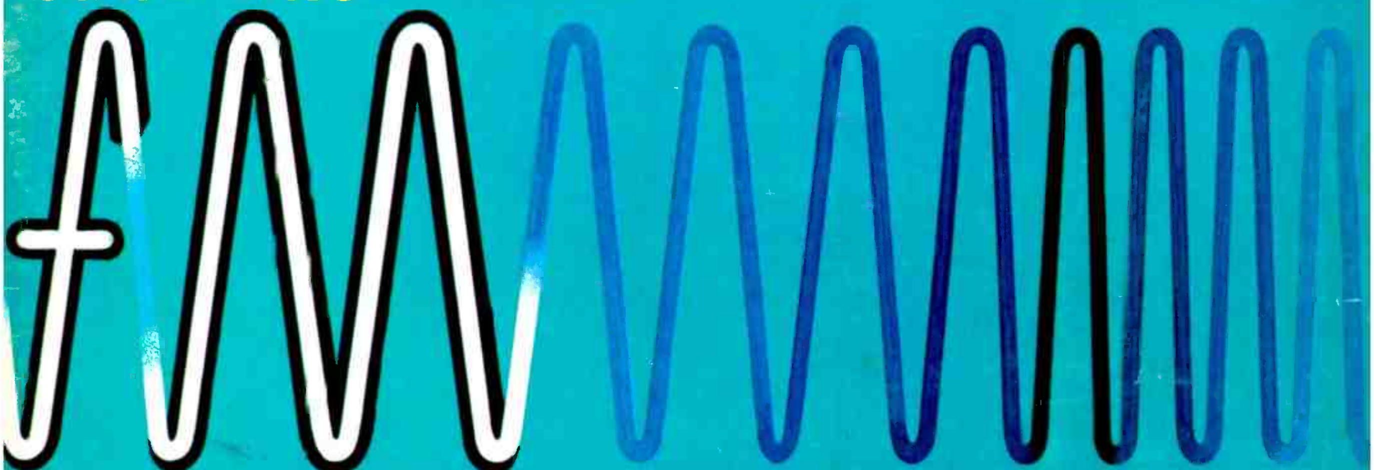
PRACTICAL WIRELESS

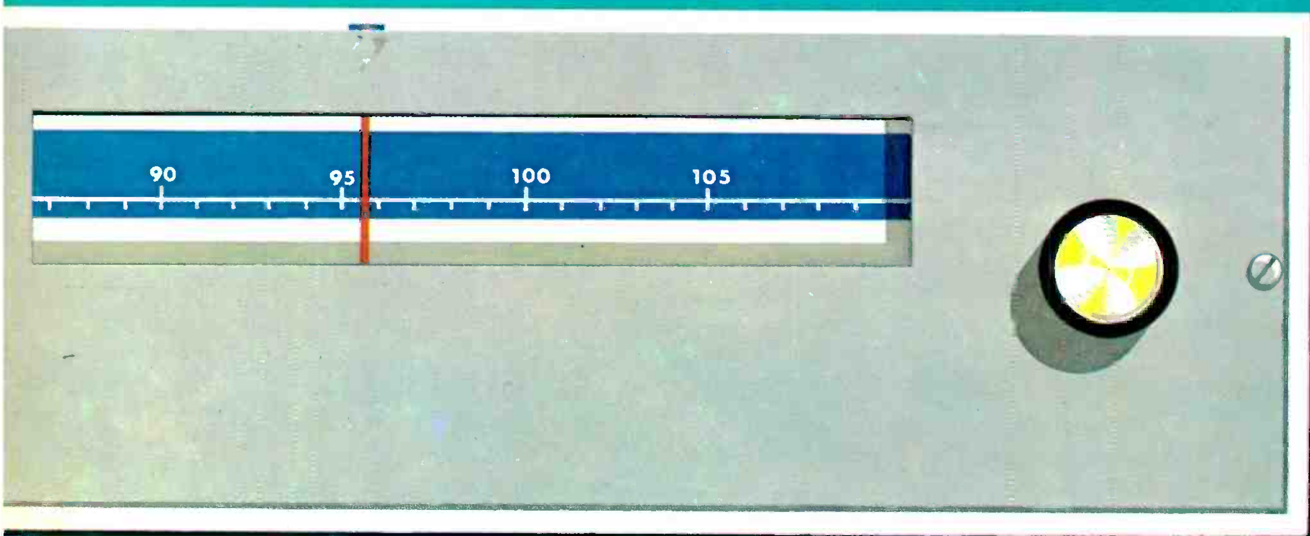
FEBRUARY 1969

3/0

build this



TUNER



ALSO TO BUILD:– GRID DIP OSCILLATOR
HIGH IMPEDANCE PROBE

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 ¾in. laminate with oiled walnut veneer finish: size 13¾ × 7¾in. 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

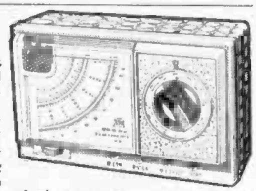
TEST EQUIPMENT

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 3½ × 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

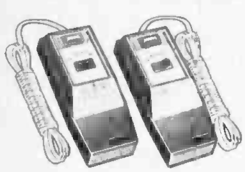
TTC Model C-1051



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 × 3½ × 1¼in. Two colour buff/green finish. Complete with test leads and battery. Original list price £5.5

Lasky's Price 75/- Post 2/6

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: 5¼ × 2¼ × 1¾in., each with neon indicator lamp. Comp. with flex and instructions.

Lasky's Price £7.19.6 Post 5/-

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE AT RECORD LOW PRICES

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
3¼in.	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			

P. & P. 1/- extra per reel. 4 reels and over Post Free. Special quotes for quantities.

●● NEWS FLASH ●●

LASKY'S GREAT 36th YEAR AUDIO-TRONICS PICTORIAL

OUT NOW!

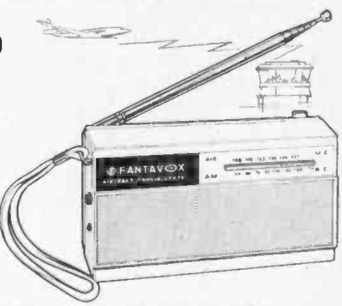
This year we celebrate our 36th anniversary by bringing to you this great new issue of our "AUDIO-TRONICS PICTORIAL" now 16 colour pages in large 16" × 11" format, simply packed with 1000's of items from our vast stocks of EVERYTHING for the Radio and Electronics Hobbyist, Hi-Fi Enthusiast, Serviceman and Radio Ham. Plus 100's of Lasky's exclusive STAR PRICE Bargains.

All items are available by Mail Order or from any of our branches.

FREE JUST SEND YOUR NAME, ADDRESS AND 1/- FOR POST ONLY.

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. 2¼in. 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 × 1¼in. Complete with batteries, magnetic earphone, instructions and circuit data.

Lasky's Price £8.7.6 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 × 2¾in. (inc. knobs). Complete with battery and full instructions.

Lasky's Price 79/6 Post 3/6

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.

Lasky's Price 85/- Post 2/-

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 3271
Open all day Saturday, early closing 1 p.m. Thursday

33 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-636 2605
Open all day, 9 a.m.—6 p.m. Monday to Saturday

152/3 FLEET STREET, LONDON, E.C.4 Tel.: FLEet St. 2833
Open all day Thursday, early closing 1 p.m. Saturday

High Fidelity Audio Centres

42 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-580 2573
Open all day Thursday, early closing 1 p.m. Saturday

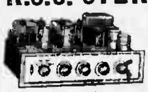
118 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 9789
Open all day Saturday, early closing 1 p.m. Thursday

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL ST., TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ **Moderate size, only 25 x 14 x 10in.** Complete Kit **18 Gns.**
★ **Response 30-20,000 c.p.s. Impedance 15 ohms.** Carr. 12/6
★ **Performance comparable with units costing considerably more.** Consists of (1) 12in. 20 watt Bass unit with cast chassis. Roll rubber cone 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.

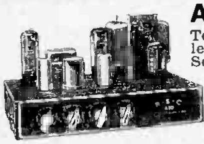
R.S.C. STEREO/20 HI-FI AMPLIFIER



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 **9 Gns.** Output for 3 and 15 ohm spkrs. SAE for leaflet. Complete kit. 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 × 2¾ × 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.	23/9
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

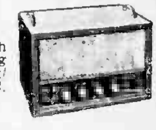
AGENT APPOINTED O. & C. ELECTRONICS 227 CHURCH ST.

R·S·C HI-FI CENTRES LTD.

R.S.C. COLUMN SPEAKERS

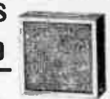
Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **C57 15 watts** inc. five 7 x 4in. speakers **£7.19.11.** **Type C48, 30 watts.** Fitted four 8in. high flux 8 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **16 Gns.**
Type C412S, 50 watts. Fitted four 12in. 11,000 line 15 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/-. **24 Gns.**
Or Deposit **£4.13.6** and 9 monthly payments of **52/6** (Total **£28.5.0**).

30 WATT HI-FI AMPLIFIER



for Guitar, Vocal or Instrumental Group
A 2 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
15 Watt 11,000 lines 3 or 15 ohms. Carr 7/6 **£5.15.0**
20 Watt 10,000 lines 3 or 15 ohms. Carr 8/9 **£8.19.9**

LOUDSPEAKERS

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

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

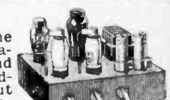
FANE 'POP' 100 LOUDSPEAKER

18" 100 Watt 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 TURNTABLES
with P.U. 4 speed. Turnover cartridge. Limited number.
Mono **69/9** Stereo **79/9**

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

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

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

J.B. VHF/FM DIAL & DRIVE ASSEMBLIES
Complete with escutcheon. Size 7" × 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 less Facia plate. (Normally 13 gns.). Carr 8/6 **£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 9¾ x 6¼ x 7½in. Peak power handling 8 watts 3 ohms or 15 ohms. **Clearance Price 59/11**

JASON VHF/FM TUNER DESIGNS

All parts FMT1 **5 Gns.** FMT2 **£6.19.11.** JTV2 **9½ Gns.** Please state channel

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

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

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

"PACKAGE 3" 30 WATT SYSTEM
★ Goldring Transcription Turntable on Plinth
★ Shure Magnetic Pick-up Cartridge
★ Super 30 Amplifier in Teak veneer housing
★ Pair of Stanton Loudspeaker Units
Special inclusive price. Fully wired units ready to "plug-in". **85 Gns.**
TERMS AVAILABLE ALL PACKAGE OFFERS

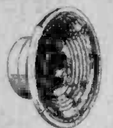
Matched for optimum performance. Send for coloured brochure showing other money saving offers.

Illustrated with TFM1 Mk II Tuner fitted
EXTREMELY ATTRACTIVE AND VERSATILE PLINTHS finished in Satin Teak veneer. Tinted Perspex hinged cover with satin chrome handle.

"PACKAGE 2" 30 WATT SYSTEM
★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ Super 30 Amplifier in Teak veneer housing
★ Pair of Stanton Loudspeaker Units
Special inclusive price. Fully wired units ready to "plug-in". **75 Gns.**

"PACKAGE 1" 13 WATT SYSTEM
★ Garrard SP25 Mk II 4 speed Player Unit
★ Goldring CS90 Ceramic P.U. Cartridge
★ TA12 Amplifier in Teak veneer housing
★ Pair of Dorset Loudspeaker Units Special inclusive price. **49½ Gns.**
Or Dep. £10 and 9 monthly payments £5.4.0. (Total £56.16.0.) Perspex cover 3gns. extra.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



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

HF501	5"	10W	57/9	HF100D	10"	15W	£5.15.0
HF801D	8"	8W	55/9	HF120	12"	15W	69/9
HF811D	8"	10W	4 gns.	HF120D	12"	15W	79/9
HF102D	10"	8W	59/9	HF126	12"	15W	89/9
				HF126D	12"	15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS
Cabinets of latest styling Satin Teak. Acoustically lined or filled woollen damping. Ported where appropriate. Credit terms available on all units.

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

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

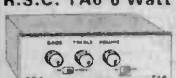
GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40-20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

E2 EQUIPMENT CABINET

Size 17" wide 14¼" deep 11½" high. Cut for TA12, Super 15, Super 30 and other amplifiers. 'Hinged' perspex cover. Satin Teak veneer finish. Price inc. carr **8 Gns.**

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

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

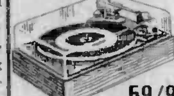


200-250v. AC mains operated Frequency Response 30-20,000 c.p.s. —2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm speakers. Max. sensitivity 5mV. Fully enclosed enamelled case. 9¼ x 2¾ x 5¼in. Attractive brushed silver finish facia plate 10¼ x 3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 Or factory built with 12 months guarantee. **8 Gns.** **6 Gns.**

RECORD PLAYING UNITS

Money saving units. Ready to plug into Amplifier or Tape Recorder.
RP2 Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Mounted on Plinth. Inc. Perspex cover. Carr. 15/-. **22 Gns.**
RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Supplied with Perspex Cover. Carr. 21/-. **26½ Gns.**

R.S.C. PLINTHS



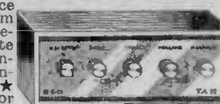
for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. Available with clear Perspex cover as ill. Inc. Carr. **59/9** **6 Gns.** Perspex cover sold separately at 3 Gns. Limited number of covers slightly damaged but repaired by makers. 39/9

INTEREST CHARGES REFUNDED on Credit Sales settled in 3 months.

