transistor amplifiers. OUR PRICE **69/6** POST 2/6

THE ABOVE GRANADA AMPLIFIER AND PLAYER DECK POST FREE IF PURCHASED TOGETHER.

WEYRAD P50—TRANSISTOR COILS

RA8W 6in. Ferrite Aerial with car aerial coil....	12/6	Spare Cores	6d.
Osc. P50/1AC	5/4	Driver Trans. LFDT4.	9/6
I.F. P50/2CC 470 kc/s..	5/7	Printed Circuit, PCA1.	9/6
3rd I.F. P50/3CC.......	6/-	J.B. Tuning Gang	10/6
		Weyrad Booklet	2/-

Telescopic Chrome Aerials 6in. extends to 23in. 5/-.

Ferrite Rod 8 x ⅜in. 4/-; 6 x ¼in. 5/-.

VOLUME CONTROLS

Long spindles. Midget Size 5K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/- **STEREO** L/S 10/6, D.P. 14/6. **5K.** S.P. Edge type, 5/-.

80 Ohm Coax 8D yd.

SEMI-AIR SPACED 40 yd. 20/-; 60 yd. 30/-. **FRINGE LOW LOSS** Ideal 625 lines yd. **1/6**

VEROBOARD 0·15 MATRIX
2½ × 5in. 3/8. 2½ × 3¾in. 3/2. 3¾ × 3¾in. 3/8. 3¾ × 5in. 5/2.
EDGE CONNECTORS 16 way 5/-; 24 way 7/6.
PINS 36 per packet 3/4. **FACE CUTTERS** 7/6.
S.R.B.P. Board **0·15 MATRIX** 2½in. wide 6d. per 1in. 3¾in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.).
S.R.B.P. undrilled 1/16in. Board. 10 × 8in. 3/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides 7 × 4in., 5/6; 9 × 7in., 6/6; 11 × 3in., 6/6; 11 × 7in. 7/6; 13 × 9in., 9/6; 14 × 11in., 12/6; 15 × 14in., 15/-.
ALUMINIUM PANELS 18 s.w.g. 12 × 12 in. 6/6; 14 × 9 in. 5/6; 12 × 8 in. 4/6; 10 × 7 in. 3/6; 8 × 6 in. 2/6; 6 × 4 in. 1/6.

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key

⅜in.	16/-	⅝in.	17/6	1⅛in.	19/6	1½in.	24/-	2³/₃₂in.	44/3
½in.	16/-	1in.	19/6	1¼in.	20/6	1¾in.	29/-	2½in.	57/3
¾in.	16/9	1¹/₁₆in	19/6	1⅜in.	21/6	2in.	39/-	1in. sq.	36/6

'SONOCOLOR' CINE RECORDING TAPE

5" reel, 900' with LP strobe markings, also cine light deflector-mirror for synchronisation. 14/- each.

Tape Spools 2/6. Tape Splicer 5/-. Leader Tape 4/6. Reuter Tape Heads for Collaro models 2 track 21/- pair. **UNIVERSAL TAPE CASSETTES** Type C60. **OUR PRICE** 14/-.

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

35/- Post 2/6.

200/250 v. A.C. Leaflet S.A.E.

MERRY CHRISTMAS

BARGAIN STEREO/MONO SYSTEM

Attractive Slimline PLAYER CABINET with B.S.R. UA25 Deck, 4 + 4 AMPLIFIER and TWO matched LOUDSPEAKERS Post 10/6 (Only 4 pairs of wires to join). **£19.19.6.**

NEW TUBULAR		ELECTROLYTICS		CAN TYPES	
2/350V ..	2/3	100/25V ..	2/-	8/600V ..	9/6
4/350V ..	2/3	250/25V ..	2/6	16/600V ..	12/6
8/450V ..	2/3	500/25V ..	4/-	16 + 500V ..	7/6
16/450V ..	3/-	8 + 8/450V ..	3/6	32 + 32/250V	3/6
32/450V ..	3/9	8 + 16/450V ..	3/9	50 + 50/350V	7/-
25/25V ..	1/9	16 + 16/450V	4/3	60 + 100/350V	11/6
50/50V ..	2/-	32 + 32/350V	4/6	8000/30V ..	8/6

SUB.MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250mF 15V 2/-; 500, 1000mF 12V 3/6; 2000mF 25V 7/-.
CERAMIC. 500V 1pF to 0.01mF, 9d. Discs 1/-.
PAPER 350V-0·1 9d; 0·5 2/6; 1mF 3/-; 2mF 150V 3/-. 500V-0·001 to 0·05 9d; 0·1 1/-; 0·25 1/6; 0·5 3/-. 1,000V-0·001, 0·0022, 0·0047, 0·01, 0·02, 1/6; 0·047, 0·1, 2/6.
SILVER MICA. Close tolerance 1%. 5-500pF 1/-; 560-2,2200pF 2/-; 2,700-5,600pF 3/6; 6,800pF-0·01, mfd 6/- each.
TWIN GANG. "0-0" 208pF + 176pF, 10/6; 365pF, miniature 10/-; 500pF standard with trimmers, 9/6; 500pF midget less trimmers, 7/6; 500pF slow motion, standard 9/-; small 3-gang 500pF 18/9. Single "O" 365pF 7/6. Twin 10/-.
SHORT WAVE. Single 10pF, 25pF, 50pF, 75pF, 100pF, 160pF, 5/6 each. Can be ganged. Couplers 9d. each.
TUNING. Solid dielectric. 100pF, 300pF, 500pF, 4/6 each.
TRIMMERS. Compression ceramic 30, 50, 70pF. 1/-; 100pF, 150pF, 1/3; 250pF, 1/6; 600pF, 750pF, 1/9; 1000pF, 2/6.

250V RECTIFIERS. Selenium ½ wave 100mA 5/-; BY100 10/-.
CONTACT COOLED ½ wave 60mA 7/6; 85mA 9/6.
Full Wave Bridge 75mA 10/-; 150mA 19/6; TV rects. 10/-.
NEON PANEL INDICATORS. 250v. AC/DC, 3/6.
RESISTORS. Preferred values, 10 ohms to 10 meg.
¼w., ½w., 1w., 20% 3d.; 1½w. 8d.; 2w. 1/-; ½w. 10% 6d.
HIGH STABILITY. ½w. 1%. 10 ohms to 10 meg. 2/-.
Ditto 5%. Preferred values 10 ohms to 22 meg., 9d.

5 watt, 10 watt, 15 watt — **WIRE-WOUND RESISTORS** 0·5 to 8·2 ohm 3w. 10 ohms to 6,800 ohms — 2/-, 2/-, 2/-
10K, 15K, 20K, 25K, 68K, 10W. 3/-

FULL WAVE BRIDGE CHARGER RECTIFIERS:
6 or 12v. outputs. 1½ amp. 8/9; 2a., 11/3; 4a., 17/6.
CHARGER TRANSFORMERS, P. & P. 5/-. Input 200/250v. for 6 or 12v., 1½ amps., 17/6; 2 amps., 21/-; 4 amps., 30/-.

WIRE-WOUND 3-WATT POTS. T.V. Type. Values 10 ohms to 30K., Carbon 30K to 2 meg. **4/6**

WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE 50 OHMS to 100 K., **7/6**

VALVE HOLDERS, MOULDED 9d.; CERAMIC 1/- EACH.

NEW MULLARD TRANSISTORS 6/- each

OC71, OC72, OC81, OC44, OC45, OC171, OC170, AF117

REPANCO TRANSISTOR TRANSFORMERS
TT45. Push Pull Drive, 9:1 CT, 6/-. TT46 Output, CT8:1, 6/-. TT49. Interstage 20:1, 6/-; TT52 Output 3 ohms, 4·5:1, 6/-.
PAIR 10W Amp. Transformer and circuit 45/-.

TRANSISTOR MAINS POWER PACK. FAMOUS MAKE. FULLY SMOOTHED. FULL WAVE CIRCUIT 9 Volt 500mA Size 5 × 3½ × 2in. **49/6**
TRANSFORMER ONLY. Size 2½ × 1¾ × 1¾in. 9 volt 10/6.

MAINS TRANSFORMERS

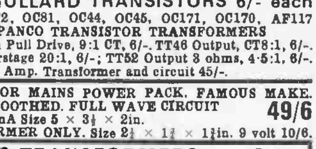
Post 5/- each

250-0-250 50 mA. 6·3v. 2a. Centre tapped	19/6
250-0-250 80mA. 6.3v. 3.5a. 6.3v. 1a. or 5v. 2a...	30/-
350-0-350 80mA. 6.3v. 3.5a. 6.3v. 1a. or 5v. 2a....	35/-
300-0-300v. 120mA., 6.3v. 4a. C.T.; 6.3v. 2a.	45/-
MINIATURE 200v. 20mA., 6.3v. 1a.	12/6
MIDGET 220v. 45mA., 6.3v. 2a	17/6
HEATER TRANS. 6.3v. 1½a., 8/6; 6.3v. 4a.	12/6
Ditto tapped sec. 1.4v., 2, 3, 4, 5, 6.3v. 1½ amp. ...	12/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, and 30v. at 2a....	30/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	35/-
3 amp., 0-12v. and 0-18v.	19/6

AUTO TRANSFORMERS 0–115–230v. Input/Output, 60w. 18/6; 150w. 30/-; 500w. 92/6; 1000w. 175/-.

COAXIAL PLUG 1/3. **PANEL SOCKETS** 1/3. **LINE** 2/-. **OUTLET BOXES. SURFACE OR FLUSH** 4/6. **BALANCED TWIN FEEDERS** 1/- yd. 80 ohms or 300 ohms. **JACK SOCKETS** Std. open-circuit 2/6, closed circuit 4/6; Chrome Lead Socket 7/6. Phono Plugs 1/-. Phono Socket 1/-. **JACK PLUGS** Std. Chrome 3/-; 3·5 mm Chrome 2/6.
DIN SOCKETS Chassis 3-pin 1/6; 5-pin 2/-.
DIN SOCKETS Lead 3-pin 3/6; 5-pin 5/-.
DIN PLUGS 3-pin 3/6; 5-pin 5/-.
WAVE-CHANGE SWITCHES WITH LONG SPINDLES.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 4/6 each.
1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 4/6 each.
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/-.
Additional wafers 5/- each wafer up to 12 max.
TOGGLE SWITCHES, sp. 2/6; sp. dt. 3/6; dp. 3/6; dp dt. 4/6.

1969 GRAM CHASSIS



Post 6/-

Three Wavebands: Long, Med., Short, Gram. Five Valves: ECH81, EF89, EBC81, EL84, EZ80. 12-month guarantee. A.C. 200-250v. Ferrite Aerial 5 watts 3 ohm. Chassis 13½in. × 7in. × 5in. dial size 13in. × 4in. Two pilot Lamps. Four Knobs. Aligned calibrated. Chassis isolated from mains **£10.19**

DE LUXE STEREO GRAM CHASSIS V.H.F., MW, SW 19-50m. SW 60-180m. Magic eye, push buttons. 6 valve plus rect. Size 15 × 7½ × 6in. high. **£19.19**

BAKER MAJOR £8

30–14, 500c.p.s., Hi-Fi double cone, woofer and tweeter cone together with a special **BAKER** magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 45 c.p.s. Rated 20 watts. Voice coils available 3 or 8 or 15 ohms. Price £8, or Module kit. 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. £10.19.6

LOUDSPEAKER CABINET WADDING 18in. wide, 2/6ft.

BAKER "GROUP SOUND" SPEAKERS—POST FREE

'Group 25'	'Group 35'	'Group 50'
12in. 25w. **6 gns.**	12in. 35w. **8½ gns.**	15in. 50w. **18 gns.**

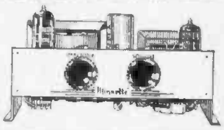
ALL MODELS "BAKER SPEAKERS" IN STOCK

E.M.I. Cone Tweeter 3½in. square, 3-20kc/s. 10W 17/6. Quality Horn Tweeters 2-18kc/s, 10W 29/6. Crossover 16/6.
LOUDSPEAKERS P.M. 3 OHMS. 2½in, 3in, 4in, 5in, 7 × 4in, 15/6 each; 8in 22/6; 6½in 18/6; 10in 30/-; 12in. Double cone 3 or 15 ohm 35/-; 10 × 6in. 30/-; 8 × 5in. 21/-.
E.M.I. Double Cone 13½ × 8in., 3 or 15 ohm models, 45/-, or with twin tweeters crossover and H/D magnet, 79/6.
SPECIAL OFFER! 8 ohm, 2½in; 80 ohm, 2½in, 2½in; 25 ohm, 6 × 4in; 35 ohm, 8in; 15 ohm, 10 × 2½in. 7 × 4in. **15/6** EACH TYPE
O/P TRANS. EL84 etc. 4/6; MIKE TRANS. 50:1, 3/9.
SPEAKER FRET Tygan various. SAMPLES S.A.E.