BLACKPOOL AGENT APPOINTED See other page

R·S·C·TA12 13 WATT STEREO AMPLIFIER

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



Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v A.C. mains ★ Frequency Response 30-20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 50mV (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. Factory built with 12 mth gntee 15 GNS Or Deposit £4.16.0 and 9 mthly pymts 29/- (Total 17 GNS.) **12½ GNS.** Carr. 7/9
Or in Teak veneer housing 18 Gns.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

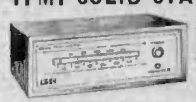
Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.**
Or Senior 15 watt inc. HF 126 15,000 line Speaker 6 Gns. Carr. 6/6 Carr. 5/9

HI-FI SPEAKER ENCLOSURES

Teak veneer finish

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

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



Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.** Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.

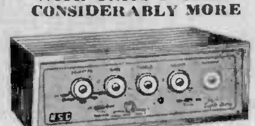
★ **High-sensitivity** ★ **200-250v. A.C. Mains operation.** ★ **Sharp A.M. Rejection.** ★ **Drift-free reception.** ★ **Output ample for any amplifier (approx. 500 m.v.).** ★ **Simple alignment instructions.** ★ **Output available for feeding tuning meter.** ★ **Output for feeding Stereo Multiplexer.** ★ **Tuner head using silicone Planar Transistors.** ★ **Designed for standard 80 ohm co-axial input.** Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only first grade transistors and components used. A quality product at considerably less than the cost of comparable units. Stereo version, all parts 18 gns. Carr. 10/-. Assembled 22½ gns. inc. carr.

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

SOLID STATE CONSTRUCTION

FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3-4 ohms.
LATEST TRANSISTORS. NKT275, NKT275, NKT274, NKT713, NKT217, NKT217, NKT717, NKT403, NKT403.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10Kc/s. **NEG FEEDBACK:** 52dB.
BASS CONTROL: +17dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·1%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 15½ **Gns.** Carr. 12/6. Terms: Deposit 4 **Gns.** and 9 monthly payments 31/1 (Total £18.3.9). Or in Teak veneer housing as illustrated. 19 **Gns.**
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

SPECIFICATIONS COMPARABLE WITH UNITS COSTING CONSIDERABLY MORE



R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector. Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **19½ Gns.**
Unit factory built 27 **Gns.** or deposit **£6.2.0** and 9 monthly payments **56/3.** (Total **£31.8.3**). Or in Teak veneer housing **30 Gns.** Carr. 15/- or Deposit **£6.2.6** and 9 monthly paymts **64/-** (Total **£34.18.6**). *Send S.A.E. for leaflet.*

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

R·S·C HI-FI CENTRES LTD.

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

Open all day Sats. except High Holborn

32 High Street. (Half-day Thurs.) Tel. 56420 **LEICESTER**
5-7 County (Mecca) Arcade, Briggate (Half-day Wed) Tel 28252 **LEEDS**
73 Dale St. (Half-day Wed.) Tel. CEntral 3573 **LIVERPOOL**
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41 Blackett Street (Opp. Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE UPON TYNE**
13 Exchange Street (Castle Market Bldgs.) (Half-day Thursday) Tel. 20716 **SHEFFIELD**

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. 14½ x 11¼ 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 × 4in. **18/6**; 10 × 6in. **27/6.** E.M.I. 8 × 5in. with high flux magnet **21/-**. E.M.I. 13½ × 8in. with high flux ceramic magnet **42/-** (15 ohm **45/-**). E.M.I. 13 × 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 × 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. **£16.0.0.** Carr. 10/6.

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. OUR PRICE **21/-**. P. & P. 1/6.

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. ¾ × 1⅛ × 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 × 1 × 1½in. 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 2¾ × 3½ × ¾in. **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 × 1⅛ × ¾in. 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 2¼ × 1 × 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 2¾ × ¾ × 2¼in. **10/6.** P. & P. 3/6. (Special quotations for quantities).

HIGH GRADE COPPER LAMINATE BOARDS

8 × 6 × 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.

LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. Only **32/6.** P. & P. 2/-.

LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **30/-**. P. & P. 2/-.

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

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

QUALITY RECORD PLAYER AMPLIFIER

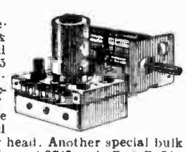
A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7" w. × 3" d. × 6" h. Ready built and tested. PRICE **75/-**. P. & P. 6/-.

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

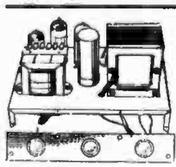
Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD autochanger or Single Player Unit (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **£3.9.6.** P. & P. 9/6.

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. × 4" d. × 4¾" 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.

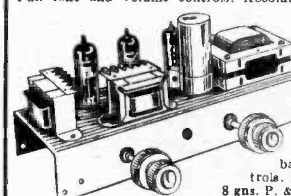
SPECIAL OFFER!

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 ACOS Stick Microphone (21/-). Output 1000mW. Uses standard 9 volt battery. Smart two tone carrying case size 12 × 4 × 9in. fitted standard input jack socket, volume controls, 7 × 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.

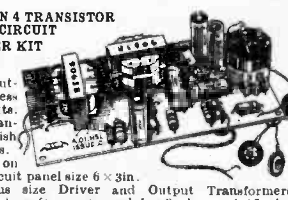


ONLY **£5.9.6**

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 × 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.

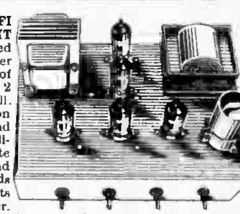
SPECIAL PRICE 45/-. P. & P. 3/-. Also ready built and tested, **52/6.** P. & P. 3/-.

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 × 3" deep × 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 2 EL84s, 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.

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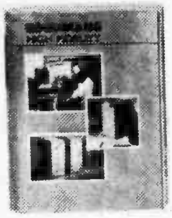

A Guide to full listening enjoyment

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

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

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MATCHING AM/FM STEREOPHONIC FM TUNER
Transistorised · Outstanding specification · Stereo de-coder (optional) **£65.5.0** + £17.5.5 P.T.

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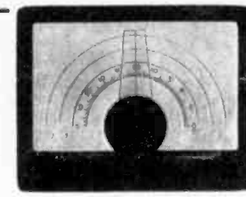

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Incorporating the Dual Ratio Ball Drive providing 36–1 Slow drive and 6–1 Fast drive under one knob with co-axial control. Scale is calibrated 0–100 and an extra blank scale is provided for individual calibration. Overall size 4⅞ x 3¾in.
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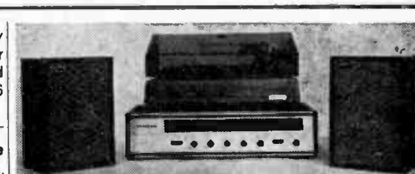

The greatest HI-FI Budget system to-day—Can't be beaten—price or quality anywhere—look at these great features—then compare.

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Teleton F2000 tuner amp. AM-FM with multiplex decoder and A.F.C.—2 x 5w channels R.M.S. Bass Volume Treble Balance controls, a truly outstanding unit	39	12	1
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P. & P. 16/– each unit.

Keletron 12in. dia. 12 watt twin cone HI-FI speaker as sold by leading manufacturer. Response 30/16,000 HZ. Usual price £5.7.6. Our price **87/6**, p/p. 5/-.

Beautiful oiled teak enclosure to suit EMI 13 x 8in. speakers. Retail value £8.15.0. Our low-low price Only **99/6** plus 8/- p/p.

This month's Waldon offer 5 x 5W transistorised stereo amplifier. Undoubtedly a most remarkable offer—outstanding performance, comparable with amplifiers in the £25–£30 price range. Brief specification includes volume, bass, treble, balance control, stereo, mono, switch, inputs, sockets, tape tuner, pick-up AUX. Being Manufacturers' distributors of this fine stereo amplifier, as an initial promotion we are prepared to offer this unit at fractionally above cost for a limited period only. **15 gns., p/p free.**

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Covers full medium wave, battery operated. Highly sensitive circuit. £4.19.6. P. & P. 2/6.

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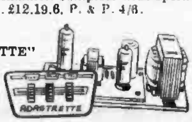

2/3 watt Record Player Amplifier. ECL82 and EZ80 valves. Output imp 3/5 ohms. Easy to fit into cabinet. Separate control panel with on/off, volume and tone controls. Complete with instructions £4.7.6. P. & P. 4/6.

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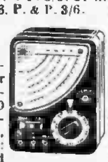
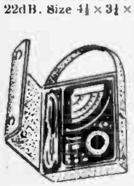
The set that plays anywhere! 6 stage transistor set, complete with earpiece. Ready built and fully guaranteed. Only 59/6. P. & P. 3/6. Or in kit form 49/6. P. & P. 3/6.

SHIRA 62D MULTI-TESTER 20,000 o.p.v.



DC Voltage: 5-25-50-250-500-2·5K (20,000 ohms per Volt). AC Voltage: 10-50-100-500-1000 Volts (10,000 ohms per Volt). DC Current: 0-50A, 0-2·5mA, 0-250mA. Resistance: 0-6K, 0-6mg (300 ohm and 30K at centre scale). Capacitance: 10F to ·001F. ·001F to ·1F. Decibels: −20 to +22dB. Size 4½ × 3¼ × 1in. 69/6. P. & P. 3/6.



TTC.C1001 MULTI-TESTER

in leather case. 20,000 opv. AC volts 10, 50, 250, 1000v, DC volts 5-25, 125, 500, 2500v. DC Current 0-50A, 0-250mA. Resistance 0-60K, 0-6 Megohm. Decibels −20 to +22dB. Size of meter 4½ × 3¾ × 1in. 85/-. P. & P. 3/6.

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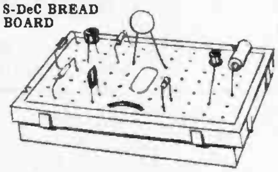
Build nine different projects from one basic kit—no mechanical knowledge required. Build a Police Siren, Metronome, Morse Code Amplifier, Electronic Massager, W/T Transmitter, Radio Telephone, One transistor Radio, Two-transistor radio, Electronic Music Kit. Completely safe-operated on 9v. PP3 battery. Complete with simple step by step instructions. ONLY 69/6 P. & P. 5/-.

S-DeC BREAD BOARD



Solderless breadboard panels, for fast reliable component connections.

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2 DeC KIT. Two decks, control panel and accessory kit together with component tray and lid all in a black plastic box. Instructions and project book included. 69/6 P. & P. 2/6.

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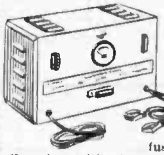

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Smart hammer grey case, 1¾in. meter, 6v and 12v switching. Safety fuses and heat vents. Complete with 5ft. three core mains lead, 5ft. red and black battery leads with heavy duty crocodile clips. 59/6. P. & P. 4/6.

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For measuring alpha, beta, and Ico. factors of transistors also for checking germanium and silicon diodes. Internal 9v. battery. Wide reading scale. Moulded case size 7 × 4½ × 3¼in. Ranges: Alpha 0·7-0·9967: Beta 0-300: Ico0-50A-5,000A. Diode Test: Forward and reverse internal resistance. Resistances: 200 ohm-1 megohm. Complete with connectors and instruction booklet. £7.19.6. P. & P. 3/6.

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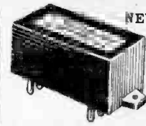
Tests in-circuit or out of circuit. Identifies PNP and NPN types. Indicator lamp provides positive information on the following tests:

Electrode open circuits and current drain. Provides reliable GO-NO-GO tests at practical collector currents of from 5mA-50mA or more on power transistors.

With accessories and instructions. Size 3¾ × 6¼ × 2¼in. £4.19.6. P. & P. 3/6.



NEW TRANSISTOR MODULES.

E.1311. PHONO PRE-AMPLIFIER. Size 2 × 1 × ¾in. built-in R.I.A.A. Characteristics enabling low output magnetic pick-up cartridges to be amplified up to 1 volt. Input 100K ohm: Gain: 28dB: Max. output: 3: Max. Input: 50mV; Distortion: 0·15% (at 1v level). Power supply: 9-12v. 29/6. P. & P. 2/-.