ALL PURPOSE HEADPHONES

H.R. HEADPHONES 2000 ohms General Purpose ..	19/6
H.R. HEADPHONES 2000 ohms Super Sensitive ..	35/-
LOW RESISTANCE HEADPHONES 3-5 ohms	35/-
DE LUXE PADDED STEREO PHONES 8 ohms	79/6

MINETTE AMPLIFIER



For all Record Players. A.C. Mains Transformer. Chassis size 7 × 3½ × 4in. High. Valves ECL82, EZ80. Quality output 3 ohm matching. Bargain offer complete with engraved control panel, valves, knobs, volume and tone controls, wired and tested. 12 month guarantee. Post 5/6 **79/6**

ALL EAGLE PRODUCTS

SUPPLIED AT LOWEST PRICES

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **79/6**

BARGAIN DE LUXE TAPE SPLICER Cuts, trims, joins for editing and repairs. With 3 blades. **17/6**

BARGAIN 4 CHANNEL TRANSISTOR MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **59/6**

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. Ready built. Printed Circuit. Calibrated slide dial tuning. Size 6 × 4 × 2½in. 9 volt. **£6.19.6.**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **69/6**

40-PAGE EAGLE CATALOGUE 5/- Post Free

★ RADIO BOOKS ★ (Postage 9d.)

Practical Transistor Receivers	5/-
Practical Stereo Handbook	3/6
Supersensitive Transistor Pocket Radio	3/6
High Fidelity Speaker Enclosures and Plans	5/-
Radio Valve Guide, Books 1, 2, 3, or 4 ea. 5/- No. 5 ea.	6/-
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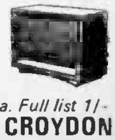
Wireless World Radio Valve Data	9/6
At a glance valve equivalents..............	6/-
Valves, Transistors, Diodes equivalents manual	10/6
How to receive Foreign T.V programmes on your set by simple modifications	5/-

SANGAMO 3 inch SCALE METERS

Various calibrations/movements, 500 Microamp; 1 Milliamp; 50-0-50 Microamp, etc. S.A.E. for list. **45/-**

POCKET MOVING COIL MULTIMETER. 0-1,000 AC./DC. ohms 0 to 100k, etc. **49/6**
SUPERIOR MOVING COIL MULTIMETER 0-2-500v.D.C. 20,000 ohms per volt, 0-1,000v. A.C. Ohms 0 to 6 meg. 50 Microamps (Full list Meters S.A.E.) **99/6**

BRAND NEW QUALITY EXTENSION LOUDSPEAKER



Black plastic cabinet. 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohms. PRICE **30/-** Size: 7½ × 5½ × 3in. POST 2/6

Minimum Post and Packing charge 2/6. *C.O.D. 5/- extra. Full list 1/-*

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, WEST CROYDON

Written guarantee with every purchase. *(Export—send remittance and extra postage, no C.O.D.)* Buses 133, 68 pass door. S.R. Stn. Selhurst Tel. 01-684-166

Fully guaranteed Individually packed VALVES

PERSONAL CALLERS WELCOME

Open 9-12.30, 1.30-5.30 p.m. Thursday 9-1 p.m.

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. Orders up to 10/-, 1/-; 10/- to £1, 2/-; over £1, 2/- per £1; over £3 post free. C.O.D. 4/- extra

COLOMOR brand — ALL valves guaranteed

AC/HL	6/-
ARP3	3/-
ARP12	3/6
AR8	5/-
ARTP1	6/-
ATP4	2/3
AZ31	9/-
BD78	40/-
BL63	10/-
B2134	16/-
BT35	55/-
BT45	150/-
BT83	35/-
CV102	3/-
CV103	4/-
CV315 (matched pair)	120/-
CV315 (Single)	50/-
CY31	7/6
D41	6/-
D77	3/-
DA100	£6
DAF96	6/-
DD41	4/-
DET20	2/-
DET25	10/-
DF91	3/-
DF92	2/6
DF96	7/3
DK92	8/6
DK96	7/3
DL63	8/-
DL92	4/-
DL93	4/-
DL94	6/6
DL96	7/3
DL810	12/-
DY86	6/-
DY87	6/6
E80F	18/-
E88CC	8/-
E90CC	8/-
E91H	7/-
E92CC	5/-
E180CC	7/-
E182CC	14/-
E1148	2/6
E2134	8/-
EA50	1/-
EA76	7/-
EABC80	6/-
EAC91	3/-
EAF42	9/9
EB91	2/-
EBC33	8/-
EBC41	9/3
EBC81	5/9
EBF80	6/9
EBF83	8/6
EBF89	6/-
EC53	8/-
EC70	4/-
EC90	4/-
EC91	8/-
ECC33	12/-
ECC81	4/-
ECC82	4/3
ECC83	5/6
ECC84	6/-
ECC85	5/4
ECC88	7/-
ECC91	4/-
ECC189	9/9
ECF80	6/6

ECF82	6/6
ECH35	11/-
ECH42	10/-
ECH81	5/6
ECH83	8/6
ECL80	7/-
ECL82	6/-
ECL83	10/-
ECL86	8/-
EF36	3/4
EF37A	8/-
EF39	6/-
EF40	9/-
EF41	10/-
EF50	4/6
EF80	4/6
EF81	6/-
EF85	6/6
EF86	6/3
EF89	5/-
EF91	3/-
EF92	2/6
EF95	5/-
EF183	7/-
EF184	6/-
EH90	7/-
EL31	15/-
EL32	3/9
EL34	10/3
EL35	5/-
EL38	17/6
EL41	9/3
EL42	11/-
EL50	8/-
EL81	9/-
EL84	4/6
EL85	7/6
EL91	2/6
EL95	5/6
EL360	22/-
EM31	5/-
EM80	7/-
EM81	8/-
EM84	7/-
EN92	5/-
ESU74	80/-
EY51	7/-
EY86	6/6
EY91	2/6
EZ40	7/6
EZ41	8/-
EZ80	5/-
EZ81	5/-
FW4/500	6/-
FW4/800	10/-
G/371K	57/6
G1/370K	20/-
G50/2G	20/-
G120/1B	35/-
GM4	45/-
GU50	28/-
GZ32	9/6
GZ34	11/6
H30	3/6
HL2	4/-
HL2K	2/6
HL23DD	5/-
HL41	4/-
HVR2	9/-
KT8C	32/6
KT63	4/-
KT66	18/6
KT67	45/-
KT71	7/6

KT76	7/-
KT88	27/-
KTZ63	7/-
L63	6/-
MH41	8/-
MHLD6	7/6
ML6	6/-
N34	8/-
N78	15/-
OA2	6/-
OB2	6/-
OB3	7/-
OC3	6/-
OD3	6/-
OZ4A	5/-
P41	7/-
PABC80	7/6
PC86	10/3
PC97	9/-
PC900	8/9
PCC84	6/3
PCC89	9/6
PCC189	12/-
PCF80	6/6
PCF82	6/3
PCF84	9/3
PCF86	8/9
PCF801	9/-
PCF802	9/-
PCF805	12/6
PCF808	14/6
PCL81	9/-
PCL82	7/-
PCL83	9/6
PCL84	8/-
PCL85	8/6
PCL86	8/6
PFL200	13/-
PL36	9/9
PL38	18/3
PL81	7/6
PL82	8/-
PL83	6/9
PL84	6/6
PL500	13/6
PX4	14/-
PX25	12/6
PY33	9/3
PY80	6/-
PY81	5/6
PY82	5/9
PY83	6/6
PY88	7/-
PY800	9/-
PY801	9/-
QQVO3-10	27/6
QQVO6-40	85/-
QQVO6-40A	100/-
QS150/15	7/6
QS95/10	5/-
QS1200	10/-
QS1202	8/-
QVO4/7	8/2
R10	17/6
RG1/240A	28/-
SP61	3/3
STV280/40	60/-
SU2150A	10/-
TDOX-20	70/-

TP22	5/-
TP25	5/-
TT11	3/-
TT15	55/-
TTR31	45/-
TZ40	60/-
TZO520	4/-
TZ20	16/-
U12/14	7/-
U18	6/-
U25	14/6
U26	14/6
U27	8/-
U52	4/6
U81	18/-
U191	14/-
U404	6/-
U801	9/6

VR105/30	6/-
VR150/30	6/-
VU39	7/-
W118	10/-
W119	9/-
X65	5/-
X66	7/6
X76M	7/-
X118	8/-
X145	8/-
Y63	6/6
Y65	4/-
Z800U	29/-
Z801U	25/-
Z900T	12/-
1B22	30/-

1C5GT	6/-
1D8GT	6/-
1G6GT	6/-
1L4	2/6
1LA6	6/-
1LC6	7/-
1LH4	4/-
1R5	6/-
1S4	5/-
1S5	4/6
1T4	3/-
2A3	5/-
2D21	4/9
3A4	4/-
3B7	5/-
3B24	14/-
3D6	3/-

3E29	50/-
3Q4	8/-
3Q5GT	6/-
3S4	5/9
3V4	6/6
4D1	4/-
5A173G	5/-
5A174G	5/-
5B251M	40/-
5B252M	35/-
5B253M	15/-
5B254M	40/-
5B255M	35/-
5R4GY	9/-
5R4WGA	27/6
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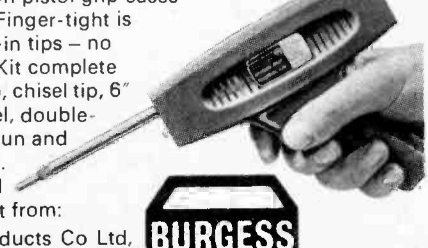

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Table 3: Comparison of Capacitor Types

Type		Value	Tolerance	Voltage	Temperature	Insulation Resistance	Cost
PAPER	Tubular E.H.T.	1000pF—10μF 1000pF—100μF	±10% to ±25% ±20%	200V—800V 200V—2500V	−55°C to +100°C −55°C to +100°C	2000M Ω/μF or >2,000M Ω	8d.—4/- up to 30/- 11/- — £7 10s.
PLASTIC		10pF—1μF 1μF—10μF	±0·1% to ±20% ±20%	30V—500V 30V—63V	−40°C to +125°C	From 1,000M Ω to 1,000,000M Ω	8d.—5/3 up to 15/- 2/-—7/3 up to 35/-
CERAMIC		0·5pF—220pF 200pF—10,000pF 0·01μF—0·47μF	±0·25pF, ±5% ±10% +40% −20% +50% −25%	500V—12kV 500V—750V 6V—30V	−55°C to +85°C −40°C to +85°C	>7,000M Ω	8d.—2/- 7d.—2/6 10d.—4/6
SILVER MICA		1pF—10,000pF	±1%	350V	−40°C to +100°C	25,000M Ω	7d.—17/-
ALUMINIUM ELECTROLYTIC		0·5μF—300μF 0·5μF—10,000μF 10,000μF—500,000μF	−20% to +100% and −20% to +50%	250V—500V 3V—150V 3V—70V	−25°C to +85°C −25°C to +70°C	0·15CV* or not less than 100μA	1/6—17/- 1/3—42/- 40/-—200/-
TANTALUM ELECTROLYTIC	Metal Case Resin Coated	0·1μF—330μF 0·1μF—50μF	±20% +50% −20%	6V—75V 3V—40V	−55°C to 125°C −40°C to +85°C	0·02mA/CV*	3/6—42/- 3/-—5/-
VARIABLE		2pF—500pF	——	100V upwards	−50°C to +100°C	1,000M Ω upwards	1/- upwards

* Permissible leakage current where C = capacitance in μF and V = working voltage.

and at high frequencies it acts as a short-circuit.

The ideal capacitor should therefore have a perfect insulator as the dielectric, and the plates and leads should be perfect conductors with no resistance or inductance. In practice parasitic elements are present as shown in the equivalent circuit of Fig. 3. They consist of a series inductance (L_S) formed by the lead inductance and the wound construction, and a parallel leakage resistance (R_L) which is due to the resistance of the dielectric and any discontinuities and impurities in it. The inductance limits the upper frequency at which the capacitor may be used and the leakage resistance limits the impedance of the circuits in which it may be used.

Design Limitations

Other design limitations are maximum voltage rating, tolerance, operating temperature range, reliability, noise generation, temperature coefficient, maximum ripple current capability, humidity rating, size and cost.

Table 3 gives the more important parameters for the various types of capacitor available. This should be used as a rough guide only, since the range of types of capacitor in each section can be very wide.

The capacitance value of a capacitor is determined by the area of the plates and the thickness of the dielectric. Capacitance is increased by increasing plate area or decreasing the dielectric thickness. Each form of construction and dielectric has particular properties and these will now be considered in greater detail.

Paper

Foil and paper capacitors were one of the earliest forms of capacitor. They are formed by winding two strips of foil with a layer of thin paper between as an insulator, as shown in Fig. 4. The foils are made to extend at either end so that foil 1 overlaps the paper dielectric and forms one end connection while foil 2 overlaps at the other end to form the other connection. This construction used to be insulated by wax and paper, but now either resin or plastic moulding is utilised. Oil-filled and metal encased capacitors are used for e.h.t. working. Metallised paper capacitors are also available, and these generally give smaller dimensions.

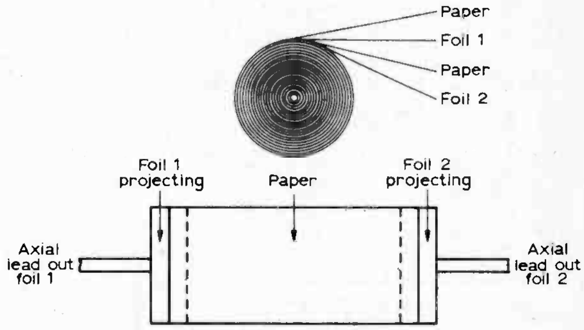


Fig. 4: Construction of a wound foil and paper capacitor, a widely used general purpose type.

Paper and foil capacitors are used as general purpose capacitors and have high working voltages, low leakage, and low cost. Oil-filled capacitors are used for e.h.t. voltage applications. They tend, however, to be bulkier for the same capacitance and voltage rating than modern plastic capacitors.

Plastic Film

Plastic film and metallised capacitors are the natural development of paper capacitors, and they have the same basic construction. Many types of plastic film are used as the dielectric, and each type has properties such as stability or smaller size which constitutes an improvement on the foil and paper styles. Metallising of both paper and plastic film has also considerably reduced the size.

Most plastic capacitors employ metallised film which is a process whereby the film is coated with a thin film of metal by vacuum deposition. Two such rolls of film are wound together to form the capacitor as shown in Fig. 5. The end-overlapping technique is used to provide end connections and a metal is sprayed on to these overlapping ends to provide a solid base for joining the wire connections by soldering or other methods. Encapsulation is usually with plastic, though some of the flat types use lacquer.

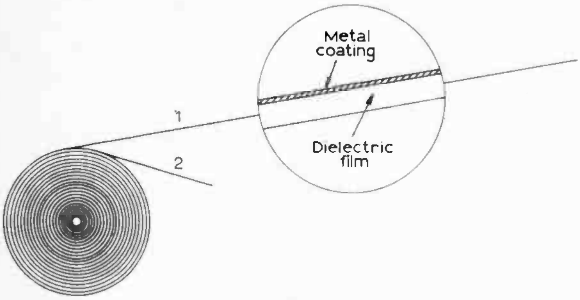


Fig. 5: Metallised film capacitor construction.

Metallised paper capacitors are used for general purpose applications and are smaller than foil and paper types. Polyester capacitors are also used as general purpose capacitors and are low cost, small size, medium voltage (400V) capacitors. They have a wide operating temperature range, close tolerance, and excellent stability. Polystyrene dielectric capacitors, although generally larger than polyester types, are excellent replacements for silver mica capacitors. They are extremely stable, have a negative temperature coefficient, high reliability, extremely high insulation resistance (greater than 10^6 MΩ), close tolerance ($\pm\frac{1}{2}\%$) and have excellent high frequency characteristics (1,000Mc/s). Polycarbonate capacitors have similar performance to the polyester capacitors but are appreciably smaller in size, though their cost is higher. They are useful for miniature circuits and are used in space satellites and rocket equipment. Teflon capacitors are high quality capacitors with high insulation resistance and wide temperature range with a low temperature coefficient. They can be supplied to $\pm 0{\cdot}1\%$ tolerance and matched for temperature coefficients of 5 p.p.m./°C.

Plastic capacitors therefore are of many sorts and are suitable for most applications provided the correct dielectric material is chosen. Polyester capacitors are now utilised as the general purpose low leakage capacitor for medium and low voltage applications over the capacitance range $0{\cdot}001\mu$F to 10μF.

Ceramic

Ceramic capacitors are found in both tubular and disc form. Figure 6 illustrates the construction of a low value tubular capacitor. The capacitance is formed by silvering a ceramic cylinder or disc, the ceramic forming the dielectric. Wire connections are made to each separate coating and the whole construction is insulated with synthetic resin. They are therefore rugged in construction.

The main advantages of this type are extremely small size, low cost, and high frequency of operation. They have a high insulation resistance and can be used up to e.h.t. voltages. The main disadvantage is a very poor temperature coefficient (800 p.p.m./°C) which renders them unsuitable for critical applications. They should

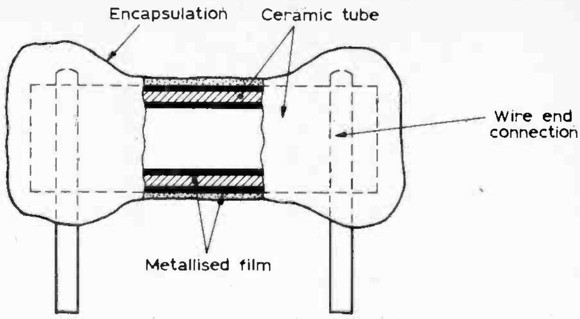


Fig. 6: Tubular ceramic capacitor construction.

not be used for tuning or timing circuits. However they are extremely useful as coupling, decoupling and bypass capacitors, and also as feed-through capacitors up to 5,000Mc/s. Low voltage microminiature plaquette types the size of a match-head are now available.

Silvered Mica

Silvered mica capacitors are manufactured as shown in Fig. 7 by utilising plates of mica with fired-on silver electrodes. The sheets of coated mica are bonded together and the wire connections soldered at each end of the plates. The whole structure is then dipped in resin to give a robust finish.

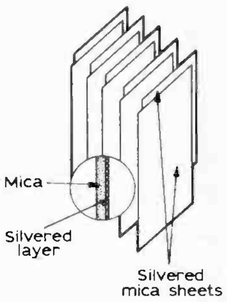


Fig. 7: Construction of a silvered mica capacitor.

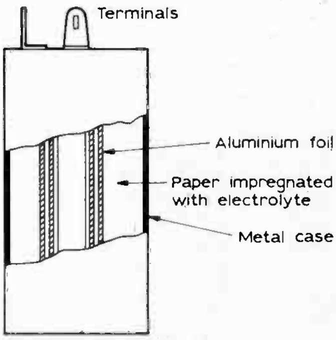


Fig. 8: Construction of an aluminium electrolytic capacitor.

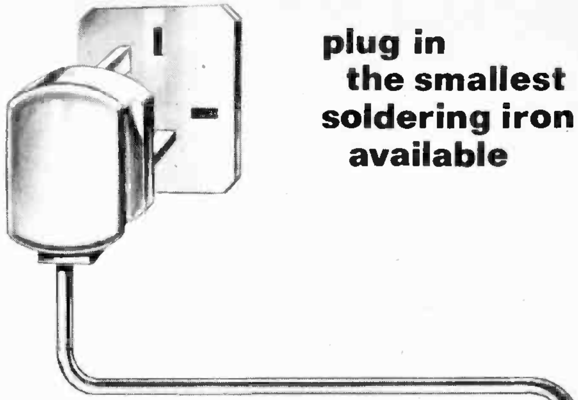
These capacitors are produced in the range 1–10,000 pF, usually with $\pm 1\%$ tolerance They exhibit great stability, reliability and have a high insulation resistance. Hence they are very suitable for critical applications such as timing and oscillatory circuits.

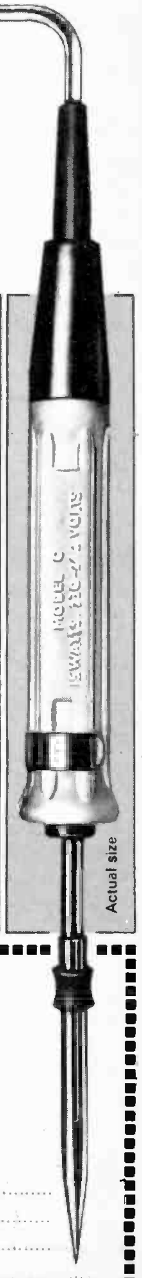
Electrolytic

Two basic forms of electrolytic capacitor are in common use: the aluminium electrolytic and the tantalum electrolytic.

The aluminium electrolytic is the general purpose electrolytic capacitor and is produced over the range $0{\cdot}5\mu$F to $500{,}000\mu$F. They are constructed as shown in Fig. 8 by rolling two strips of aluminium foil with paper dipped in electrolyte as the dielectric. The construction is sealed in a metal case to which one electrode (usually negative) is connected. The case is insulated if required by a plastic sheath. As the electrolyte is a corrosive paste sealing is important to prevent leakage.

These capacitors operate by electrolytic action and are analogous to batteries. They have definite polarities to d.c. voltages and oppose a.c. voltage changes by





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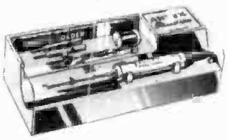

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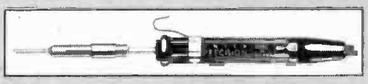

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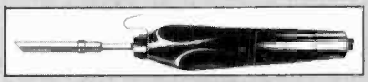

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chemical reaction in a similar fashion to a battery. Generally they are of large physical size, and have a definite lifetime which is determined by the drying up of the electrolyte. By this action very high values of capacitance are achieved. The voltage ratings must be strictly observed, as must the polarities. Since their insulation resistance is low large leakage currents can flow. The explosion of an under-rated electrolytic capacitor is dangerous and very messy. It is worth mentioning that reliability of these capacitors is increased by operating them near to their rated voltage.

Generally these are only used in non-critical applications such as smoothing and decoupling. Tolerances are very large, usually +50% —20%.

Tantalum capacitors, although they employ electrolytic action, use a solid electrolyte. They are considerably smaller than aluminium electrolytics, though more expensive, and are extremely useful for low voltage miniature circuits. Until recently they were only available in a metal-cased form but are now available in a resin encapsulation which has resulted in a considerable price reduction.

Variable Types

Both air spacing and mica dielectric types are available. The capacitance variation is obtained by varying the proximity of the movable vanes to the fixed vanes as shown in Fig. 9. The larger types, which have capacit-

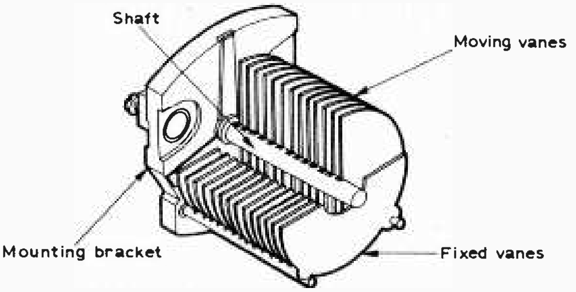

Fig. 9: Typical larger type of air-spaced variable capacitor for oscillator and tuned circuit tuning.

ance variations of 5–500pF, are used for oscillator and tuned circuit tuning purposes and are available in dual and triple ganged configurations. The smaller flat, beehive, or cylindrical types are used as trimming capacitors and after initial tuning are locked in position. These generally have a capacitance range of 2–60pF.

Summary

Metallised paper and polyester capacitors are suitable as general purpose capacitors, with polycarbonate as a miniaturised alternative. Ceramic capacitors are useful for coupling and decoupling at medium and high frequencies, and electrolytic capacitors for these functions at low frequencies. Silvered mica and polystyrene capacitors are ideal for critical applications.

The Future

Trends will be towards the development of cheap, close tolerance, high stability capacitors, probably through the use of modern plastic films. The present types of capacitors will continue to shrink in size and improve in quality. Miniaturisation in the electrolytic sphere will be a continuing trend.

TO BE CONTINUED

THE SOLID STATE

—continued from page 668

Consider the device of Fig. 12 biased as shown. The positive bias on the base relative to the emitter means that current is flowing between the emitter and base. Since the emitter has a considerable surplus of conduction electrons (being heavily doped) and the base has only a slight surplus of holes (being lightly doped) most of this current is carried by electrons.

The other junction, between the base and collector, is reverse biased. Electrons on the n side and holes on the p side are pulled back from the junction and no current would be expected to flow. The base region, however, is very thin, and the electrons which are moving rapidly from the emitter to the base come under the influence of the much higher positive bias at the collector than at the base. Thus most of the electrons from the emitter keep moving straight on, cross the base-collector junction and end up in the top n region to be collected at the positive bias connection of the collector. If the base region is thin enough, a very large proportion of the electrons moving from emitter to base will end up at the collector. For example, we might have an emitter current of 1,000μA (=1mA) with 10μA flowing through the base contact and the remaining 990μA appearing at the collector. This gives us a ratio of collector current to base current of 990/10=99 and this is the quoted figure of current amplification given the symbol h_{fe}. This figure is not absolutely constant: it usually reaches a maximum at some value of collector current (Fig. 13)—

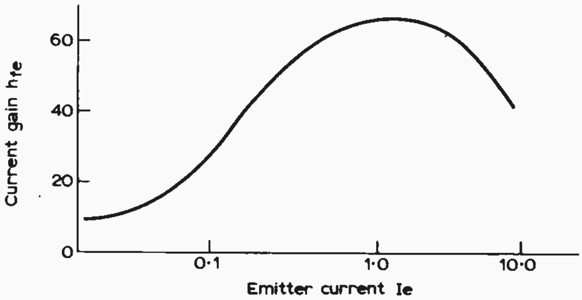

Fig: 13: Typical graph of current gain against emitter (or collector) current for small transistors (common emitter circuit).

usually 1mA in small transistors—so that perfectly linear amplification is not possible though good linearity is possible if the graph of h_{fe} against collector current is flat-topped and the operating conditions are within this region.