E.1312. TAPE PRE-AMPLIFIER. Incorporating N.A.R.T.B. curve characteristics, this amplifies tape head signals up to 1 volt within the frequency range of 30Hz-15KHz. Input imp 100Kohm: Gain: 25dB: Max. output: 2v; Max. Input: 50mV; Distortion: 0·15% (at 1v level): Power supply: 9-12 volts. 29/6. P. & P. 2/-.

E.1313. MICROPHONE PRE-AMPLIFIER. Enables a low output microphone to be used with an amplifier or radio. Input imp. 100K ohms; Gain: 28dB: Max. output: 3v; Max. input: 50mV; Distortion: 0·15% (at 1v level); Freq. res. 10Hz-50KHz. Power supply: 9-12v. 29/6. P. & P. 2/-.

E.1314. POWER AMPLIFIER. When used in conjunction with E.1311, E.1312 and E.1313, units this amplifier module produces about 300mW output for speaker connection (8-16 ohms), without necessity for an output transformer. Input imp. 1,000 ohms; Gain: 20dB; Output: 300mW; Distortion: 3% (at 200mW output level). Freq. res. 50Hz-10KHz. Power supply: 9v Current 20mA at no signal, 80mA at max. output. 29/6. P. & P. 2/-.

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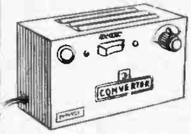
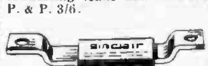


AC/DC CONVERTOR.

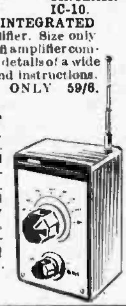
Enables transistor equipment to be operated from AC mains. 6/9/12v output selector switch and on/off switch. Grey case size 4 × 2¾ × 2in. complete with mains lead, connecting leads and instructions. 59/6. P. & P. 3/6.



NEW—SINCLAIR IC-10. INTEGRATED CIRCUIT

10 watt Amplifier. Size only 1 × 0·4 × 0·2in. A true hi-fi amplifier complete with manual giving details of a wide range of applications and instructions. Guaranteed 5 years. ONLY 59/6. P. & P. 1/6.

NEW—VHF AIRCRAFT BAND CONVERTOR.



When placed within 1in. of a MW band radio full coverage of VHF Aircraft Band 108-135Mc/s. can be obtained. All transistor, 9v battery operation Fully tunable. 18½in. × 7 section telescopic aerial. Size 4 × 2¾ × 1½in. 79/6. P. & P. 3/6.

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With soft rubber earpieces. Impedance 8-16 ohms. Frequency response. 23-13,000cps. With lead and stereo plug.

Only 59/6. P. & P. 3/6.

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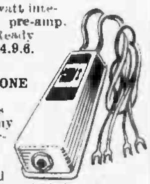
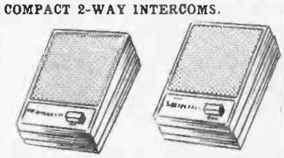
SINCLAIR Z12 12 watt integrated amp. and pre-amp. Size 3 × 1¾ × 1½in. Ready built with manual £4.9.6. P. & P. 3/6.



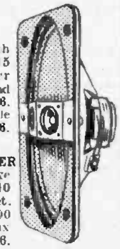
STEREO HEADPHONE JUNCTION BOX.

Enables headphones to be used with any amplifier. Incorporates amplifier leads, speaker terminals, jack socket and speaker/headphone switch. 29/6. P. & P. 2/-.

COMPACT 2-WAY INTERCOMS.



For table or wall mounting. Smart two tone grey cases size 3½ × 1¾ × 2½in. Complete with lead, staples and 9v battery. 49/6. P. & P. 3/6.



EMI COMBINATION LOUDSPEAKERS.

13½ × 8¼in. eliptical with two 2½in. tweeters. 15 ohm impedance. Power handling 10 watts. Brand new and guaranteed. 99/6. P. & P. 7/6. (Also available without tweeters. 59/6. P. & P. 7/6).

"HI-TEN" LOUDSPEAKER

British made full range 10in. unit handles up to 10 watts. Ceramic magnet. Freq. response: 40-10,000 cps. Imp: 15 ohms. Flux density: 10,000 lines. 49/6. P. & P. 4/6.

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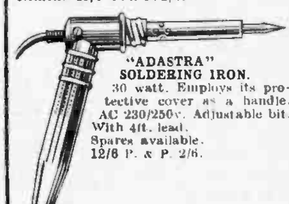
With interchangeable tips, extension barrels, comfortable grip with trigger control, "U" shaped 3½in. bit to minimise wear. Light beam is automatically directed on to end of bit when ON/OFF trigger is in use. Complete with 2-pin plug 230-250 volts. Spares available. 85 watt element. 49/6 P. & P. 2/6.



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30 watt. Employs its protective cover as a handle. AC 230/250v. Adjustable bit. With 4ft. lead. Spares available. 12/6 P. & P. 2/6.

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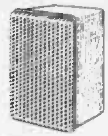
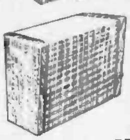
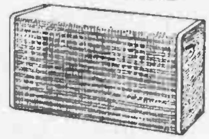


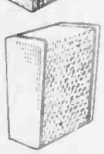
THE MILTON. A Hi-Fi Bookcase Cabinet. Size 9 x 5 x 6in., with 5in., speaker. Finished in Teak cloth with bold silk front 30/-. P. & P. 4/6.



THE IMP. Extension Speaker Cabinet. Wedge shaped, size 7½ x 6½in. fitted 7 x 4in. speaker. Covered with attractive walnut with fawn Vynair front. Keyhole slot in back. Only 25/6. P. & P. 4/6

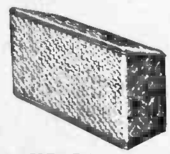


THE STEREO. A superior extension speaker cabinet fitted with two 7 x 4in. speakers. Size 16 x 9 x 8½in. Finished in fawn Vynair with natural/teak ends. £3. P. & P. 5/-.



DUO. Wedge shaped Speaker Cabinet. Size 7½ x 7½in. fitted 7 x 4in. speaker. Covered in attractive two tone Vynair. Price 32/6. P. & P. 4/6.

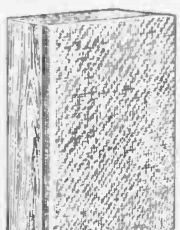
CLARENCE. Extension Speaker Cabinet fitted 8 x 5in. speaker. (3 ohms imp.) and volume control. Size 10½ x 8½ x 4½in. Finished in black and grey Vynair. 45/-. P. & P. 4/6



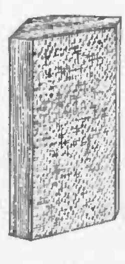
THE SCOTT. Table top or wall mounting Speaker. Size 16½ x 10½ x 5½in., tapered as illustrated. Fitted 13½ x 8in. Speaker with volume control. Finished in teak cloth and contrasting Vynair. (Please state 3 or 15 ohm imp.) £4.5.0. P. & P. 7/6.

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.

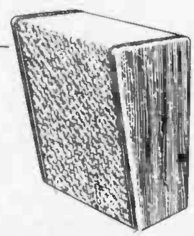
SPEAKER ENCLOSURES



The Baker. Size 8 x 15½ x 23½in. 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.



The Cowdrey. Corner Cabinet in natural teak finish for 13½ x 8in. speaker also cut out for tweeter, £3.15.0. P. & P. 8/6.



The Tennyson. Wedge shape for table or wall mounting 13½ x 16 x 8½in. Cut out for 13½ x 8in. speaker with port. Finished wood grain cloth and matching Vynair. £2.2.6 P. & P. 7/6.

The Vernon. Table top or wall mounting enclosure for 13½ x 8in., speaker (Similar to The Scott illus. above). 37/6. P. & P. 6/-.

The Haydon. 16½ x 15 x 7½ in., wood grain cloth and contrasting Vynair covered suitable for 12in. speaker, 72/6. P. & P. 9/-.

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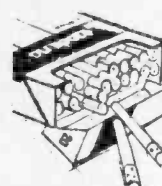

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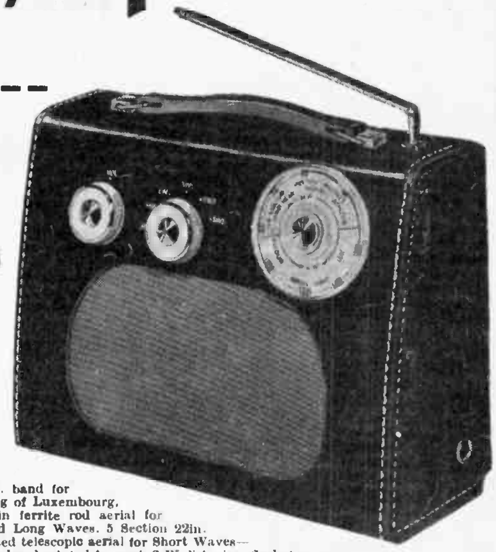

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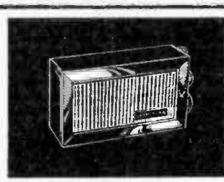

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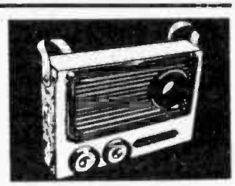

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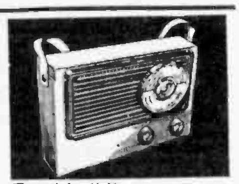

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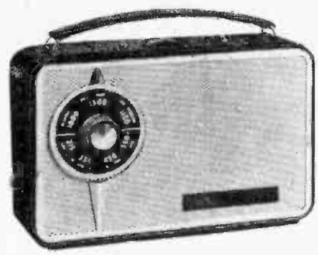

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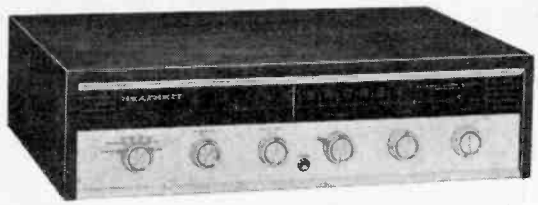

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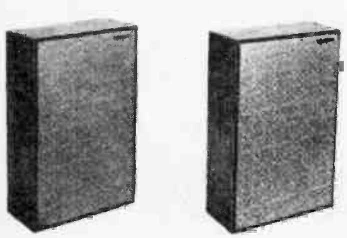

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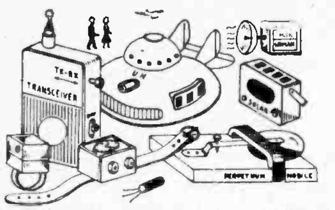

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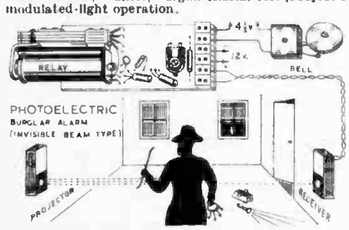

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Everything needed (except plywood) for building: 1 Invisible-Beam Projector and 1 Photocell Receiver (as illustrated). Suitable for all Photoelectric Burglar Alarms, Counters, Door Openers, etc.
CONTENTS: 2 lenses, 2 mirrors, 2 45-degree wooden blocks, 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.

AMPLIFIERS

SSAR3. 10W push-pull output. TW99 output trans. Four valve. Full chassis mounting. New and boxed. Complete with circuit drawings. **£2.10.0.** P. & P. 10/-.
SSAR7. 100W output. Three valve. TW132 output trans. Selenium rectifiers. 8μF. condenser. Full chassis mounting. New and boxed. Complete with circuit drawings. **£2.10.0.** P. & P. 10/-.

JUST RELEASED

R.A.F. Receiver Type R3673. Details on request.
Mixer Units Type 18. H.F., M.F., L.F. Valve V885. **10/-**. P. & P. 2/6.
Micro-Ammeters for Instrument Mounting, etc. 0–100mA. **30/-**. P. & P. 2/6.
Micro-Ammeters Type Y. 0–100mA. Heavy duty in case complete with leads, **£3.** P. & P. 5/-.
Flexible Metal Tubing. Galvanised. Watertight, **35/-** 100ft. P. & P. 7/6.
ELECTRO-METHODS. Low Inertia Motor 24V d.c. 2,000 r.p.m., **20/-**. P. & P. 2/6.
CHASSIS UNIT. 7 valves ECC82 (3), EB91 (3), 6F33 (1). 45 Capacitors. Resistors, etc. Valve bases and cans, **20/-**. P. & P. 2/6.
TRANSFORMERS (examples).
SSTR073. Pri. 230V. Sec. 35V (0·5A), 6·3V (2A), 225–0–225V (27mA). oil filled, **25/-**. P. & P. 5/-.
SSTR009. Pri. 230V. Sec. 0–50V (50mA). 4V (1A), 6·3V (8A). **25/-**. P. & P. 5/-.
1,000 Transformers in stock.
CAPACITORS. 30 assorted 0·01mF to 1mF (our selection). **10/-**. P. & P. 2/-.
CABLE. Six core (100yd. new) with drum assembly, **25/-**. P. & P. 4/6.