The maximum values of h_{fe} which can be obtained depend on how thin the base region can be made, and in this respect very great improvements in performance have been achieved by modern techniques. Probably the most important advance has been the discovery that a crystal of semiconductor exposed to the vapour of the same material will grow in the same crystalline form, but at a slow controllable rate, so that very thin layers can be grown which are still part of the original crystal. This technique is called epitaxy, and the word epitaxial occurs in nearly every description of recent transistor construction.

TO BE CONTINUED

new books

STEREO HANDBOOK

By G. W. Schanz. Published by Iliffe Books Ltd. 135 pages. Size 8½ x 5¾in. Price 16s.

THERE have been so many books on stereo that one more may seem something of a luxury. By producing it as a stiff paper-back and keeping the cost reasonable, Iliffe have made this Philips original a luxury we can all afford. The considerations we must apply are thus: does it say all it should, and, does it add anything new?

On both counts we can recommend this book. Without getting too technical, yet without talking down to the interested reader with babytalk explanations of fundamentals that too often introduce such volumes, the principles of stereophony from the 1,550 experiments of Adraan Willaert with two choirs to the present-day multiplex broadcasts, are intelligently discussed. In particular, the treatment of stereo broadcasting, various methods of decoding and testing decoders will be of interest to PW readers.

The early part of the book quotes some interesting data on room acoustics (we particularly liked the illustration describing reverberation and the frequency dependency of absorption of various materials). Tape and disc recording processes are outlined and practical stereo connections to DIN standard are shown in detail. It is in such matters that the average man, perhaps convinced by a demonstration that stereo is an undoubted advantage, finds the stumbling block. Numerous practical facts on microphones, tape recording and pickups will be found scattered through these early pages. As may be expected, examples of constituent parts of the stereo chain are drawn from Philips products; but this is no deterrent. The overall impression is of a book written with a true desire to impart knowledge, and an undoubted ability to do so.—*BRG.*

POINTS ON PICK-UPS

By P. Wilson. Published by A. C. Farnell. 140 pages. 8½ x 5½in. Price 10s. 6d.

VERY often, the best work on a particular subject is a manufacturer's brochure, or, in some exceptional case, the service manual. Here we have a reference work by a distributor who must originally have commissioned the paperback —some ten years ago—to foster the sales of the goods he handled. Now, though we could not go so far as to say the sales of the book have outstripped the sales of the goods, they must certainly form a pleasing entry in the ledger.

There have been five previous editions of *Points on Pick-ups*, and this, the sixth, has been brought fairly well up to date. It is impossible to keep abreast with innovations in this field, so ripe for development as new materials and newer techniques come along, but the majority of the well-known and popular pickups, cartridges and stylii are illustrated.

The method is to list the cartridges alphabetically as to maker, with a photograph and basic details. On a facing page the stylus appropriate to that cartridge is drawn, with details such as colour code and tip size. Head shells for some cartridges are included, and one section is devoted to pickup arms where these are complete with a particular cartridge. Accessories also receive attention, again with photographic illustration wherever possible.

The introduction to this edition debates the case against compromise while describing the main requirements for compatible (mono-stereo) cartridges, and a two-page note on stylii includes a number of tips on their use (if you will pardon a pun almost as provocative as the title of the book!)

This is such a regular part of the bookshelf of a radio and hi-fi dealer that one tends to forget its additional usefulness to the ordinary chap, who merely wants to identify his stylus before he can order a replacement, or who may, perhaps, be wondering what changes of cartridge he can make. There are omissions: a section on cartridge connections, and a few notes on matching may save unwitting expense for the unwary. But at the price, who can carp? Well worth anyone's half-guinea.—*HWH.*

FUNDAMENTALS OF DIGITAL MAGNETIC TAPE UNITS

By Univac. Published by Foulsham-Sams Technical Books Ltd. 96 pages. Size 8½ x 5½in. Price 21s.

WHO is this bloke Univac, you may ask? This book, whose title is almost as long as the authorship credit, has that classic formulae of having been written by a committee. Well, almost. It was prepared by the Field Engineering Department, Univac Data Processing Division, of the Sperry Rand Corporation, and, as ever, has the introductory chapter for we poor foreigners who cannot understand American, contributed by our old friend, W. Oliver.

Let it be stated at the outset, that digital magnetic tape units are a different proposition from our humble domestic tape recorders, although the fundamental principles remain. Which is not to say that the book is of no interest to the tape recording enthusiast. It may serve as a fruitful source of ideas especially if circuits are studied with care and a trifle of inspiration. This reviewer can see some possibilities in an amplitude detector and a two-polarity RZ "write" circuit for future experiment.

The early chapters deal with magnetic theory, tapes and heads, and the middle section goes into some well-illustrated detail of mechanisms. Again, this is unlikely to be of direct use to the amateur, and it is to be hoped that the professional will have a deeper knowledge than this book endeavours to test.

Nevertheless, the method of writing, with terminal questions to each chapter and an absence of ponderous overstatement, makes the book an interesting addition to the enthusiast's library—if he feels that his marginal interest will justify the layout of a guinea.—*AWB.*

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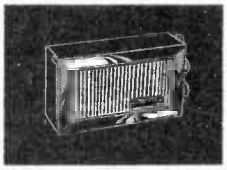

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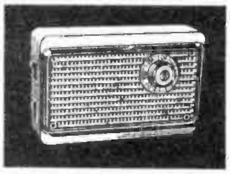

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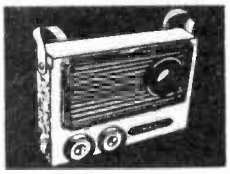

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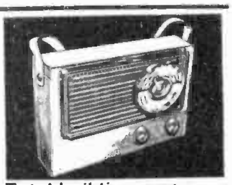

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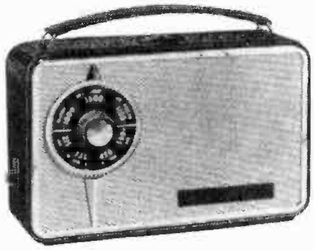

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

MANY of you may be DX-ing over the Christmas and New Year periods and may be wondering what stations put out good seasonal programmes. Well *R. Japan* usually puts out some interesting programmes round about Christmas and New Year in Japan. On Christmas Day I usually listen to *R. Sweden, R. Nederland, R. Australia, R. Japan, Voice of Germany, Cologne, Swiss Shortwave Service, R. South Africa, R. Portugal* and *R. Canada.*

Here now are the circuit predictions for December.

West Africa: 1000-1400 25, 21, 17 and 15Mc/s; 1400-1600 25, 21, 17, 15 and 11Mc/s; 1600-1800 21, 17, 15, 11 and 9Mc/s; 1800-2000 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2000-2200 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 2200-2400 15, 11, 9, 7, 6, 5 and 4Mc/s; 2400-0200 15, 11, 9, 7, 6, 5 and 4Mc/s; 0200-0600 11, 9, 7, 6, 5, 4 and 3Mc/s; 0600-0800 15, 11, 9, 7 and 6Mc/s; 0800-1000 25, 21, 17, 15 and 11Mc/s.

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

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

South Asia: 0800-1000 25, 21, 17, 15 and 11Mc/s; 1000-1200 25, 21, 17, 15, 11 and 9 Mc/s; 1200-1400 25, 21, 17, 15, 11, 9 and 7Mc/s; 1400-1600 17, 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 1600-1800 11, 9, 7, 6, 5, 4 and 3 Mc/s; 1800-0200 9, 7, 6, 5, 4 and 3Mc/s; 0200-0400 9, 7, 6 and 5Mc/s; 0400-0600 9 and 7 Mc/s; 0600-0800 21, 17, 15 and 11Mc/s.

South East Asia: 0800-1000 25, 21, 17 and 15Mc/s; 1000-1200 25, 21, 17, 15 and 11Mc/s; 1200-1400 25, 21, 17, 15, 11 and 9Mc/s; 1400-1600 21, 17, 15, 11, 9, 7, 6, 5, 4 and 3Mc/s;1600-1800 11, 9, 7, 6, 5, 4 and 3Mc/s; 1800-2000 9, 7, 6, 5 and 4Mc/s; 2000-2200 9, 7, 6 and 5Mc/s; 2200-2400 9 and 7Mc/s; 2400-0200 9Mc/s only; 0200-0600 circuit closed; 0600-0800 21, 17 and 15Mc/s.

North East Asia: 0800-1000 17, 15 and 11Mc/s; 1000-1200 11 and 9Mc/s;1200-1800 9Mc/s only; 1800-2400 try 9 and 7Mc/s; 2400-0600 9Mc/s only; 0600-0800 11 and 9Mc/s.

Australia via Asia: 0800-1000 21 and 17Mc/s; 1000-1200 21, 17 and 15Mc/s; 1200-1400 21, 17, 15, 11 and 9Mc/s; 1400-1600 21, 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 1600-1800 11, 9, 7, 6, 5 and 4Mc/s; 1800-2000 9 and 7 Mc/s; 2000-2200 9Mc/s only; 2200-0600 circuit closed; 0600-0800 17Mc/s only.

West Coast South America (North of Chile): 1200-1800 25 and 21Mc/s; 1800-2000 21 and 17Mc/s; 2000-2200 17 and 15Mc/s; 2200-0600, up until 2400 15, 11, 9, 6, 5, 4 and 3Mc/s, after 2400 drop 15Mc/s; 0600-0800 11, 9 and 6Mc/s; 0800-1000 15, 11 and 9Mc/s; 1000-1200 21, 17 and 15Mc/s. Now here are this month's DX-tips:

AUSTRALASIA

Australia: During the winter season listen out for the new *R. Australia* transmitter station at Darwin. At the time of going to press no schedule details are available.

ASIA

Japan: *R. Japan*, Tokyo up until March 2 will transmit the morning service to Europe on 17,825 and 15,135 from 0700-0830. The evening service to Europe from 1930-2100 will be heard on 11,965 and 9,700.

EUROPE

Fed. Rep. Germany: *R. Deutsche Welle* is now on the following schedule for its English transmissions which are beamed to Africa, S. Asia, Far East and Pacific and North America, from transmitters at Juilich. 0600-0630 17,845, 15,275, 11,785; 0845-0940 21,650, 17,845, 15,275, 11,785; 1045-1055 11,965, 11,905, 9,605; 1045-1100 21,560, 17,875, 15,275; 1550-1620 17,875, 15,275; 1900-1910 15,405, 11,795, 9,605; 2110-2200 15,275, 9,765, 7,290; 2145-2205 11,925, 9,735; 0130-0250 9,735, 9,640, 6,025; 0300-0340 11,945, 9,640 9,545 and from 0445-0545 9,650, 9,545 and 6,145.

Sweden: *R. Sweden*, Stockholm, is now operating the following schedule up until March 2. 0830-0900 11,880, 9,625; 0900-0930 9,625; 0930-1030 21,690, 9,625; 1030-1100 9,625; 1100-1210 11,705, 9,625; 1230-1330 21,690, 9,760; 1400-1530 21,675, 15,240; 1600-1700 17,770, 15,310; 1730-1800 15,240, 6,065; 1800-1830 15,240; 1830-1930 15,240 11,865; 1945-2015 6,065; 2015-2115 9,625, 6,065; 2130-2230 11,705, 6,065; 2245-2345 11,810, 11,705; 2400-0230 11,705, 5,990; 0300-0430 11,705; 0445-0615 21,675 and 0630-0715 6,065.

Switzerland: *Swiss Shortwave Service*, Berne, now has English programmes until March 2 at the following times. 0700-0800 on 11,775 and 9,590 daily, weekdays only also on 9,535 and 6,165; 0845-0945 15,135, 11,775; 1000-1100 21,520, 17,855, 15,305; 1130-1230 11,865, 9,665; 1315-1415 21,520, 17,845, 15,305; 1500-1600 17,830, 15,305; 1815-1915 15,305, 11,775; 1930-2030 9,665, 6,015; 0130-0230 11,715, 9,535, 6,120; 0445-0545 9,720, 6,120. So until next month a merry Christmas and good DX-ing in 1969.

THE AMATEUR BANDS by DAVID GIBSON, G3JDG

THERE'S no doubt about it, the flavour of the month is 10 metres. Every other letter told me to stop moaning and start listening, and they sent a huge pile of DX scalps from 28Mc/s just to prove the point. Even little lads with BC receivers plugged into the television aerial have been hearing things so we can't say it's beginner's luck.

Talking about kicking a man when he's down. No sooner do I finish with the 10 metre logs than all the L.F. sleuths give me a right verbal bashing with choice callsigns logged on 40 and 80. Some very good openings have been in evidence all the way up the bands and it could be a FB Winter for aerial danglers everywhere.

Under the heading of News and Views comes a report that this week's callsign is OM, which could be a bit confusing. These tabs are worn by OK stations to commemorate the "formation" of Czechoslovakia.

Congratulations to two s.w.l's who have been reincarnated with an R.A.E. pass. **Robert Dinning** is one, and **Francis McVerry** has got the call GM3XUV and is loose on 40 metres with a rock-bound homebrew running 10 watts. He has already worked most of Europe with the rig.

Listen on 3804kc/s for W1FZJ/KP4 who listens for callers on 3800kc/s, but if you're transmitting remember that the frequency tolerance for band-edge working on 80 metres is 0·26%.

FORTY AND DOWN

William Mantovani (Doncaster), heard 80 metres sigs from—ET3USA, VO1FX, VEØMD and W1FZJ/KP4. He says that he heard this last station last January but that the W is now four S-points up by comparison. Wish someone would say that about my signals. On 40, the log reads—PY7AUT, WB2WYZ/P/4X4, 8P6BH, 9N4KR, 9M2DQ. Gear in use, HAM-1 and an a.t.u. plus a 260ft. long wire.

A. Houghton has reached the ripe old age of twelve (congratulations Sir) and has a Bush AC71 domestic receiver. He reports that 160 is very busy and managed to grab an EI callsign too. On 40, his best is VQ3VAA. The antenna is a 110ft. double L. (Wonder what the double L that is?)

R. King (not at the key contacts I hope) is a 40 metre fan judging from the log. Located in Yorkshire with an HA500 and a 66ft. end fed he claims—CM2DC, CT1LJ, EA3QW, EA4JV, F6AFP, GC5ALO, GD3JIU, HC4WM, HP1NBR, IS1EP, IT1AVA, K1MBH, K2MRG/MM, KP4BRY/MM, LX1SL, OZ7NQ, PAØDX/M, PY1DAH, PY2ENX, PY6ABB, PY7LC, VK3OZ, VP1CP, WA1GNE, W2EQM, W4MPE, W8OO/M/4, ZS1JA, 4X4IX, 5N2ABG, 9M2DQ.

S. Krol (Lancs.), P.W. transistor superhet modified as per "April 1967", ¼ wave end fed advises—listen 3775kc/s just after midnight for AP2MR, for ZL's (ZL2BCG) at 0600 every morning, W1FZJ/KP4 and WØVXO/KV4 around 3804kc/s about 0430 onwards most mornings. Don't forget ON4UN's DX net on 80 on Friday and Monday nights.

TWENTY AND FIFTEEN

Jim strikes again, **Jim Baker** that is. He relates the hair-raising tale of LG5LG. Apparently this call was located at Morokuilen (I couldn't even find it in my atlas). This is a field on the LA/SM border and amateurs of any nationality are permitted to operate on that piece of "free territory". "Cor, now I've 'eard it orl", says he, packing the transistor rig and looking up the boat trains.

D. Redmond (Holyhead), ground plane plus an RA-1 had some FB s.s.b. sigs on 20 from—CE3NI, CE6EF, CE6EW, CP6GO, TI2DVH, PJ2AW, PYØARM, PY3HT, PY7AKL, VK3NO, VP1RD, YV3DA, YV5LOR. On 15—PY2EFF, VK2FA, VK2FU, VK2JM, VK5DE, 9V1OW.

P. Lovell (Kent), 4-valve s'het with a home-brew b.f.o. 30ft. vertical plans to take the R.A.E. in December. He heard I1BPW in QSO with guess who—JX3DH. (No comment.)

Robert Dinning (Ayrshire), HA350 plus PR30 plus RQ10 plus a pair of hi-fi headphones (I don't hear much but the quality of what I don't hear is marvellous!), went s.s.b'ing on 20 for—AP2KJ, CR7HY, HBØAG, HP4BIO, JX4EJ (never said a word), KA9NF, KC4USV, KG6IH, KR6SO, KX6DQ, LG5LG (funny Dud, funny), PYØARM, MP4BGU, OX5AP, TA1AV, VK3EU, VK5FU, VP8HZ, VQ8CS, VS5OJ, VS6DR, WA4WMA/AM (region 2), WB4IRT/AM, (region 1), YUØJ, ZL1APZ, ZS9Q, 3A2CP, 9J2MJ, 9K2AM, 9M2XX, 9V1NV, 9X5AA. On 15 the best were—CR6BA, CX2CN, DU1RZ, HK5AZA, HR1JMS, HS3MK, KG6AJQ, KR6RB, KV4FQ, MP4TCF, TG9RN, TU2AY, VK2AVT, VK9LR, VQ9OH, VR1L, VS6DR, VU2DKZ, XW8AX, YBØAB, YN1PS, ZD8CC, ZS3T, 3A2CX, 3V8AA, 9K2BV, 9N1MM.

TEN

Who heard VU2GGB, UF6HO, 6Y5NY, 8R1S, CX8DM, CO2BY, 4A1WS, KG4DH, 9J2RV, HI8XJP, ZE8JY, 9V1PB and VP8JT all on 10 metre phone? Confession of the above from **A4862** (Essex). He also has an SB300 and a 4 element beam at 60 feet. Crikey, you could almost see them as well from up there!

P. Baker (Wales), HE30, 150ft. long wire lassoed these on phone—CN8MI, CR4BC, CR6GU, CR7LI, ET3REL, HR3AC, MP4BGU, PY1AGP, SVØWO, VE1YO, VQ9DH, W6DRB, W6FMR, YV1DA, ZC4GM, 5Z4AA, 8P6CA, 9G1UQ, 9J2VX, 9K2BJ, 9Q5IA, 9Y4BF.

RESOLUTIONS

How about checking the gear? The aerial and earth system needs an annual going over. Just think, a dodgy aerial or a bad connection could cost you a lot of 1969 DX. The station receiver too, when was it last lined up? The real experts check their receivers once a year at least.

If you have trouble finding the countries of origin of all those callsigns, then a ninepenny postal order to the R.S.G.B. will bring a countries list which will solve all your problems.

A VY MX OM'S ES YL'S (?) ES HPE CUAGN NXT YR DE G3JDG.

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Communications Receiver 540-10 metres

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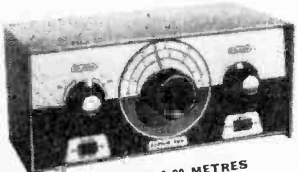

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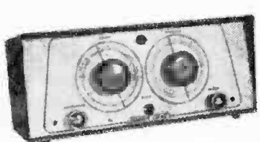

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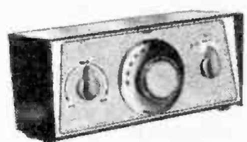

R.F. PRE-SELECTOR MODEL P.R.30
1.5-30Mc/s
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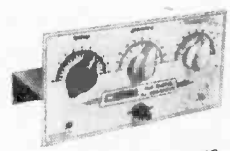

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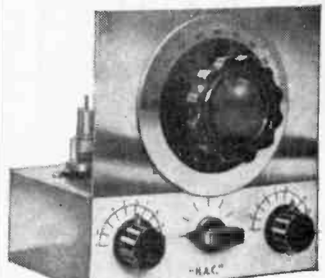

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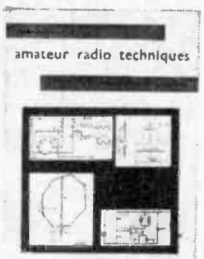

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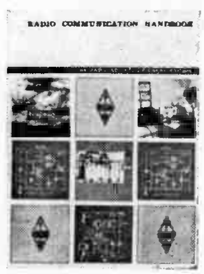

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35 DOUGHTY STREET, LONDON, WC1

No. 22 Leyton & Walthamstow AMATEUR RADIO SOCIETY G3WHY

CLUB SPOT

IMAGINE being interested in radio, yet living in a district where there was no radio club. No ensemble of happy smiling understanding faces who were enthusiastic about the hobby.

Of course, if you live in London E.10, or thereabouts, then you don't have a thing to worry about 'cos you've got the Leyton and Walthamstow Amateur Radio Club practically on your doorstep, and they are always very pleased to welcome a new face too.

The present membership has crept above twenty —why not drop in on the club and make it above thirty? Meetings are held at 7.30 p.m. on Tuesdays and at least ten members hold current callsigns so there will be no lack of activity from the practical aspect. The club also boasts its own callsign—G3WHY, which is aired at every opportunity. The club station is frequently on the air on 160 metres and 2 metres although plans are being hatched to extend activity to the h.f. DX bands in the very near future.

Help is always to hand for those needing any assistance whether practical or theoretical. Regular classes are held for those wanting to learn Morse and advice is on tap for anyone with problems regarding the R.A.E.

At least two members have braved the u.h.f. region and have taken the precaution of arming themselves with a /T licence. Several demonstrations both /T and /A have been given in local clubs and at various events.

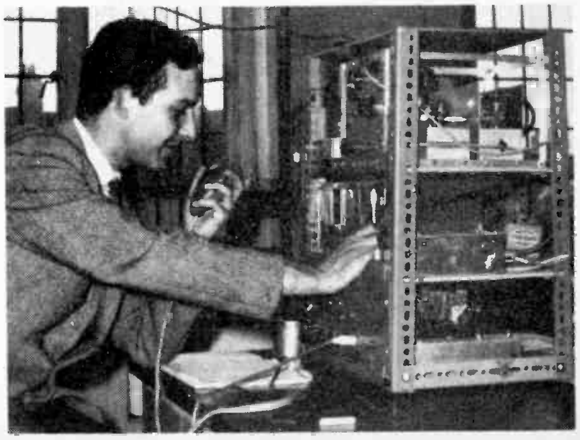
The club has a keenness for contests and although no pots have been won this doesn't deter them from having a go and having a good time in the process. Not only does the club enter both h.f. and v.h.f. field days but also runs its own mini-field-days during the long Leyton summers. Although not professing to be on a par with the national events, these are a great success and perhaps more important, everyone who attends seems to have a great deal of fun.

The club has a variety of interests and thus the meetings vary in content. Junk sales, lectures, natter-nights, etc. all form part of the club menu.

The Hon. Sec. assures that the members are a ". . . fairly normal bunch of blokes with all the usual vices". Almost worth while going along just to see isn't it?

Place for the weekly meetings is the Leyton Senior Evening Institute, Essex Road, London, E.10. If you'd like to check first, then why not give "Charlie" a buzz? You can find him at 114 Farmillo Road, Leyton, London, E.17, and the phone book says you can reach him on LEY 4673.

Above: *Some of the gang caught hovering near a few of the entries for the annual construction contest which took place last June.*
Right: *Will it work and what's that bit doing? Two critical pairs of eyes examine one of the entries in the constructors contest.*
Below: *CQ two—CQ—two, here G3WHY. The club station in action on 144Mc/s from the Senior Evening Institute on a typical Tuesday evening.*



THE MEDIUM WAVE COLUMN

WITH the season well established and a fall predicted for the sunspot count, DXers will be looking forward to a good winter on the medium waves. Conditions to North America were very good during the summer—KMOX (1120) St. Louis was logged several times during August. In the autumn however, this path became rather unstable, conditions varying rapidly from day to day. No reports yet of the west coast of the United States though the writer did log a weak station on 1000 on 22nd October at 0624 hours GMT which was heard, during a peak, to mention the Seattle Police Force (KOMO?). Recent loggings from North America include CBN (640), CBH (860), WCBS (880), CJCH (920), CJON (930), WINZ (940), CHNS (960), ZFB1 (960), WINS (1010), KDKA (1020), WBZ (1030), CBA (1070), WBAL (1090), WNEW (1130), and *Radio St. Pierre* (1375). The latter is in the French islands of St. Pierre et Miquelon located near Newfoundland. This is a "medium wave only" country as St. Pierre is the sole broadcasting station.

Further south, XEOY (1000) in Mexico City has been heard a number of times with the call "Es Radio Mil". A new one in the Caribbean is WBMJ (1190), San Juan, Puerto Rico, with programming in English. It was fair at 0130 GMT on 25th October. CMBQ (1060) in Havana, Cuba, is the only other station heard recently from this area. *Radio Americas* (1165) has now gone off the air for good.

Brazil has been coming in well at about 0200 hours GMT with PRA3 (860), PRE8 (880), PRF4 (940), PRG2 (1040), PRE3 (1180), all in Rio de Janeiro. From Argentina, LR3 (950) *Radio Belgrano*, LR1 (1070) *Radio el Mundo* and LS10 (1030) *Radio Libertad*, all in Buenos Aires, together with LU6 (1150) *Radio Atlantica La Plata*, have been logged. From the northern part of the Continent PJB2 (800) Bonaire, Netherlands West Indies, with programming in English, is an easy station for the newcomer to the band. ZFY (760), the *Voice of Guyana* has been heard at midnight GMT with a weakish signal. From nearby Surinam, SRS (725) in Paramaribo, broadcasting rather attractive local music, occasionally has announcements in English, and can often be heard. A loop aerial is a great help here in reducing splash from the all-night German station on 728. The letters SRS incidentally, although used as a callsign, are actually the initials of the organisation running the station. An interesting logging from the west coast of South America is OAX4U (1010) Lima Peru. This station is now 50kW and it has been heard frequently in England and the United States since midsummer, sometimes with a strong and steady signal. The call is *Radio America*, followed by a trumpet fanfare.

A number of African stations are audible in the late evening. Dakar (764) in Senegal is usually strong, with programming in French, also Conakry (1403) in Guinea, again in French. There are two regulars from the Canary Islands, R.N.E. (620) in Las Palmas and CES4 (1097) in Tenerife. The latter is invariably mixed with EFE14 Madrid but it is worth the effort to get material for a report to this station as it issues a rather pretty, coloured, embossed QSL card. CSB91 (1529) in Funchal, Madeira, closes down at midnight GMT with a rather weak signal. The language used is Portuguese.