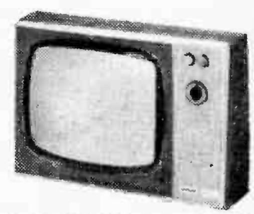
TEST INSTRUMENTS, ETC. S.A.E. FULL LIST

STATUS SUPPLIES
STATUS HOUSE, WILKINSON AVE., BLACKPOOL

17in.—£11.10.0
19in. SLIMLINE
SOBELL—24 Gns.

TWO-YEAR GUARANTEE
EX-RENTAL TELEVISIONS

FREE ILLUSTRATED
LIST OF TELEVISIONS
17"–19"–21"–23"
WIDE RANGE OF MODELS
SIZES AND PRICES
DEMONSTRATIONS DAILY



TWO-YEAR GUARANTEED
TUBES 100% REGUNNED
14in.—69/6 17in.—89/6
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EXCHANGE BOWLS. Carr. 10/6
Ex MAINTENANCE TESTED TUBES
17in.—35/-. Carr. 5/- (not slimline)

COCKTAIL/STEREOGRAM CABINET £25

Polished walnut veneer with elegant glass fronted cocktail compartment, padded. Position for two 10in. elliptical speakers. Record storage space. Height 35½in., width 52¾in., depth 14½in. Legs 1 gn. extra.
OTHER MODELS. SEND FOR FREE LIST

TRANSISTOR CHASSIS
D1 49/6
6 Transistors. LW/MW. Brand New. Famous British Manufacturer. (LESS SPEAKERS). Dia. 7½" x 3¼". P. & P. 4/6.

TRANSISTOR CASES 19/6. Cloth covered, many colours. Size 9½"x6½"x3½" P. & P. 4/6. Similar cases in plastic 7/6.
TRANSISTOR RECORD PLAYER CABINETS 19/6. Dim. 11" x 14½" x 5½". P. & P. 7/6.
SINGLE PLAYER CABINETS 19/6. P. & P. 7/6.
AUTO CHANGERS £8.19.6. Garrard 3000 with sonotone 9T. A.C. D/S stereo cartridge.
STRIP LIGHT TUBES 3/9 each. 11" (284 mm.) 230/240 volts, 30 watts. Ideal for cocktail cabinet illuminating pictures, diffused lighting etc. 6 for £1. P. & P. free.

DUKE & CO. (LONDON) LTD.
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P.W. F.M. TUNER
Complete kits of specified parts

Resistor Kit (31 pieces)	10/6
Capacitor Kit (28 pieces)	32/6
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Coil Kit. Comprising set of 3 Weyrad IF Transformers, Formers and wire etc for L1, 2 and 3	28/6
Tuning gang Kit. Comprising Jackson C21 with ¼" shaft, Drive, Drum, Pulleys, Pointer and cord	22/–
Drilled chassis	7/6
Aluminium front panel, undrilled	2/6
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P.T.F.E. feed through insulators, set of 3	5/6

Post and Packing per order 2/6 (first class)
Complete Kit All of above Post paid **£8.0.0**

C. & D. ELECTRONICS
17 ST. LUKES ROAD, PALLION, SUNDERLAND, CO. DURHAM

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

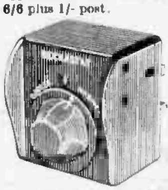
Double pole with neon let into side so luminous in dark. Ideal for dark room light or for use with waterproof element—new plastic case. 5/6 each. 3 heat model 7/6.

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.

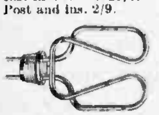
PP3 ELIMINATOR. Play your pocket radio from the mains! save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions, only 6/6 plus 1/- post.

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, Mirroware, 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.

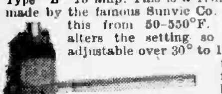
MAINS TRANSISTOR POWER PACK

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.

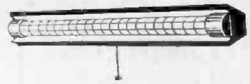


Type "D". We call this the ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the 10ft. pipes from freezing, if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/6. P. & P. 1/-.

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

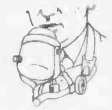
Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 18/-, plus 2/- post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

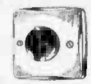


Fine American made dynamic type, adjustable on breast plate with neck straps, 7/6, post 4/6.

12V BLOWER

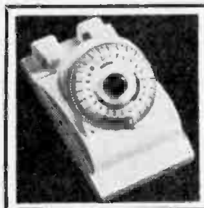
Heavy duty motor with centrifugal blower coupled to one end. Ideal for car heater. 12/6, plus 4/6 post.

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 outlet 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 11⅝in. 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

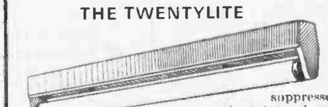
FROM THERMAL RUNWAY OR OVERHEATING

Thyristors, 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/-

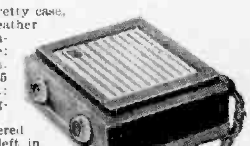
ATLAS SLIMLINE FLUORESCENTS

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 ½ 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.

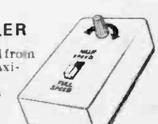
MICRO-SONIC



7 transistor Key chain Radio in very pretty case, size 2⅜ x 2⅛ x 1⅛in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 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 29/6, plus 2/6 post.

INDICATOR LAMP

Panel mounting, consists of neon lamp in red plastic lens with resistor in lead 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 headband 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

1,250 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

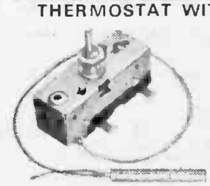
Each kit comprises seven items—Choke, 2 tube ends starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15–20 w. 19/6. Kit B—30 40 w. 19/6.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

THERMOSTAT WITH PROBE



This has a sensor attached to a 15A switch by a 14in. length of flexible capillary tubing—control range is 20deg.F. to 150 deg.F. so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 12/6 each

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

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7¼ to 47in. Hole in bottom for 6BA screw. 7/6.

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

ELECTRONICS (CROYDON) LTD

Dept PW 266 London Road, Croydon CRO-2TH

Also 102/3 Tamworth Road, Croydon

SEW PANEL METERS

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

CLEAR PLASTIC METERS

5mA	37/6	300V. D.C.	37/6
10mA	37/6	15V. A.C.	37/6
50mA	37/6	300V. A.C.	37/6
100mA	37/6	S Meter 1mA	39/6
500mA	37/6	VU Meter	59/6
1 amp.	37/6	1 amp. A.C.*	37/6
5 amp.	37/6	5 amp. A.C.*	37/6
10V. D.C.	37/6	10 amp. A.C.*	37/6
20V. D.C.	37/6	20 amp. A.C.*	37/6
50V. D.C.	37/6	30 amp. A.C.*	37/6

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

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

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

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

Type MR.52P. 2½in. square fronts.

50µA	59/6	100-0-100µA	45/-
50-0-50µA	49/6	500µA	42/6
100µA	49/6	1mA	37/6

Type MR.85P. 4¼in. × 4¼in. fronts.

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

Type MR.65P. 3½in. × 3½in. fronts.

50µA	65/-	50V. D.C.	39/6
50-0-50µA	52/6	150V. D.C.	39/6
100µA	52/6	300V. D.C.	39/6
100-0-100µA	49/6	15V. A.C.	39/6
500µA	45/-	50V. A.C.	39/6
1mA	39/6	150V. A.C.	39/6
5mA	39/6	300V. A.C.	39/6
10mA	39/6	500V. A.C.	39/6
50mA	39/6	S meter 1mA	45/-
100mA	39/6	VU meter	65/-
500mA	39/6	50mA A.C.*	39/6
1 amp.	39/6	100mA A.C.*	39/6
5 amp.	39/6		
10 amp.	39/6	200mA A.C.*	39/6
15 amp.	39/6	500mA A.C.*	39/6
20 amp.	39/6	1 amp. A.C.*	39/9
30 amp.	39/6	5 amp. A.C.*	39/6
50 amp.	39/6	10 amp. A.C.*	39/6
10V. D.C.	39/6	20 amp. A.C.*	39/6
20V. D.C.	39/6	30 amp. A.C.	39/6

BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.

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

*Moving iron, all other moving coil.

"SEW" EDGEWISE METERS

MODEL PE 70. Dimensions 3 17/32 × 1 11/32 × 2¾in deep overall. Available as follows:

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

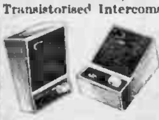
ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. 67/6 P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets.
£6 19 6 P. & P. 3/6.

INTERCOM/BABY SITTER



Transistorised Intercoms, ideal for home/office/workshop etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions. 2 station 59/6 P. & P. 2/6. 4 station £6 12 6 P. & P. 5/-.

SINCLAIR EQUIPMENT

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.

ALL POST PAID

SPECIAL OFFER

Two Z12 Amps., PZ4 Power Supply. Stereo 25 Preamplifier, £22, or with two Q14 speakers, £37.

NEW SINCLAIR 2000 SYSTEM

35 watt Integrated Amplifier, £29. Carr. 5/-. Self-powered FM Tuner, £25. Carr. 5/-.

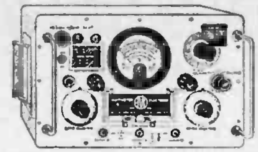
GARRARD TAPE MOTORS

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/-.

FIELD TELEPHONES TYPE L

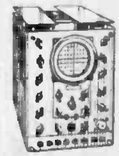
Generator ringing, metal cases. Operates from two 1·5V. batteries (not supplied). Excellent condition. £4.10.0 per pair. Carr. 10/-.

AVO CT.38 ELECTRONIC MULTIMETERS



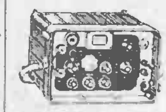
High quality 97 range instrument which measures A.C. and D.C. Voltage, Current, Resistance and Power Output Ranges D.C. volts 250mV–10,000V. (10 megΩ–110 megΩ input). D.C. current 10µA–25 amps. Ohms: 0–1,000 megΩ. A.C. volt 100mV–250V (with R.F. measuring head up to 250 Mc/s) A.C. current 10µA–25 amps.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

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



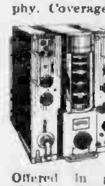
An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22 10 0 Or complete with all accessories, probe, leads, lid, etc. £25 Carriage 30/-.

AM/FM SIGNAL GENERATORS



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

ADMIRALTY B.40 RECEIVERS



Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, band-pass filter, noise limiter, crystal controlled B.F.O., calibrator, O/P output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19½ × 13½ × 16in. Weight 114 lbs. Offered in good working condition. £22 10 0 Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s. £17 10 0 Carr. 30/-.

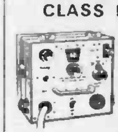
MARCONI CT44/TF956

AF Absorption Wattmeter

1 µ/watt to 6 watts. £20. Carr. 10/-.

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

CLASS D WAVEMETERS



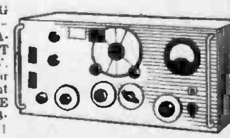
A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5 19 6 Carr. 7/6.
Or brand new with accessories. £7 19 6 Carr. 7/6.

AUTO TRANSFORMERS

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

150 W.	£1.12 6	P. & P 3/6.
300 W.	£2. 7.6.	P. & P. 3/6.
500 W.	£3.10.0.	P. & P. 6/6.
1,000 W.	£5.10.0.	P. & P. 7/6.
1,500 W.	£6.10.0.	P. & P. 8/6.
3,000 W.	£7.10.0.	P. & P. 12/6.
7,500 W.	£15.10.0.	P. & P. 20/-.

MARCONI TEST EQUIPMENT



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

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 TEST EQUIPMENT

Brand new and boxed in original sealed cartons.

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

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

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

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

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

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

TT18 TRANSISTOR TESTER
£37.10.0
Carriage 10/- per item.

AMERICAN TAPE

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

3in. 225ft. L.P. acetate	3/6
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5¾in. 1,200ft. L.P. acetate	12/6
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7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

TAPE CASSETTES

C60–60 minutes	10/3
C90–90 minutes	14/3

Over £2 post paid.

G. W. SMITH
& CO (RADIO) LTD.
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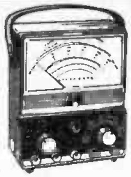
Also see oppos. page

MULTIMETERS *for EVERY purpose!*

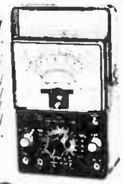
LAFAYETTE DE-LUXE 100K Ω/VOLT "LAB TESTER" Giant 6½in. scale. Built-in meter protection. 0/·5/2·5/10/50/250/500/1,000V D.C. 0/3/10/50/250/500/1,000V A.C. 0/10/100 μA/10/100/500mA/2·5/10A. 0/1K/10K/100K/10M/10M Ω.—10 to 49·4dB. £18.18.0. P. & P. 5/-.

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

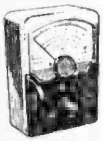


LAFAYETTE 57 Range Super 50k Ω/volt Multimeter. D.C. volts 125mV–1000V. A.C. volts 1·5V–1000V. D.C. current 25μA–10 amp. Ohms 0–10meg Ω dB. –20 to +81 dB. Overload protection. £12.10.0. Carr. 3/6.

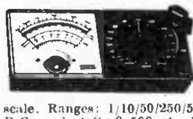
MODEL AS-100D. 100K Ω/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10μA/6/60/300mA/12 amp. 0/2K/200K/2M/200M Ω. –20 to +17dB. £12.10.0. P. & P. 3/6.



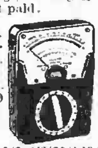
NEW MODEL 500 30,000 O.P.V. with overload protection, mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg./60 Meg. Ω. £8.17.6. Post paid.



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

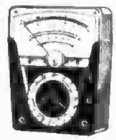


MODEL TE-90 50,000 O.P.V. mirror scale overload protection 0/3/12/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. ·03/6/60/600mA. D.C. 16K/160K/1·6/16meg Ω. –20 to +63dB. £7.10.0. P. & P. 3/-.

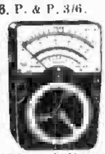


MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0·2mFd. £5.19.6. P. & P. 3/6.

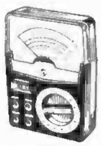
MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 Meg. μ £5.10.0. P. & P. 3/-.



MODEL TE-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/6meg. £4.17.6. P. & P. 3/-.



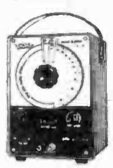
TE-51. NEW 20,000 Ω/VOLT MULTIMETER with overload protection and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0·60μA/12/300mA. D.C. 0/60K/6 meg. ohm. 92/6. P. & P. 2/6.



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

TY75 AUDIO SIGNAL GENERATOR

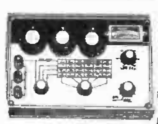
Sine Wave 20 CPS–200 Kc/s. Square Wave 20 CPS–30 Kc/s. High and low impedance output. Output variable up to 6 volts. 220/240 volts A.C. Brand new with instructions. £16. Carr. 7/6. Size 210 x 150 x 120 mm.



TE-20D RF SIGNAL GENERATOR

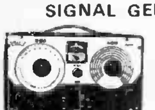
Accurate wide range signal generator covering 120 Kc/s–500 Mc/s on 6 bands. Directly calibrated. Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. £15. Carr. 7/6. Size 140 × 215 × 170 mm.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 MEG Ω 6 Ranges ± 1%. L.1μH–111 HENRYS 6 Ranges – 2%. C. 10pF–1110mFd. 6 Ranges ± 2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case, Size 7½ × 5 × 2in. £20. P. & P. 5/-.

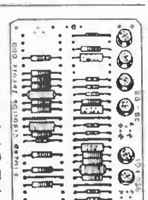
ARF-100 COMBINED AF-RF SIGNAL GENERATOR



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.

PRINTED CIRCUITS

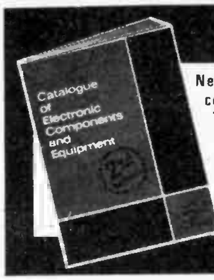
Ten asstd. boards with transistors, diodes, resistors, condensers, etc. Guaranteed min. 20 transistors. Ideal experimenters. 10 for 10/-. P. & P. 2/-.



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.

NEW CATALOGUE



Nearly 200 pages giving full details of a comprehensive range of **COMPONENTS, TEST EQUIPMENT, COMMUNICATION EQUIPMENT AND HI-FI EQUIPMENT.** Each section greatly enlarged and fully illustrated. Thousands of items many at bargain prices.

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FULL CURRENT RANGE OFFERED BRAND NEW AND GUARANTEED AT FANTASTIC SAVINGS.

SRP22 Mono	£6.10.0
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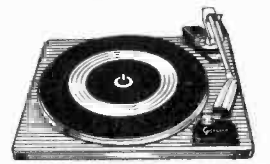
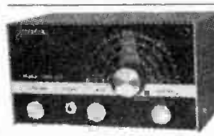
*1000 Stereo	£6. 6.0
*1025 Mono	£7.10.0
*1025 Stereo	£7.19.6
*2000 Stereo	£7.19.6
o2025 Stereo	£8. 8.0
*2025T/C Mono/Stereo	£8.17.6
*3000 Stereo	£9.19.6
*SP25 MKII	£11.19.6
*SL55	£11.19.6
A70 MK II	£12 10 0
*AT60 MKII	£13.10.0
*SL65	£14.14.0
AP75	£19. 0.0
401	£28. 7.6
SL75	£29. 0.0
SL95	£35. 0.0

Carriage/insurance 7/6 extra any model. *Special offer base and cover available for these models at £4.10.0. Carr. 5/-. Full range of Garrard accessories available



UNR-30 4-BAND COMMUNICATION RECEIVER

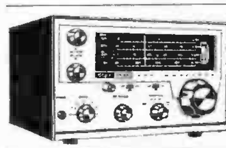


Covering 550 Kc/s–30 Mc/s. Incorporates variable BFO for CW/SS/B reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**

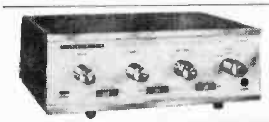
LAFAYETTE SOLID STATE HA600 RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s 400 Kc/s and 550 Kc/s–30 Mc/s FET front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limiter ● S meter ● 24in 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.

NEW STAR SR-200 SSB AMATEUR RECEIVER



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



LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes. IHF music power 30 W at 8 ohms. Res. 30–20,000 ± 2 dB at 1 W. Distortion 1% or less. Inputs: 3 MV and 250 MV. Output: 3–16 ohms. Separate L. and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold-anodised extruded front panel with metal case. $10\frac{1}{4} \times 3\frac{9}{16} \times 7\frac{13}{16}$in. 115/230 v. A.C. £28. Carr. 7/6.

★ 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.

MODEL ZQM TRANSISTOR CHECKER

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

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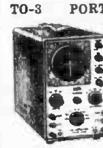

3in. tube. Y amp. Sensitivity ·1v p-p/CM. Bandwith 1·5 cps–1·5 MHZ. Input imp. 2 meg Ω 25 PF. X amp. sensitivity. ·9v p-p/CM. bandwidth 1·5 cps–800 KHZ. Input imp. 2 meg Ω 20 PF. Time base. 5 ranges 10 cps–300 KHZ. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 MM. Weight 15½lb. 220/240 V. A.C. Supplied brand new with handbook. £35.0.0. Carr. 10/-.

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CODAR CR.70A

Communications Receiver 540-10 metres

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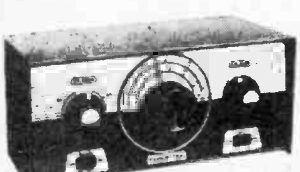
Carriage 7/6 extra.

***Ideal for SWLs *5 valves (inc. two twin triodes) giving 7 valve line-up *Excellent on amateur and shipping frequencies *Calibrated signal strength meter (illuminated) *Automatic volume control *Separate B.F. oscillator for morse and S.S.B. signals *Two speed vernier tuning**

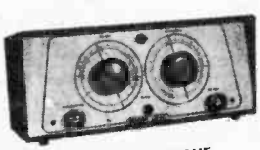
The Codar CR.70A is an excellent general coverage communications receiver for the keen short wave listener. Very reasonably priced at just £19.10.0 the CR.70A is outstanding value for money. In four stable ranges, the receiver covers from 540 metres medium wave, right through the shipping and coastguard frequencies all the short wave and international amateur bands up to and including 10 metres, where the rapidly improving conditions that now prevail allow the regular reception of world-wide call-signs!

The CR.70A has a high 'Q' aerial input stage giving extremely high gain with low noise level. Double tuned, iron cored I.F. transformers produce high selectivity. Ready to plug into 200-250 volt AC mains, the CR.70A needs only your aerial and a 2-3 ohm loudspeaker. The cabinet measures only 13" x 5¾" x 7¾" and the control panel is finished in black and white with chrome trim knobs. Fully guaranteed for 12 months!

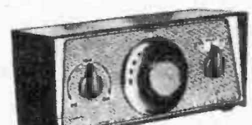
Buy your Codar equipment from your radio hobby store or direct from Codar. The order form will also bring fully descriptive leaflets (8d stamps appreciated).



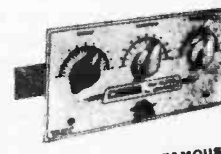
T28 RECEIVER FOR 160 & 80 METRES AMATEUR BANDS
9 transistors, bandspread 1.8-2Mc/s and 3.5-4Mc/s 12 volts, only 8" x 4" x 3½", Ideal portable, mobile or home receiver. Efficient BFO, printed circuits. ONLY £15.17.6. Carr. 4/6.



CR45 MAINS T.R.F. SHORT-WAVE RECEIVER
World wide reception. *Separate electrical band-spread. *3 slow motion drives. *Output 3 watts for 2/3 ohm speaker. *Valves ECC81, EL84, EZ80. Size 12" x 5½" x 7". CODAR-KIT CR.45K with 3 coils (10-28, 25-75, 60-176 metres). £9.15.0. Carr. 6/-, or ready built CR.45 £11.19.6. Carr. 6/-. Extra coils 5/4 each.



R.F. PRE-SELECTOR MODEL P.R.30 1.5-30Mc/s
Provides up to 20dB gain plus substantial image rejection. Improved signal/noise ratio and selectivity. Power requirements 180-250 volts 12mA H.T. 6.3 volts, .3 amp L.T. Size 8¼" x 5" x 4". Ready built complete with cables, plugs and instructions. £5.19.6. Carr. 4/6. Self-powered P.R.30x £7.19.6. Carr. 4/6.



MINI-CLIPPER—OUR FAMOUS SHORT-WAVE RECEIVER
* Can be built in one evening. * Complete with valve, one coil 25-75 metres and 4 page instruction manual. Price £2.4.6. Carr. 3/-. Extra coils 5/4

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VOL 44 No 10
Issue 744

FEBRUARY 1969

TOPIC OF THE MONTH

Farewell PMG!

THE GPO has long been overdue for a complete shake-up. Apart from what Mr. Stonehouse, Postmaster-General, has recently described as the imminent "communications explosion", it has for many a year seemed ludicrous that a single organisation should be responsible for handling a complex of important activities ranging from supplying postage stamps to running telecommunications systems.

In an effort to rationalise matters, a 224-page Post Office Bill has been published. It contains 138 clauses and 11 schedules—and it repeals or amends about 500 Acts of Parliament! When this Bill becomes law (which will probably be October of this year), the office of master of the Post Office—i.e., Postmaster-General—will cease to exist. The status of the Post Office will be changed from that of a Government Department to that of a nationalised corporation. A Minister of Posts and Telecommunications will be created to take over certain functions of the PMG (such as telecommunications and broadcasting).

Although this move will go some way to meeting some obviously overdue reorganisation, there are several disquieting factors. We would have liked to have seen the creation of a separate authority—on the lines of the Federal Communications Commission in the USA—to handle matters relating to frequency allocation, for the situation will still exist whereby the Post Office is at the same time the allocator and user of frequencies.

Moreover, it will still be empowered to manufacture, install, maintain and repair anything required "for the purpose of its business or of the business of a subsidiary of its".

However, perhaps the most disturbing Clause is that which gives the Minister power to control the use of "*electric, magnetic, electro-magnetic, electro-chemical and electro-mechanical energy*" for the distribution of sound and vision programmes for the purpose of *information, education* or *entertainment*. Also, the existing upper frequency limit of 3-million Mc/s will be abolished, thus bringing into the net optical systems of communication.

When this Bill becomes law, the Post Office will, in effect, have exclusive privileges to telecommunications of every conceivable type. While it is appreciated that the Bill is drafted to bring legislation up to date and to close undesirable loopholes, we are all going to have to think hard about whether or not we are breaking the law. Under the terms of the Bill you may be in danger by making a tape recording (electro-magnetic)!

Even though such powers are not obviously intended to be used in such a sweeping and all-encompassing manner, the threat will still be there and we will have to rely upon the benevolence of the incumbent Minister. We can only hope that during its passage through the House, the more dictatorial aspects of the Bill will be substantially modified.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

MARCH ISSUE WILL BE PUBLISHED ON FEBRUARY 7th

NEWS AND COMMENT...

NEW MOTOROLA POWER TRANSISTORS

A voltage rating of 325V—the highest of any EIA-registered germanium power transistor—is combined with low cost in a germanium power transistor offered by Motorola Semiconductors Ltd.

It is one of two new epitaxial-base germanium power transistors which combine the advantages of low cost and low saturation voltage typical of germanium transistors with the high voltage capability and fast switching speeds of silicon transistors. These features make the transistors, the 2N5324 and 2N5325, ideal for power switching, inverters, TV deflection, switching regulators, amplifiers, and industrial power supply applications. The high voltage rating makes them excellent for direct line operation without an expensive step-down transformer.