From the Near East, Baghdad (760) is often strong at 0300 hours GMT when signing on. The two BBC relay stations in Cyprus on 638 and 719 are also audible, in English, at this time, the latter being much the weaker of the two. Finally, Kuwait (1345) has been heard at 0335 with a good signal.

CHARLES MOLLOY

Sinclair launch their System 2000 range with the amplifier, tuner and speaker shown here. The tuner and amplifier are separate units which may be mounted together for convenience. Each is complete in itself and may be used with existing high fidelity equipment. The System 2000 uses new components and ingenious construction in ways which reduce costs, increase performance and improve reliability.

For example, look at the circuits of most F.M. tuners and you will find that they vary very little. Look at the System 2000 tuner. You will notice the absence of conventional coils. They have become an integral part of the printed circuit and never need adjustment—another step in increasing reliability and reducing the final price.

Almost all other tuners use the Foster-Seeley discriminator or the ratio detector. The System 2000 tuner uses a pulse counting discriminator. This is free from drift and possesses a lower level of distortion than any other system. Inter-station noise suppression, mains tuning and stereo indicators together with a sensitivity for full limiting of an incredible 3 microvolts are all incorporated. An additional attractive feature is provision for plug-in remote and switched tuning units (available separately). The amplifier and loudspeaker are equally outstanding and well worth comparing for yourself. Ask your dealer for a demonstration or write or ring us for a leaflet.

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Size—3in x $1\frac{1}{2}$in x $1\frac{1}{4}$in. Class B Ultralinear Output: Frequency response from 15 to 15,000Hz $\pm$1dB: Output suitable for loudspeakers from 3 to 15 ohms impedance. Two 3 ohm speakers may be used in parallel: Input 2 mV into 2K ohms: Output 12 watts R.M.S. continuous sine wave (24 watts peak); 15 watts music power (30 watts peak) Power requirements 6—20V d.c. from battery or PZ.4 Mains Supply Unit. Ready built, tested and guaranteed.

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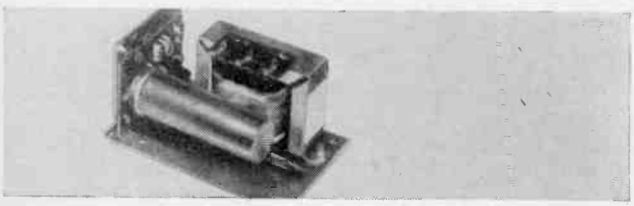

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25V	1·6	6·4	12·5	25	50	80
40V	1	4	8	16	32	50
64V	0·64	2·5	5	10	20	32
Price	1/6	1/3	1/2	1/-	1/1	1/2

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4V	800	1,250	2,000	3,200
6·4V	640	1,000	1,600	2,500
10V	400	640	1,000	1,600
16V	250	400	640	1,000
25V	160	250	400	640
40V	100	160	250	400
64V	64	100	160	250
Price	1/6	2/-	2/6	3/-

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.** ·0068, 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, 500, 560, 680, 820pF, **1/-.** 1,000, 1,200, 1,500, 1,800, 2,200, 2,700, 3,300, 3,900pF, **1/3.** 4,700, 5,000, 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, 5,000, 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.** 0·47, 0·5μF, **6/3.**

JACK PLUGS (Screened): Heavily chromed, ¼in Standard: 2/9 each. Side-entry: 3/3 each.
Standard (Unscreened): 2/3 each.

JACK SOCKETS (¼in Plug): With chrome insert. 2/9 each. Available with: Break/Break, Make/Break, Break/Make, Make/Make contacts.

POTENTIOMETERS (Carbon): Long life, low noise, ¼W at 70°C. ±20% ≤ ½M, ±30% < ½M. Body dia., ⅞in. Spindle, 1in × ¼in. 2/3 each. Linear: 100, 250, 500 ohms, etc., per decade to 10M. Logarithmic: 5k, 10k, 25k, etc., per decade to 5M.

SKELETON PRE-SET POTENTIOMETERS (Carbon): Linear: 100, 250, 500 ohms, etc., per decade to 5M.
Miniature: 0·3W at 70°C. ±20% ≤½M, ±30% > ½M. Horizontal (0·7in × 0·4in P.C.M.) or Vertical (0·4in × 0·2in P.C.M.) mounting, 1/- each.
Submin. 0·1W at 70°C. ±20% ≤ 1M, ±30% > 1M. Horizontal (0·4in × 0·2in P.C.M.) or Vertical (0·2in × 0·1in P.C.M.) mounting, 10d each.

RESISTORS (Carbon film), very low noise. Range: 5%, 4·7Ω to 1MΩ (E24 Series): 10%, 10Ω to 10MΩ (E12 Series).
¼W (10%), 1¼d (over 99, 1⅛d). 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%), 2¼d (over 99, 2d), 100 off per value 15/6.

SEMICONDUCTORS: OA5, OA81, 1/9. OC44, OC45, OC71, OC81, OC81D, OC82D, 2/-. OC70, OC72, 2/3. AC107, OC75, OC170, OC171, 2/6. AF115, AF116, AF117, ACY19, ACY21, 3/3. OC140, 4/3. OC200, 5/-. OC139, 5/3. OC25, 7/-. OC35, 8/-. OC23, OC28, 8/3.

SILICON RECTIFIERS: (0·5A). 170 P.I.V., 2/9. 400 P.I.V., 3/-. 800 P.I.V., 3/3. 1250 P.I.V., 3/9. 1500 P.I.V. 4/-. (0·75A); 200 P.I.V., 1/6. 400 P.I.V., 2/-. 800 P.I.V., 3/3. (6A); 200 P.I.V., 3/-. 400 P.I.V., 4/-. 600 P.I.V., 5/-. 800 P.I.V., 6/-.

THYRISTORS (5A): 100 P.I.V., 8/-. 200 P.I.V., 10/-. 400 P.I.V., 15/-.

SWITCHES (Chrome finish, Silver contacts): 3A 250V, 6A 125V. Push Buttons: Push-on or Push-off 5/-. Toggle Switches: SP/ST, 3/6. SP/DT, 3/9. SP/DT (with centre position) 4/-. DP/ST, 4/6. DP/DT, 5/-.

PRINTED CIRCUIT BOARD (Vero).
0·15in Matrix: 3¾in × 2½in. 3/3. 5½in × 2½in, 3/11. 3¾in × 3¾in, 3/11. 5in × 3¾in, 5/6.
0·1 Matrix: 3¾in × 2½in, 4/-. 5in × 2½in, 4/6. 3¾in × 3¾in, 4/6. 5in × 3¾in 5/3.

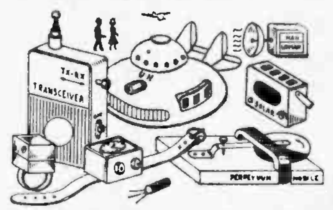
RECORDING TAPE (Finest quality MYLAR—almost unbreakable).
Standard Play: 5in, 600ft, 7/6. 5¾in, 850ft, 10/6. 7in, 1,200ft, 12/6.
Long Play: 3in, 225ft, 4/-. 5in, 900ft, 10/6. 5¾in, 1,200ft, 13/-. 7in, 1,800ft, 18/-.

SEND S.A.E. for JANUARY, 1969 CATALOGUE

PRINTED CIRCUIT KIT

BUILD 40 INTERESTING PROJECTS on a PRINTED CIRCUIT CHASSIS with PARTS and TRANSISTORS from your SPARES BOX

CONTENTS: (1) 2 Copper Laminate Boards 4½" × 2½". (2) 1 Board for Matchbox Radio. (3) 1 Board for Wristwatch Radio, etc. (4) Resist. (5) Resist Solvent. (6) Etchant. (7) Cleanser/Degreaser. (8) 16-page Booklet *Printed Circuits for Amateurs.* (9) 2 Miniature Radio Dials SW/MW/LW. Also free with each kit. (10) Essential Design Data, Circuits, Chassis Plans, etc. for 40 TRANSISTORISED PROJECTS. A very comprehensive selection of circuits to suit everyone's requirements and constructional ability. Many recently developed very efficient designs published for the first time, including 10 new circuits.



EXPERIMENTER'S PRINTED CIRCUIT KIT

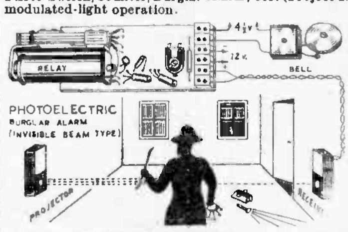
8/6

Postage & Pack. 1/6 (UK)
Commonwealth:
SURFACE MAIL 2/-
AIR MAIL 8/-
Australia, New Zealand South Africa, Canada.

(1) Crystal Set with biased Detector. (2) Crystal Set with voltage-quadrupler detector. (3) Crystal Set with Dynamic Loudspeaker. (4) Crystal Tuner with Audio Amplifier. (5) Carrier Power Conversion Receiver. (6) Split-Load Neutralised Double Reflex. (7) Matchbox or Photocell Radio. (8) "TRI-FLEXON" Triple Reflex with self-adjusting regeneration (Patent Pending). (9) Solar Battery Loudspeaker Radio. The smallest 3 designs yet offered to the Home Constructor anywhere in the World. 3 Subminiature Radio Receivers based on the "Triflexon" circuit. Let us know if you know of a smaller design published anywhere. (10) Postage Stamp Radio. Size only 1·62" × ·95" × ·25". (11) Wristwatch Radio 1·15" × ·80" × ·55". (12) Ring Radio ·70" × ·70" × ·55". (13) Bacteria-powered Radio. Runs on sugar or bread. (14) Radio Control Tone Receiver. (15) Transistor P/P Amplifier. (16) Intercom. (17) 1-valve Amplifier. (18) Reliable Burglar Alarm. (19) Light-Seeking Animal, Guided Missile. (20) Perpetual Motion Machine. (21) Metal Detector. (22) Transistor Tester. (23) Human Body Radiation Detector. (24) Man/Woman Discriminator. (25) Signal Injector. (26) Pocket Transceiver (Licence required). (27) Constant Volume Intercom. (28) Remote Control of Models by Induction. (29) Inductive-Loop Transmitter. (30) Pocket Triple Reflex Radio. (31) Wristwatch Transmitter/Wire-less Microphone. (32) Wire-less Door Bell. (33) Ultrasonic Switch/Alarm. (34) Stereo Preamplifier. (35) Quality Stereo Push-Pull Amplifier. (36) Light-Beam Telephone "Photophone". (37) Light-Beam Transmitter. (38) Silent TV Sound Adaptor. (39) Ultrasonic Transmitter. (40) Thyristor Drill Speed Controller.

PHOTOELECTRIC KIT

CONTENTS: 2 P.C. Chassis Boards, Chemicals, Etching Manual, Infra-Red Phototransistor, Latching Relay, 2 Transistors, Condensers, 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.



PHOTOELECTRIC KIT

39/6

Postage and Pack. 2/6 (UK)
Commonwealth:
SURFACE MAIL 3/6
AIR MAIL £1.0.0
Australia, New Zealand, S. Africa, Canada and U.S.A.
Also Essential Data Circuits and Plans for Building

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/-.

JUNIOR PHOTOELECTRIC KIT

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".
Price 19/6. Postage and Pack. 1/6 (UK). Commonwealth 2/-; Air Mail 4/-.

JUNIOR OPTICAL KIT

CONTENTS: 2 Lenses, Infra-red Filter, Lampholder, Bracket, Plans, etc. Everything (except plywood) to build 1 miniature invisible beam projector and photocell receiver for use with Junior Photoelectric Kit.
Price 10/6. Post and Pack. 1/6 (UK). Commonwealth: Surface Mail 2/-; Air Mail 4/-.

PHOTOELECTRIC PARKING LAMP SWITCH

Automatically turns parking lamp on at dusk, off at dawn. Protects your car. Saves the battery. Miniature construction. Simply insert in parking lamp lead. Price: 27/6. Post & Packing 2/6 (U.K.)

THYRISTOR LIGHT DIMMER

Add a touch of luxury to your home. Adjust the light at parties, while watching TV, etc. Ideal for Children's bedroom. (100 watts max.) Replaces on-off switch.
Price: 59/6. Post & Packing 2/6 (U.K.)

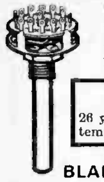
YORK ELECTRICS
333 YORK ROAD, LONDON, S.W.11

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.

DRY JOINT TESTER

The most reliable way of testing for a dry joint is to measure the resistance between the component lead and the printed circuit board. Our kit for doing this comprises a large scale (3in.) moving coil meter, a variable resistance for adjusting zero setting, and a wiring diagram with instructions. The only additional items you will need are a battery, some wire, a pair of test rods. Price 19/6, postage and insurance 2/6.

MINIATURE WAFER SWITCHES



4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 3/6 each. 36/- dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 10/- post free.

BLANKET SWITCH

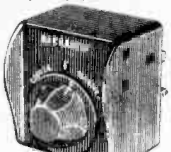
Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. 5/6 each. 3 heat model 7/6.