The transistors have very low collector cut-off currents; only 7mA maximum at rated V_{CEX} *(325V for the 2N5325 and 250V for the 2N5324), along with maximum* $V_{CE(sat)}$ *of 0·5V and* $V_{BE(sat)}$ *of 0·75V at 10A collector current. Minimum gain is 20 at 5A, and power dissipation is 56 watts at a case temperature of 25°C. The safe operating area is guaranteed at both 3 and 10 amperes for critical power designs.*

For information on the 2N5324 and 2N5325, write to Motorola Semiconductors Ltd., York House, Empire Way, Wembley, Middlesex.

MONACO MEMBERS

The International Amateur Radio Union (IARU) now has a new member—the Association des Radio Amateurs de la Principaute de Monaco.

RSGB's NEW HOME

The Radio Society of Great Britain has settled into new premises at 35 Doughty Street, London WC1. Several years of searching culminated in the acquisition of a five-floor building near Grays Inn Road, which has helped to relieve severe overcrowding experienced for some time at Little Russell Street. The staff moved in on 4th November, and special open days were held on 14th-15th December so that members could inspect their investment.

ROYAL NAVAL AMATEUR RADIO SOCIETY

At the AGM of the above Society, held recently, the motion was passed that "Associate membership of the RNARS be extended to include members of the Merchant Navy and foreign navies". The first foreign members include GM5AHS and ON50J.

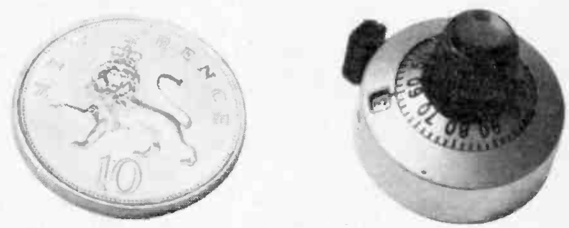
CBS RADIO NETWORK ANNOUNCES AFFILIATION

Paul R. Bartlett, President, Radio New York Worldwide, Inc., and Clark B. George, President, CBS Radio Division, recently announced an affiliation agreement, which will initially send some 85% of the broadcasts of the CBS Radio Network overseas via shortwave. CBS Radio Network lines to WNYW Radio New York, will start these broadcasts on their way to five high powered transmitters outside of Boston, Massachusetts.

From May, 1942 to 1st October 1948 CBS Radio operated a shortwave service to Latin America that grew to 126 stations at its height. This and parallel facilities were taken over by the United States Government during World War II. After the end of the war, most shortwave broadcasting was consolidated into the Government's non-commercial Voice of America. WNYW Radio, then known as WRUL, however, continued as the sole commercial operation.

An interesting sidelight of the arrangement is the fact that Radio New York Worldwide has its New York studios and offices at 485 Madison Avenue, for many years the home of the Columbia Broadcasting System. The agreement announced today not only returns CBS Radio to shortwave broadcasting after 20 years—it re-establishes the network's ties to an address with which CBS had been synonymous until the move to its new headquarters building at 51 West 52nd Street, New York City.

PRECISION TURNS—COUNTING DIALS



The Type 11 precision multidials are eleven turn devices with a total count of 1099. The first significant numeral appears in a special viewing window. These are accurately engineered units possessing several advanced features. They are designed for mounting in those locations where the highest precision adjustment is demanded.

Features include: Positive Readout where rapid transfer is made between 97 and 0 eliminates possibility or mis-reading. High maximum rotational speed up to 1,500 r.p.m. and positive braking with no creep under lock.

These units are very attractively finished in satin chrome, with black plastic knobs and easy to read numerals.

They are designed to fit ¼in. diameter shafts, as standard, but will also fit ⅛in. and $\frac{3}{16}$in. shafts using an adaptor. Further details from Guest Electronics Ltd., Nicholas House, Brigstock Road, Thornton Heath, Surrey.

NEWS AND COMMENT...

MINI RADAR

This instrument is a miniature battery-operated radar, which can measure velocities of up to 100m.p.h. where a body is travelling in a straight, angled, or curved path, and which in addition can measure high rotational speeds of the order of one million r.p.m. The device, known as the "Allscott Mini-Radar Type MRJ5", provides a means of measurement, the accuracy of which is limited only by the accuracy of the chosen method of indication, without coming into contact with the object being surveyed. It is fully portable with provision for connection to external instruments, such as digital counters, oscilloscopes or computers, in order to provide additional dynamic data.

The heart of the Mini-Radar is a GUNN-effect diode which generates the microwave frequency of 13·4 Gc/s at a power output of 5mW maximum unmodulated c.w. and operates off a simple 12V nominal d.c. battery. The equipment thus costs a third of the price of conventional apparatus with a considerable saving in space and weight.

Further information from: James Scott (Electronic Engineering) Limited, Carntyne Industrial Estate, Glasgow, E.2. Telephone: 041-SHE 4206/9.

BBC-WALES AND VHF RADIO RELAY STATION

The BBC's new television and v.h.f. radio relay station at Bettws-y-Coed, Caernarvonshire, was brought into service on 25th November. BBC-Wales television is transmitted on channel 4, with horizontal polarisation. V.H.F. radio services are on the following frequencies: Radio 2 88·2Mc/s; Radio 3 90·4Mc/s; Radio 4 92·6Mc/s.

NEW PRICE LISTS

The Solar Electronic Company have just published their second set of lists. There are 16 pages in the new copy and they are divided into separate sections: Hi-Fi, SWL, Kits, Test Gear, Electronic and Audio gear and Semiconductors. All equipment is said to be new and there are many discount items. The set of lists costs 1s. 6d. post paid from Solar Electronic Co., Refuge Buildings, St. Thomas Street, Sunderland.

1969 RSGB PRESIDENT

J. Graham, G3TR, Past President of the RSGB has been succeeded by J. W. Swinnerton, G2YS. Mr. Swinnerton has been a member of the Society Council for the past ten years.

NOT QUITE SO MINIATURE

On page 572 of the December 1968 issue of *Practical Wireless* under the heading Miniaturising Hi-Fi, the depth of the P20 was unfortunately given as 21 inches. This should have read 2¼ inches.—*some difference!!!*

CELLARDYKE SHORTWAVE RADIO GROUP

Cellardyke Shortwave Radio Group are conducting a poll in which any shortwave listener in the world can vote. We ask you to list what in your opinion are the three (3) best QSL cards issued by any shortwave station. The cards which can be considered are those issued from 1st January 1967 and if a station has issued several cards in this time please state which in particular you are voting for.

Will you also please state what in your opinion a QSL card should contain, do you agree with Date Time and Frequency of reception or what do you look for when you receive your card?

This venture requires the greatest possible support and if it is a success, the poll will be held every two years.

The closing date for your vote is Monday, 31st March 1969 and the results will be published as soon after this as possible. Please support us now and send your vote to:

C.S.W.R.G., (Poll), 66 James Street, Cellardyke, Anstruther, Fife, Scotland.

The station coming out on top will be rewarded in some way by us and if you have any suggestions as to the nature of the reward we would be happy to consider them.

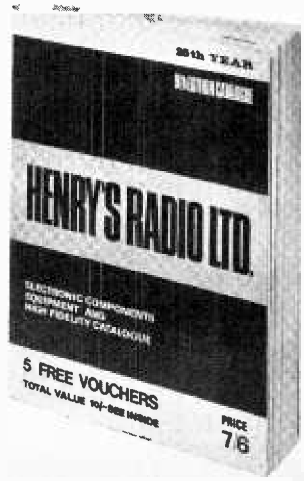
TROPHY FOR PHIL. THOROGOOD

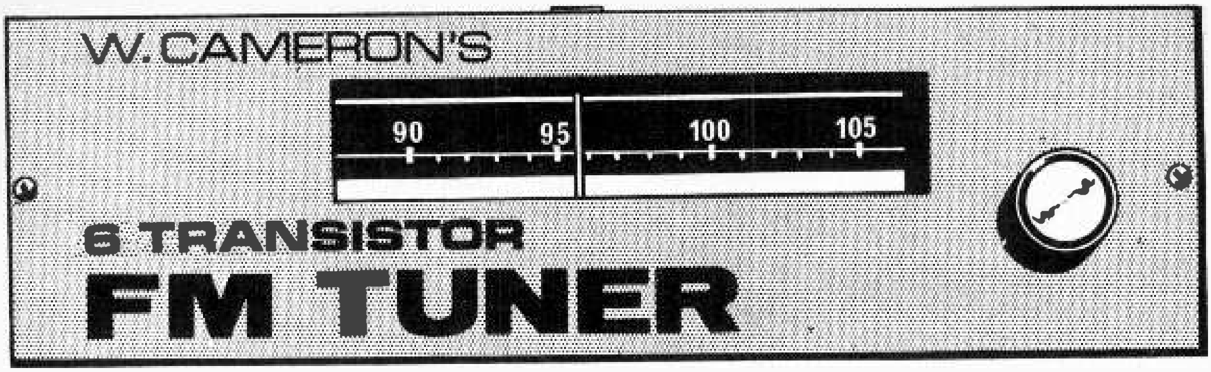
P. A. (Phil.) Thorogood, G4KD, who has been the manager of the RSGB annual exhibition for the past ten years and the Society's London regional representative for many years has been awarded the Founder's Trophy by the Council in recognition for his outstanding services to the Society over the past 20 years.

This trophy was donated by the late René Klein who founded the Society (originally called the London Wireless Club) in July, 1913.

NEW FROM HENRY'S

The latest revised 9th Edition of their catalogue is now available from Henry's Radio Ltd., 303 Edgware Road, London W.2. Price is 7/6d. plus 1/6d. post and packing, but the five 2s. in the £1 gift vouchers included (total value 10s.) enable you to recover the catalogue's cost on subsequent orders. This issue contains 320 pages with numerous circuits, data and new features.





A SIX-transistor f.m. tuner may seem to be a rather ambitious project to the less experienced constructor, and so it can be. Every effort has been made in designing this tuner, however, to make certain that all components can be purchased easily, and that the layout has been adequately described to ensure success, provided the constructor follows the plans precisely, especially in the front end up to and including the mixer.

The aim has been to develop a high quality unit, with adequate sensitivity, at very moderate cost. Admittedly the less conventional type of tuner with untuned low frequency wide band i.f.s and pulse counting discriminator would probably be cheaper, but it is doubtful whether this type is any easier to set-up satisfactorily even though there are no i.f. circuits to align. It is also doubtful whether that type would operate into a stereo decoder to provide satisfactory reproduction from the BBC's stereo broadcasts.

Alignment of FM receivers normally calls for a wobbulator (sweep generator), or at least an r.f. signal generator, but as relatively few constructors will possess or have access to these, a simple method of alignment is described later, which does not demand use of any alignment aids except a high resistance voltmeter. The i.f. transformers used, incidentally, are such that even with this simple method of alignment, a surprisingly linear i.f. response is possible.

In order to ensure excellent stability, construction is on a metal chassis. This is of grade 2x tinned plate, which can be obtained from most hardware or builders' merchants. The metal chassis ensures stability because of its screening and the facility of being able to solder earth returns directly to it. The gauge used is quite substantial as the chassis is small, and when bent into the required shape, is remarkably rigid. The front panel is of 18s.w.g. aluminium. Printed circuits have been ruled out because of the difficulty constructors may have of reproducing boards precisely, and also because printed circuits often create their own trouble in r.f. circuits and can be a source of incurable instability.

Germanium transistors are used for mixer and i.f. stages; these are the well proven Mullard AF116. Silicon planar types are used for r.f. amplifier and oscillator stages; both type BF167, chosen, apart from their inherently good thermal stability, because being n-p-n, the collector tuned circuits can be taken directly to chassis, thus obviating the necessity for decoupling circuits and giving a much improved performance.

It is advisable to obtain new rather than surplus transistors to ensure that they are of the correct construction (i.e., TO-7 for AF116 and TO-72 for BF167) and also to have the satisfaction of knowing that they will be within close limits.

A separate oscillator and mixer are used, rather than a self-oscillating mixer, for good reasons. It is generally accepted that more stable operation results from the

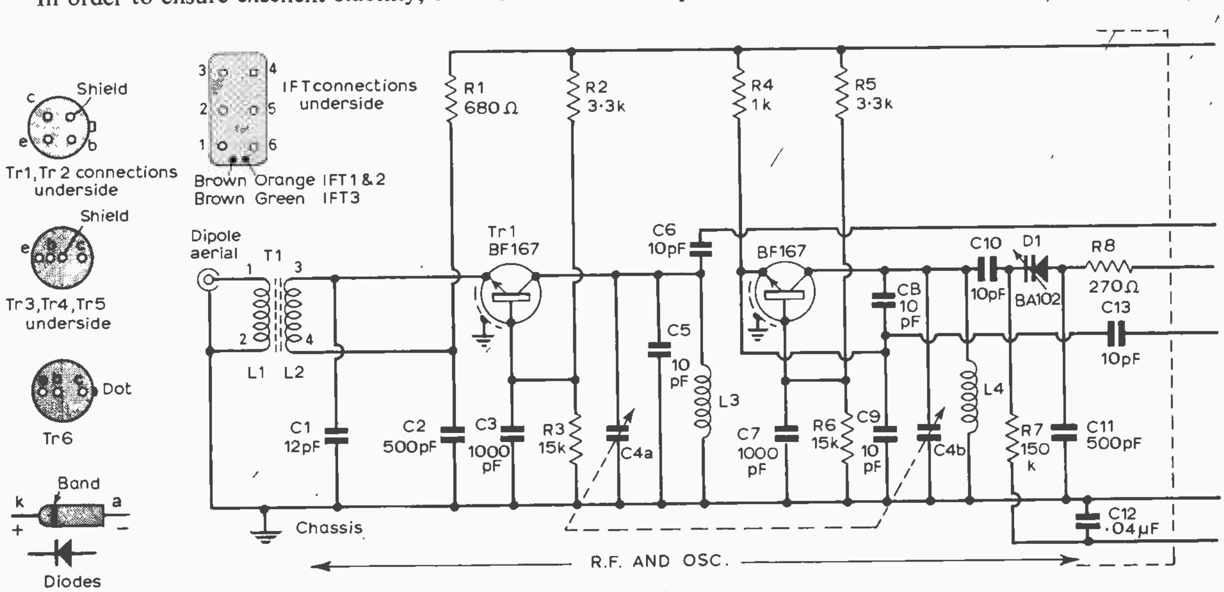


Fig. 1: The complete circuit of the transistor f.m. tuner, with automatic frequency control incorporated. Automatic gain control and an

use of a separate oscillator. It gives rather better freedom from pulling, and certainly helps to prevent the "brute force" passage of the oscillator signal through the i.f.s. Also, because each transistor serves only one function and can be optimised without compromise, the front-end gain will be higher and the noise level less.

With a well designed self-oscillating mixer, its normally inherent defects can be overcome to a large extent by carefully calculating the component values, and arranging the circuits with extra inductance to form bridge arrangements offering nulls to unwanted frequencies, i.e. to the i.f. as far as the oscillator frequency is concerned and to the mixer-oscillator as far as the i.f. is concerned. This can be achieved in mass production where each unit is identical, but is almost impossible for the constructor, working from diagrams and with limited test equipment.

The small saving in cost using a self-oscillating mixer may be worthwhile to a manufacturer, but for the constructor the advantages of the separate oscillator (apart from the transistor, there are few if any extra components) make the small extra cost of no consequence.

Circuit Description

Aerial coupling and matching is by the broadband coupling transformer T1 (Fig. 1). Because of its bandwidth and the loading of the low impedance emitter input, the value of C1 is not too critical and may be anywhere between 12pF and 20pF. An alternative input circuit is shown in Fig. 2. As the impedance into the emitter of TR1 is in the order of 50 ohms, the aerial can be connected direct without serious mismatch. The 500pF capacitor is simply to isolate the aerial from d.c. The gain of the stage may be increased by shunting the emitter resistor with a small capacitor, which tends to make the stage regenerative, up to the point where the value of C is increased to such a value as to cause oscillation. An average value for stable operation is 15pF.

The increase in gain achieved by using this capacitor is unfortunately accompanied by a sharpening of the tuning of L3 (due to this tendency towards regeneration)

SPECIFICATION

Frequency coverage	87—108Mc/s
Sensitivity	5μV
R.F./I.F. 3dB Bandwidth	190kc/s
A.F.C. Holding Range approx. ±	500kc/s
Audio Output Nominally	200mW
Audio Bandwidth	55kc/s

and in consequence an undesirable reduction in bandwidth. While this would be acceptable for normal mono reception, it would be detrimental for stereo, where a wide bandwidth is necessary. Referring again to the coupling transformer T1, as the transistor TR1 is a power driven device, there can be no voltage gain from the circuit L2, C1. It does, however, provide rather more gain than the alternative method mentioned above, by virtue of better aerial matching and the removal of the shunting effect of R1. It also improves front end selectivity while maintaining the necessary bandwidth.

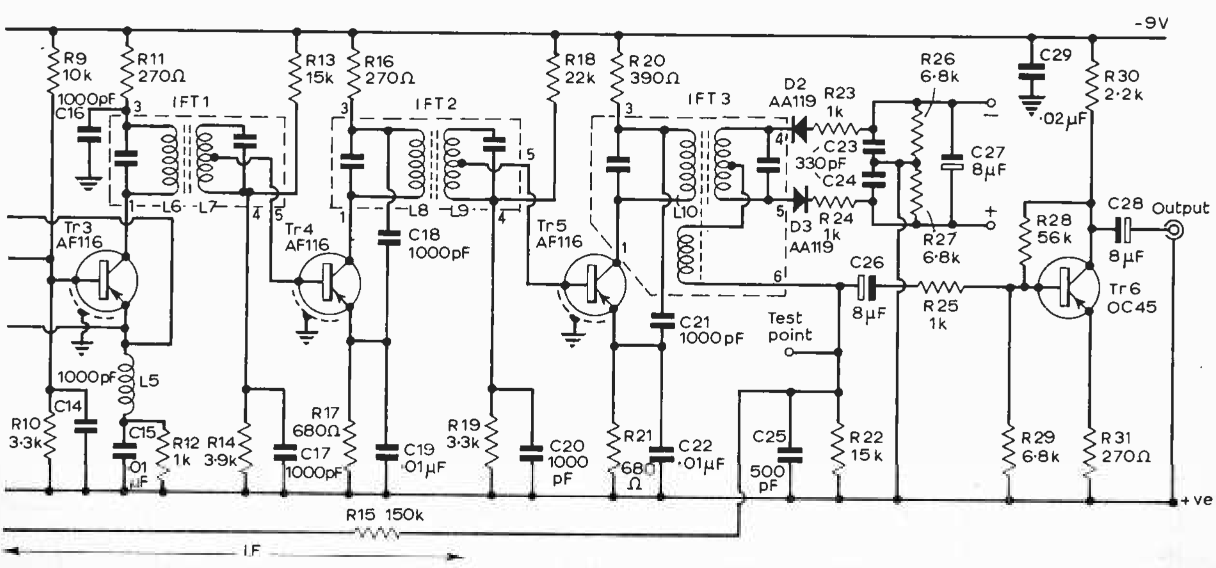
Transistors TR1 and TR2 operate in common base, as also does TR3 as far as signal and oscillator frequencies are concerned. TR1 collector tuned circuit comprises L3, C4a, and C5. Coupling to the mixer is via C6.

The oscillator TR2 uses a very stable Colpitts circuit. Feedback is to the emitter via the capacitive tap, C8–C9. Oscillator injection into the mixer is via C13. The oscillator tuned circuit comprises L4, C4b, and also the variable capacitance diode D1 with C10 and C11.

A.f.c. voltage is applied from the discriminator via R7 and R15. The function of the diode and automatic frequency control will be explained later.

Injection of signal and oscillator frequencies is into the emitter of TR3 (the mixer is actually the emitter-base diode of this transistor), the resultant intermediate frequency being amplified by normal transistor action and taken off by IFT1, L6.

L5 isolates the v.h.f. signals from the emitter resistor



i.f. trap can also be included if desired, details being given in Figs. 9 and 10.

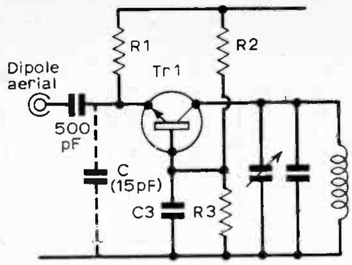


Fig. 2: An alternative untuned input circuit.

and bypass capacitor C15, while C15 ensures good i.f. amplification from TR3 at which frequency L5 is of little consequence. The i.f. amplifier is quite straightforward and does not require comment.

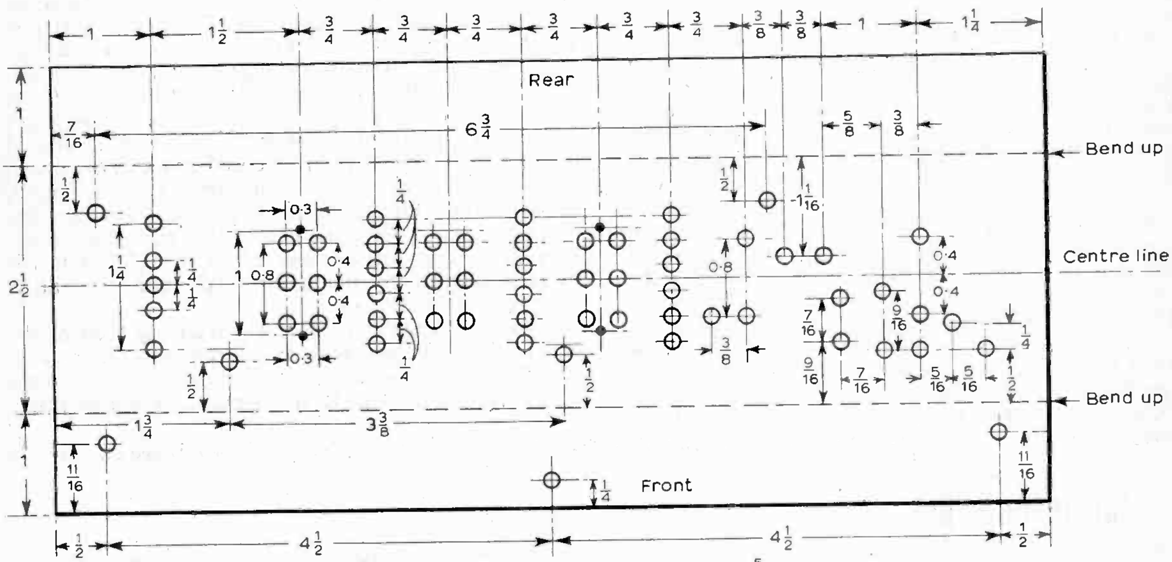
It will be noted that the a.f. output from the discriminator conforms to current practice whereby de-emphasis is not included, but only i.f. filtering. This is to ensure a wide audio frequency response if and when used with a decoder, sufficient to accommodate the highest "audio" frequency in stereo reception prior to the decoder, i.e. 53kc/s. The actual a.f. bandwidth is 55kc/s before rather sharp attenuation.

The transistor TR6 provides a small amount of audio gain, but its main function is a buffer, to present a constant impedance to the ratio detector, and to enable the output of the tuner to be fed into any impedance.

Construction

Chassis drilling and bending details are shown in Fig. 3 and the front panel in Fig. 4. When completed, the main component parts should be mounted first, in the order discussed below.

Transistor holders for TR3, 4, 5 and 6 are made from strips of paxolin 1⅝in. × ⅜in. secured to the underside of the chassis with 6BA screws and nuts. A tiny hole is



All dimensions in inches   All holes $\frac{5}{32}$ dia. except those shown ●, which are $\frac{5}{64}$

Fig. 3: The drilling plan for the chassis, seen from below.

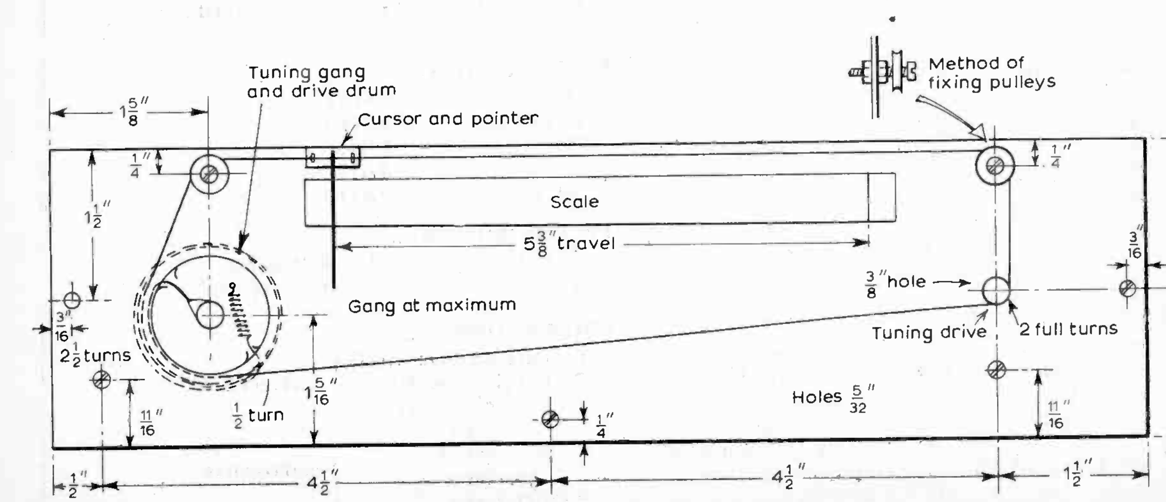
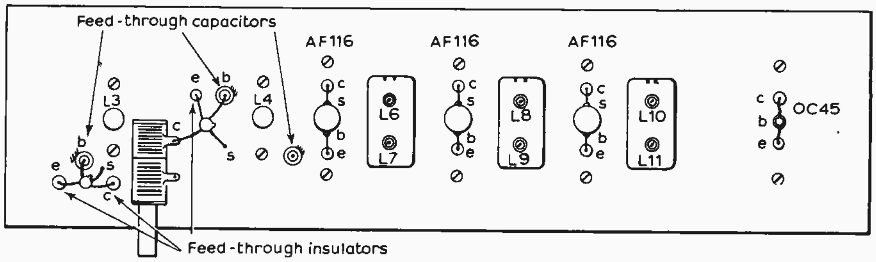


Fig. 4: Layout of the front panel, seen from the rear, with assembly details for the cord dial drive.