PHOTO-ELECTRIC KIT

All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit. Laminated Boards and chemicals. Latching relay. Infra-red sensitive Photocells and Hood, 2 transistors, cond., terminal block. Plastic case. Essential data, circuits and P.C. chassis plans of 10 photo-electric devices including auto. car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warbling tone electronic alarm—project lamp stabiliser, etc., etc. Only 39/6, plus 2/- post and insurance.

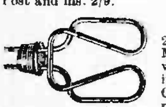
PP3 ELIMINATOR. Play your pocket radio from the mains! save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions, only 6/6 plus 1/- post.

BECKASTAT



This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures. 13A loading. Will save its cost in a season 19/6. Post and ins. 2/9.

KETTLE ELEMENT



230/240V 1500 watt. Made by Best for kettles with $^{9}/_{16}$ in. dia. hole including: Best, Besco, Chalfont, Davidson, Dimplex, Grafton, Hawkins, Jurymaid, Morroware, Monogram, Pifco, Revo, Towen, Swan. Normally 32/6. Our price 15/- plus 2/6 post.

QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. 19/6, post and insurance 1/6. 12v. car model also available.

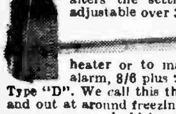
MAINS TRANSISTOR POWER PACK

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.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. 9/6 plus 1/- post. Suitable box for wall mounting, 5/-. P. & P. 1/-.

Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven kiln immersion heater or to make flame-start or fire alarm, 8/6 plus 2/6 post and insurance.

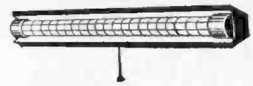


Type "D". We call this the Ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the 10ft. pipes from freezing, if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/6. P. & P. 1/-.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 7/6, plus 1/- post.

Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 18/-, plus 2/- post and insurance.

INFRA-RED HEATERS



Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instruction—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watts element, all parts, metal casing, as illustrated, 19/6, plus 4/- post and insurance. Pull switch 3/- extra.

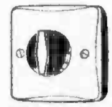
BREAST MICROPHONE

Fine American made dynamic type, adjustable on breast plate with neck straps, 7/6, post 4/6.

12V BLOWER

Heavy duty motor with centrifugal blower coupled to one end. Ideal for car heater. 12/6, plus 4/6 post.

VARYLITE



Will dim fluorescent or incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob £3.19.6.

THIS MONTH'S SNIP

Electric Clock

with 3 amp switch made by Smiths for Dreamland. These are mains driven and frequency controlled so are extremely accurate. The dial enables "switch-on" time to be accurately set. Switch off is 3 hours later or by manual control. Intended for switching electric blankets this needs only one setting for the season. Suitable also to control tape recorder, radio and lamp etc. up to 600W. In neat plastic case with mains lead and two outlot plugs. New and unused. 39/6, post and insurance 3/6.

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 11⅜in. diam.—Overall height 5¼in. A £6 speaker offered for only £3.9.6 plus 7/6 p & p. Don't miss this offer.

PROTECT VALUABLE DEVICES

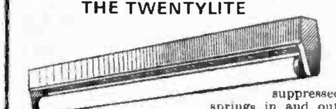
FROM THERMAL RUNWAY OR OVERHEATING

Tyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected; simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90 deg.–190 deg. F. or with the dial removed range setting is between 80 to 800 deg. F.

Price 10/-

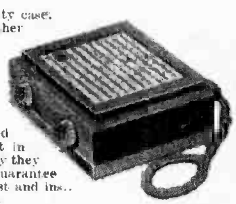
ATLAS SLIMLINE FLUORESCENTS

THE TWENTYLITE



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 ¼ 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.

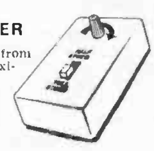
MICRO-SONIC



7 transistor Key chain Radio in very pretty case, size 2⅞ x 2⅛ x 1¼in.—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 Kc/s. or 455 Kc/s. 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. Everlasting batteries 7/- pair.

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 25/-, plus 2/6 post.

INDICATOR LAMP

Panel mounting, consists of neon lamp in red plastic lens with resistor in leads for mains operation 2/6 each, 24/- doz.

SPRING COIL LEADS

As fitted to telephones, 4 core 2/6 each, 3 core 2/- each.

HEADPHONES

Ex-W.D. unused and perfect, single with head-band 4/6. Double with headband 8/6.

16 RPM GEARED MOTOR

Made by Smith's Electrics, these are almost silent running, but are very powerful. They operate from normal to 240V. mains and the final shaft speed is 16 r.p.m. 15/-. Post & ins. 2/9.

COPPER CLAD ELEMENT

1250 watts—4ft. long but bent to U shape, ideal for overhead heater—just mount reflector above. 12/6 each, plus 4/6 post. £6 doz. post paid.

FLUORESCENT CONTROL KITS

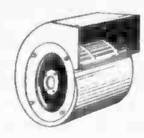
Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15–20 w. 19/6. Kit B—30–40 w. 19/6. Kit C—80 w. 19/6. 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 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

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.

REED SWITCH

Suitable for dozens of different applications, such as burglar alarms, conveyor belt switching. These are simply glass in cased switches which can be operated by a passing permanent magnet coil. A special buy enables us to offer these at 2/6 each, or 24/- a dozen. Suitable magnets are 1/- each.

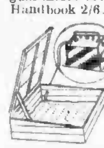
CENTRIFUGAL FAN



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, 200-250 v. 50 C.P.S. motor. £3.19.6, post and insurance 7/6.

See in the Dark INFRA-RED BINOCULARS

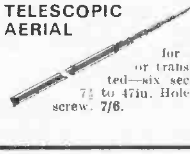
These infra-red binoculars when fed from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for TV cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order but sold without a guarantee. Price £3.17.6, plus 10/- carr. and ins. Handbook 2/6.



Be first this year! SEED AND PLANT RAISING

Soil heating wire and transformer. Suitable for standard size garden frame. Post and ins. 3/6. **19/6**

TELESCOPIC AERIAL



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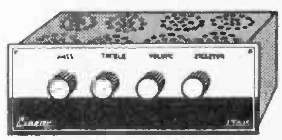

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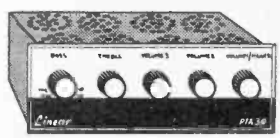

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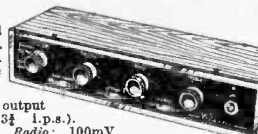

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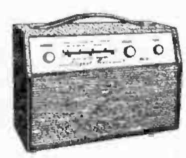

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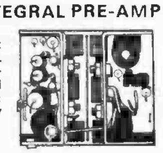

Specifications: *RMS Power Output* (into 3 ohms speaker): 10 watts continuous (sine wave), 13 watts music power. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 micro-amp). *Total Distortion at* 1Khz): at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40Khz. *Speaker:* 3–4 ohms (3–15 ohms may be used). *Supply voltage:* 24V d.c. at 800mA (6–24V may be used).

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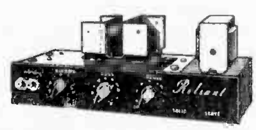

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Output Impedance—3 to 4 ohms

Inputs—1. -xtal mic 10mV
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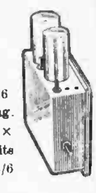

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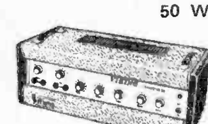

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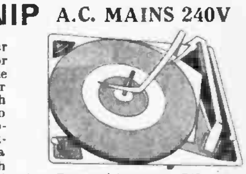

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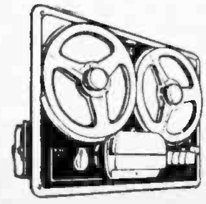

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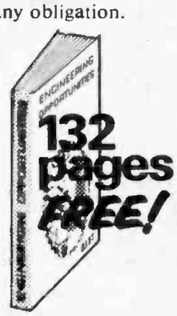

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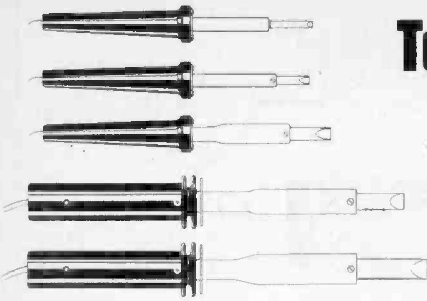

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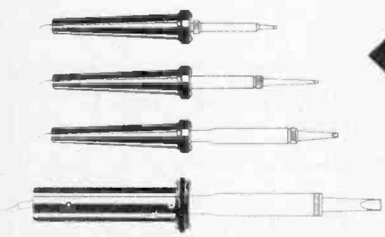

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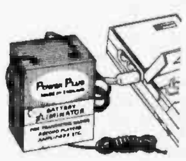

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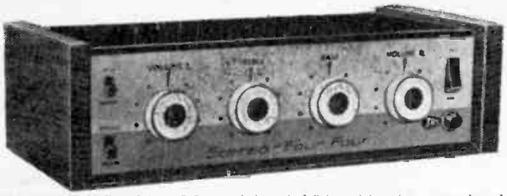

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- A.F.C. & A.G.C.
- Noise Limiter
- Chassis Ready Built
- Pre-tuned

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

S.A.E. brings full details.

Total price (for mains operation) **£29.10.0** (carr. 10/-)

Kit to make MONO tuner inc. chassis and tuning assembly (p.p. 3/6)	**15 gns.**
Add-on Stereo Unit (p.p. 2/6)	**10 gns.**
Power Unit (p.p. 2/6)	**£2.5.0**
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LM3000 Record Player with 9T.A. Stereo Cartridge. £10.5.0
AT.60 Mk. II De-luxe Auto-changer, die-cast turntable. Less cartridge. £13.5.0
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Brand new in makers' cartons. Packing and carriage on any one of above 7/6.
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2 + 2 VALVE PRE-AMP Built, complete with valves, dial, etc. 13 gns. (*carr. 7/6*).
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Power requirements 200V/25mA; 6·3V, 1·5A. TRS unit available.

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CONDENSERS Silver Mica. All values 2 pf. to 1,000 pf 6d. ea. Ditto ceramics 9d. Tub. 450v. T.C.C., etc. .001 mfd. to 0.1 mf./350 v. 10d. .02 mf. to 0.1 mfd. 500 v. 1/-. .25 T.C.C. 1/9. .5 T.C.C. 2/-. **CLOSE TOL. S/MICS.** 10% 5 pf.-500 pf. 8d. 600-5,000 pf. 1/-. 1% 2 pf.-100 pf. 9d. 100 pf. 9d. 100 pf.-500 pf. 11d. 375 pf.-5000 pf. 1/6.

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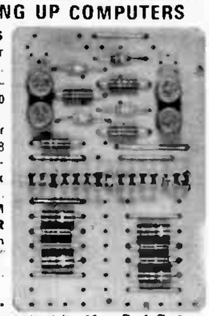

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4½in., 2in. diam. Screw terminals.
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4,000mF	72V d.c. wkg.
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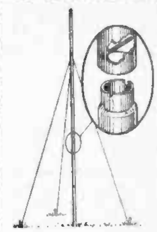

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100 SETS OF AB101/TRC1 MAST EQUIPMENT. With guys and ancillary parts. £25 per set (ex warehouse).

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COLLINS (U.S.A.) RECEIVERS.
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. LAST FEW £8.10.0. Carr. 15/-.

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(continued on next page)

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(continued)

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Transistors. OC70, OC71, OC72, OC81, OC81d, OC45, OC170, OC171, at 2/- each.
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Metal Rectifiers, 12v 1 amp contact cooled TCC 3/9 each.
Metal Rectifiers, 12v 2 amp 3/6 each.
Metal Rectifiers, 12v 4 amp 7/6 each.
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Toggle Switches, spst 2/-, dpdt 3/- each.
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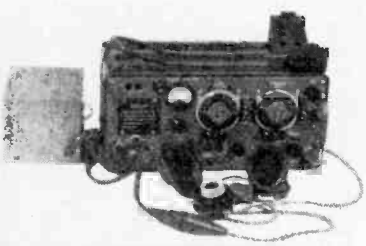

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This is one of the latest releases by the govt. of an extremely recent R/T set covering 2–8Mc/s in two switched bands, containing 13 valves (3 EL32s in TX output) which can be used for more CW or R/T. Also has netting trimmer, BFO, RF and AF controls, switched meter for checking all parts of set, size 17 x 8 x 12 in. Power required LT 12V D.C., HT 325V D.C. Supplied brand new and boxed with headphones and mike also two spare valves and circuit of set. Few only at £5.10.0, carr. 30/– New plug in power supply made by us for either 12V D.C. input £3.10.0 or 200/250V A.C. £3.17.6.

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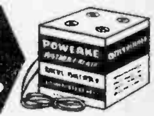

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(continued on facing page)

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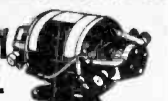

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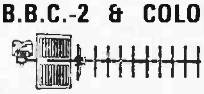

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6SG7	6/-
6SH7	4/6
6SJ7	7/-
6SL7GT	6/-
6SN7GT	5/6
6SQ7	7/-
6SR7	7/-
6SS7	3/-
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6U4GT	12/-
6U8	6/-
6V6GT	6/-
6X4	4/6
6X5GT	5/-
6X8	11/-
6Y6G	11/6
7C5	13/6
7Z4	7/6
9BW6	7/-
9D2	3/6
9D7	9/-
10C2	10/-
10D2	8/-
10F1	18/-
10F9	10/-
10F18	7/6
10L1	7/6
10LD11	10/-
10P13	12/-
10P14	16/-
12AC6	7/-
12AD6	6/-
12AL5	7/6
12AQ5	7/-
12AT6	4/6
12AT7	6/-
12AU6	5/-
12AU7	5/9
12AV6	5/6
12AX7	5/6
12B4A	9/6

12BA6	6/-
12BA7	6/-
12BE6	6/-
12BH7	6/-
12BT6	4/6
12BY7	10/-
12DQ7	10/-
12E1	20/-
12E14	52/6
12K5	10/-
12K8	8/-
12Q7GT	5/6
12SA7GT	8/-
12SC7	4/6
12SG7	6/-
12SK7	6/6
12SQ7	7/6
13D3	5/9
19AQ5	6/-
20CV	62/6
20D1	9/-
20L1	18/-
20P1	10/-
20P3	12/-
20P4	19/-
20P5	19/-
25BQ6GTB	12/-
25C5	9/-
25CU6	12/-
25L6GT	6/6
25Z4G	6/-
25Z5	8/-
25Z6GT	11/-
30A5	7/-
30C15	14/-
30C17	15/-

30C18	14/-
30F5	16/-
30FL1	15/-
30FL12	17/6
30FL13	8/-
30FL14	14/6
30L1	6/-
30L15	16/-
30L17	16/-
30P12	15/-
30P19	14/-
30PL1	15/-
30PL13	17/6
30PL14	17/-
35A5	10/-
35B5	12/-
35C5	6/6
35D5	12/-
35L6GT	8/-
35W4	4/6
35Z3	10/-
35Z4G	4/-
35Z5GT	6/-
50A5	12/-
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75C1	8/-
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813	75/-
837	15/-
866A	14/-
884	10/-
5670	10/-
5751	11/-
5763	12/-
5886	40/-
6080	27/6
6146	27/6
6197	20/-
6360	25/-
6939	40/-
7360	30/-
7551	30/-
7581	22/6
7591A	20/-
AZ31	9/-
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DF96	7/-
DH81	10/-
DH101	9/-
DK92	8/3
DK96	7/6
DL68	13/-
DL96	7/-
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DY86	6/-
DY87	6/6
DY802	9/-
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EAF801	10/-
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EBC33	8/-
EBC41	8/6
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EBF83	8/-
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EBL31	24/-
ECC33	10/-
ECC34	8/-
ECC40	10/-
ECC70	17/-
ECC81	6/-
ECC82	5/9
ECC83	5/6
ECC84	5/6
ECC85	5/-
ECC86	8/-
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ECC89	11/-
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ECC807	14/-
ECF80	6/6
ECF82	6/6
ECF83	14/-
ECF86	9/6
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ECH35	11/-
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ECH81	5/3
ECH83	8/-
ECH84	9/-
ECL80	7/-
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ECL82	6/-
ECL83	10/-
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EF40	9/-
EF41	9/-
EF42	13/-
EF54	10/-
EF55	12/-
EF80	4/6
EF83	9/6
EF85	6/6
EF86	6/-
EF89	5/-
EF91	4/-
EF92	7/6
EF93	4/-
EF94	5/-
EF95	5/-
EF96	3/6
EF98	10/-
EF183	6/-
EF184	6/6
EF804	20/-
EH90	7/-
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EL34	9/6
EL36	8/6
EL41	9/6
EL42	10/-
EL81	9/-
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EM81	7/6
EM84	7/-
EM87	10/-
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EN91	6/-
EY51	7/-
EY80	8/6
EY81	7/-
EY83	10/-
EY84	9/6
EY86	6/6
EY87	8/-
EY88	8/-
EZ40	7/6
EZ41	8/6
EZ80	5/-
EZ81	5/-
GZ32	9/6
GZ33	13/6
GZ34	10/-
HL42DD	8/-
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MH4	7/-
MH41	9/-
ML4	8/-
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PC86	11/-
PC88	11/-
PC95	7/6
PC97	8/-
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PCC84	6/-
PCC85	7/6
PCC88	11/-
PCC89	9/6
PCC189	10/-
PCC805	16/-
PCC806	16/-
PCE800	15/-
PCF80	6/6
PCF82	6/3
PCF84	8/-
PCF86	8/6
PCF87	15/-

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PCF801	9/-
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PCF805	14/-
PCF806	12/-
PCF808	14/6
PCL80	15/-
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PCL82	7/-
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PCL88	17/-
PCL800	17/6
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PL81	7/6
PL83	8/-
PL83	7/-
PL84	6/6
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PY32	10/-
PY33	12/6
PY80	5/6
PY81	5/6
PY82	5/-
PY83	6/6
PY88	7/6
PY800	9/-
PY801	9/-
QU37	27/-
SP41	5/6
SP61	5/-
TP22	10/-
TT21	35/-
U19	40/-
U20	12/-
U22	8/-

U25	14/6
U26	14/6
U31	8/-
U33	30/-
U76	4/-
U81	10/-
U281	8/-
U282	8/-
U403	8/-
U404	5/-
UABC80	6/-
UAF42	9/6
UBC41	8/6
UBC81	8/6
UBF80	6/6
UBF89	7/-
UBL1	8/6
UC92	6/-
UCC85	7/-
UCF80	9/6
UCH21	9/6
UCH42	9/6
UCH81	6/6
UCL81	10/-
UCL82	7/-
UCL83	9/6
UF9	10/-
UF41	9/9
UF42	10/-
UF43	10/-
UF80	7/-
UF85	7/3
UF89	7/-
UL41	9/6
UL84	6/6
UM4	10/-
UM84	7/-
UU8	7/-
UU9	7/6
UY21	9/6
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W729	10/-
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INTEGRATED CIRCUIT AMPLIFIERS

RCA Type CA3020
Integrated Circuit Audio Amplifier in TO5 encapsulation (size of a small transistor), equivalent to seven n-p-n silicon transistors, 3 diodes and 11 resistors. Power output 550mW. Total harmonic distortion 1%. Will operate on voltage from 3 to 9 volts. 30/- plus 2/- p.p.

GENERAL ELECTRIC Type PA222
Epoxy moulded in-line package equivalent to six n-p-n transistors, one diode and six resistors. It will provide output of up to 1·2 watts into 15 ohms. Battery operation 22 volts. 40/- plus 2/- p.p.

The construction of amplifier using the above integrated circuits had been described in March and August issues of P.W. please note that we only supply the IC's and no other parts are supplied by us.

SPECIAL OFFER OF SILICON RECTIFIERS
1N5054: 1,000 p.i.v., 1·5 Amp. miniature wire ended epoxy encapsulated. 4/6 each
For orders of 12 or more. 3/6 each

LOW and MEDIUM CURRENT THYRISTORS

3/40, 400 p.i.v. 3 amp, stud mounted. Gate voltage 3·0v. at 20mA max. 7/6
BLUE SPOT, 200 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max. 12/6
GREEN SPOT, 400 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max. 17/6

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CR80–021A, 80 amps, 25 p.i.v.	23/-
CR100–201A, 100 amps, 200 p.i.v.	35/-
CR100–215A, 100 amps, 250 p.i.v.	40/-
CR100–301A, 100 amps, 300 p.i.v.	45/-
CR100–351A, 100 amps, 350 p.i.v.	50/-
CR100–401A, 100 amps, 400 p.i.v.	55/-
CR100–501A, 100 amps, 500 p.i.v.	75/-

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Type RAS508AF, 960 p.i.v. at 6 amps, max., stud mounted 10/6

DRY REED INSERTS

Glass dry reed inserts approx. ¼in. dia. x 1in. long with axial leads. One "make" contact of 100mA capacity at 50V. Can be operated by permanent magnet or 30–50 Amp-turns relay coils. PRICE 18/- per doz. post free.

CURRENT PRODUCTION CATHODE RAY TUBES

2AP1—2in. screen. EHT 500 to 1000V. Typical sensitivity at 500V. X—·220mm/V; Y—·260mm/V. USM11 Base. Overall length 7⅝in. 40/-
3BP1—3in. screen. EHT 1500V. Typical sensitivity X—·150mm/V; Y—·200mm/V. B14A Base. Overall length 10¼in. 55/-
5CP1A = DG13-2—5in. screen, with P.D.A.; EHT 4000 and 2000V. Typical sensitivity X—·275mm/V; Y—·325mm/V. B14A Base. Overall length 16¾in. 100/-
All the above tubes have 6·3V heaters and are suitable for general oscilloscope to use.

GERMANIUM POINT CONTACT DIODES

CG4E = CV448 2/-; OA5 3/-; OA6 4/-; OA7 4/-; OA47 2/6; OA70 2/-; OA79 2/3; OA81 1/9; OA85 1/6; OA90 2/-; OA91 2/-; OA95 2/-.

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THE TECHNICAL INFORMATION SECTION HAS BEEN FURTHER EXPANDED TO INCLUDE MORE DETAILS OF SEMICONDUCTORS. PLEASE SEND S.A.E. (Quarto Size) FOR FREE CATALOGUE.

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OC29	14/9
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OC36	12/6
OC42	5/-
OC43	9/-
OC44	4/-
OC45	3/6
OC58	12/8
OC70	4/-
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OC72	5/-
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OC75	5/-
OC76	5/-
OC77	7/-
OC78	5/-
OC78D	3/3
OC81	4/6
OC81D	3/-
OC83	4/6
OC84	5/-
OC122	12/6
OC139	7/6
OC140	9/6
OC141	12/6
OC170	5/6
OC171	5/6
OC200	4/4
OC201	10/-
OC202	13/-
OC203	6/3
OC204	6/-
OC205	13/-
OC206	14/-
AC107	10/-
AC125	6/6

AC126	5/-
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AC128	4/6
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AF114	6/-
AF115	6/-
AF116	5/6
AF117	4/6
AF118	10/-
AF124	6/6
AF125	6/-
AF126	5/2
AF127	5/3
AF178	12/6
AF186	11/-
AFY19	22/6
AFZ11	9/-
AFZ12	10/-
ASY26	6/-
ASY28	6/6
ASY29	6/-
ASY73	10/-
ASY74	15/-
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ASZ16	14/9
ASZ17	15/-
ASZ18	15/-
ASZ20	4/6
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BCY31	5/-
BCY33	5/-
BCY34	5/-
BCY39	5/-
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BF194	7/-
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BFY11	7/6
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BSY26	5/-
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2S004	15/-
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Set for P.W. Calibrated Oscillator: 7 OC170 (similar to NKT675) and 1 OA200 35/-
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The PW Britannic Two / The PW Mercury Six	(May 1962)	6/-
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The PW Query Service is designed primarily to answer queries on articles published in the magazine and to deal with problems which cannot easily be solved by reference to standard text books. In order to prevent unnecessary disappointment, prospective users of the service should note that:

(a) We cannot undertake to design equipment or to supply wiring diagrams or circuits, to individual requirements.

(b) We cannot undertake to supply detailed information for converting war surplus equipment, or to supply circuitry.

(c) It is usually impossible to supply information on imported domestic equipment owing to the lack of details available.

(d) We regret we are unable to answer technical queries over the telephone.

(e) It helps us if queries are clear and concise.

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This coupon is available until 10th January, 1969 and must accompany all queries in accordance with the rules of our Query Service.
PRACTICAL WIRELESS, JANUARY 1969

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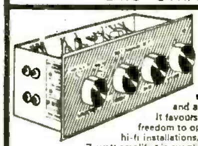

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With full Bass Treble and Volume Controls

A brilliant new design suitable for home or portable installations. For use with magnetic and crystal/ceramic cartridges, radio tuners, microphones, tape head replay and auxiliary inputs. Output is for 3 to 16 ohm speakers.

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AUTOBAHN MANUAL as the EASI-TUNE, but with a single MW/LW Push Button. — £10.10.0. pp. 4/6

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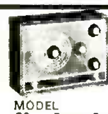

MODEL		PRICE £	s.	d.	Leaflet No.
22	Power Supply	14	0	0	22
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31	R.F. Generator	12	10	0	25
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33	Inductance Bridge	20	0	0	29

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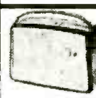

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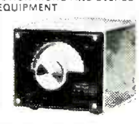

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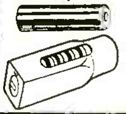

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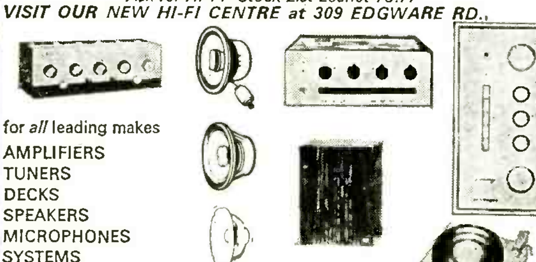

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