Fig. 5: This diagram of the chassis top should clarify the orientation of the transistors and transformers.



drilled through the paxolin centres showing through the holes previously drilled in the chassis, and through which the transistor leads will be inserted later.

The i.f. transformers are mounted so that the coded end (two colour paint spots) is nearest the rear of the chassis. The mounting tags are bent over and soldered to the underside of the chassis, taking care that the connecting pins are centred in their holes, clear of the chassis.

Next can be fitted the feed-through capacitors, which are simply inserted into their respective holes and soldered to the chassis.

The feed-through insulators are supplied unassembled comprising an insulating bush of p.t.f.e. and silver-plated pin terminal. The bush is inserted into its chassis hole and then the pin pushed home into the insulator. It is a very tight fit and requires a fair amount of pressure, so the chassis should be supported during this operation to prevent it being distorted. A piece of metal tube or a small box key can be held under the bush, while the pin is pushed home firmly with pliers.

Transistors TR3 to TR6 can now be mounted; these are inserted into their holders with the collector lead nearest the rear of the chassis. The transistors should be pushed down to about $\frac{5}{16}$in. from the chassis so that sufficient lead length is below the chassis for direct connection to their respective points in the circuit. The shield lead is soldered direct to the chassis. Two 6BA screws of $\frac{5}{32}$in. or $\frac{3}{16}$in. length are required for securing the tuning gang; longer screws will touch and short-circuit the stators. The connections on the gang are extended downwards with $\frac{1}{2}$in. lengths of 22 s.w.g. tinned wire, insulated with sleeving, to pass through the chassis. To avoid confusion in the mounting ~~of the~~ BF167 transistors, this is shown in Fig. 5. The tagstrips can now be put into position. These are normally supplied in lengths of 28 tags, so the unwanted tags must be cut off. Twenty-six tags are required on tag-strip "a" and 20 tags on strip "b", but first cut off the unwanted mounting lugs. The lugs to be removed are numbers 11, 14 and 23 on strip "a" and 1, 4, 13 and 19 on strip "b". The strips are secured to the chassis each with two 4BA screws and nuts, or may be soldered, using the holes already drilled in the chassis as markers. The remaining mounting lugs are soldered to the chassis. Not all the tags will be required on strip "a", but it is more convenient to mount the single long strip rather than several small ones.

Two 6BA screws are used for securing each of the coil formers. If the screws are started and then heated slightly with the soldering iron, they will screw home easily without damage to the formers. It will be found

—*continued on page 773*

★ components list

Resistors:

R8, 11, 16, 31	270Ω
R20	390Ω
R1, 17, 21	680Ω
R4, 12, 23, 24, 25	1kΩ
R30	2·2kΩ
R2, 5, 10, 19	3·3kΩ
R14	3·9kΩ
R26, 27, 29	6·8kΩ
R9	10kΩ
R3, 6, 13, 22	15kΩ
R18	22kΩ
R28	56kΩ
R7, 15	150kΩ

All 10%, ½ watt

Capacitors:

C1	12pF poly or ceramic
C2, 11, 25	500pF poly or ceramic
C3, 7, 14	1000pF feed-through
C4a and b	15pF swing, 2 gang. Jackson Bros. C21, ¼in. shaft
C5, 6, 8, 9, 10, 13	10pF polystyrene ± 1pF
C12	0·04μF ceramic
C15, 19, 22	0·01μF ceramic
C16, 17, 18, 20, 21	1000pF poly or ceramic
C23, 24	330pF poly or ceramic
C26, 27, 28	8 or 10μF electrolytic
C29	0·02μF

Semiconductors:

TR1, 2	BF167
TR3, 4, 5	AF116
TR6	OC45
D1	BA102
D2, 3	AA119

I.F. Transformers:

IFT1, 2	T41/3K, Weyrad
IFT3	T41/4R2, Weyrad

Miscellaneous:

Tuning cord drive type G Drum 1¼in. type BIL Two ½in. dia. pulleys	Jackson Bros.
1 Type A core 3 Feed-through insulators 2 Coil formers	Radiospares

PART 1 MAGNETIC SOUND RECORDING

W.S.FOWLER

EXPERIMENTS in the recording and reproduction of sound commenced in the last quarter of the nineteenth century. One of the earliest methods to be explored was that of using electromagnetic principles to cause a change in the magnetic field of a ribbon of magnetisable material. By 1900, a workable system had been produced and patented by Valdemar Poulsen.

Poulsen's system was however overtaken commercially by the success of the rival Edison Bell "phonograph" system of sound recording. This method relied upon the translation of electro-magnetic impulses into a physical groove pattern inscribed upon a disc or cylinder (the very earliest records were, of course, made acoustically as well as being played acoustically).

The advantage of the phonograph system was that the sound, once recorded, could be reproduced fairly easily through the familiar method of a gramophone needle, sound box and horn or acoustic chamber: no electronics were necessary. Furthermore, the phonograph master disc could be easily "pressed" and many thousands of copies could readily be produced.

Magnetic recording therefore remained almost forgotten (apart from some minor BBC use) until the second World War. Then it became evident that some rugged, reliable and compact form of recording was highly desirable to replace the bulky and easily-broken shellac twelve inch disc. The Allies turned to the original Poulsen wire recorder design, and many models of recorder were produced which were capable of giving acceptable quality results both with speech and music. On the domestic front, the "Wirek" combined wire recorder and record player proved popular, using a record/playback head developed under the American Armour Research Foundation. When the Allies overran Germany in 1945, it was discovered that the Germans had developed an advanced magnetic recording system using plastic-coated tape rather than wire.

Both wire and tape systems operate on the same principles, and depend upon the magnetisation, at various field strengths, of either the wire or tape medium. In the recording process, the original sound waves are converted into electrical impulses and fed to the recording head: this is a narrow-gapped electro-magnet of fairly small dimensions. The "blank" tape or wire is driven past the recording head gap and a "permanent" induced magnetic field is established which corresponds to the magnetic equivalent of the original electrical version of the sound waves.

In the replay process, the wire or tape is again driven past the electro-magnetic head. On this occasion however, the head works on the dynamo principle: as the magnetised tape or wire passes the head gap, it induces a magnetic field into the electro-magnet. This is converted by the electro-magnet into an electrical charge in the field coils. These coils are connected to a sensitive a.f. amplifier and the signals are then amplified and reproduced as sound waves by the loudspeaker.

SOME EXPERIMENTS

Some interesting experiments can be carried out which illustrate the principles of magnetic recording, using parts from old high resistance (impedance) headphones. The headphone should be dismantled and the semicircular permanent magnet piece removed, this is to be used later for erasing purposes. We are then left with the soft iron polepiece with its electro-magnetic winding (see Fig. 1); there are two of these in a headphone. These polepieces should then be bolted together using the original bolting hole if possible. The aim is to produce a small horseshoe electro-magnet. The windings on each of the limbs of the horseshoe are connected in series.

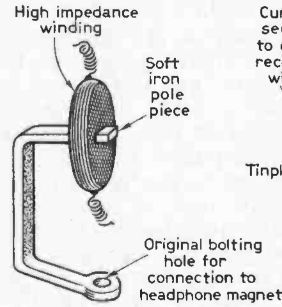


Fig. 1: The headphone electromagnet.

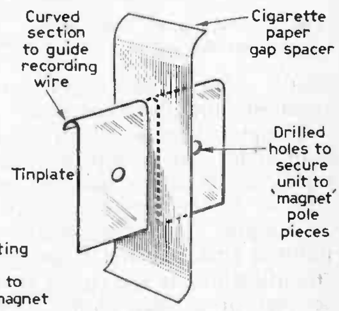


Fig. 2: The experimental recording/playback head.

Next cut two pieces of ordinary tinplate to about the size of a postage stamp. The top edge of each piece should be curled over slightly as shown in Fig. 2, in order to provide guides for the tape or wire. These two pieces are then secured across the face of the horseshoe (either by tapping and bolting or simply strapping with Sellotape). The aim here is to reduce the gap across the horseshoe to as small a dimension as possible. It is useful to insert a cigarette paper between the two tinplate pieces, as shown in Fig. 2, in order to act as a spacer. This cigarette paper need not be removed but simply trimmed off.

For the purposes of the experiment, a small 3in. reel of magnetic tape should be used or alternatively a reel of recording wire (the latter needs careful handling, as it is the diameter of very fine fuse wire and easily snarls up). For the transport system, it is sufficient to allow the material to be drawn off a free-wheeling spool, simply secured over a centre pivot constructed from a small pivot such as a piece of a wooden pencil. The tape or wire should be drawn from the spool across the "head" at a sharp angle, and on to the take-up spool.

The take-up spool is a blank 3in. tape spool with a piece of felt glued on one side. This take-up reel is put on a gramophone turntable as if it were a gramophone record. Operation of the gramophone deck (preferably at 78 r.p.m.) will drive the tape or wire from the take-off spool, past the head and on to the wind-up spool. The felt pad on the take-up spool will provide enough friction to prevent the spool slipping on the turntable.

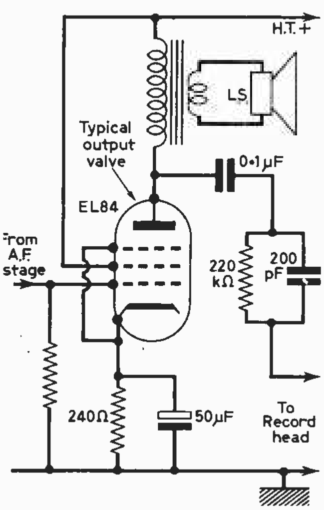
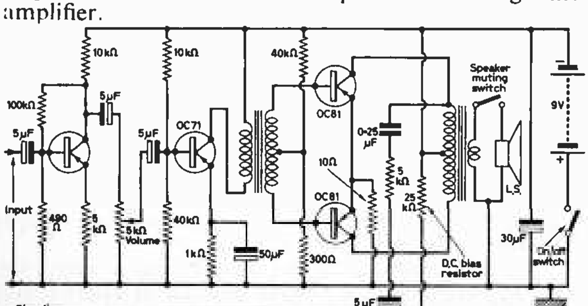


Fig. 3: Tapping off from an output valve.

To provide a recording signal, an input is fed (via screened leads) from the output valve of a radio receiver or record player. The method of "tapping off" from a valve circuit is shown in Fig. 3, the earpiece output from a transistor set may be also tried. With some transistor sets, the signal will need stepping up to high impedance via a small speaker transformer used in reverse (i.e. the high impedance side is used as the *output*). When the signal has been recorded, the spools are rewound by simply swopping the spools over. The spools are again reversed in position, and the "recorder" is ready for replay.

The signal recorded on the tape or wire is of low amplitude, and a sensitive amplifier is needed for replay purposes, a suitable prototype is shown in Fig. 4. Other similar circuits may be constructed or adapted for experimental purposes. The main point is that the first stage must provide fairly high amplification, as the signal is comparable in strength to that of a microphone. However, the normal "4 transistor" amplifier shown here is sufficient for experimental purposes. The recording is reconnected for replay purposes to the input of the replay amplifier, and the "transport system" again operated. The original sound will now be reproduced through the amplifier.



Fig, 4: Circuit of a sensitive amplifier suitable for the experiments.

RECORDING BIAS

A considerable amount of distortion will be noticed in this first attempt at recording. This is largely due to the fact that the recording tape or wire is not equally sensitive to the magnetic field at all amplitudes and frequencies of the applied signal. The wire or tape, in fact, possesses a *characteristic* in the same way as a valve has a characteristic. Just as, by the use of suitable bias, a valve can be made to operate on the linear portion of its characteristic, so, by suitable biasing, a tape or wire can be made to operate in a more linear fashion.

A simple form of direct current bias is shown in Fig. 5, the bias voltage from a 9 volt battery is fed via 20-30kΩ resistor to the recording head. Some variation of bias can be achieved for optimum results by the inclusion of a potentiometer in the circuit, as shown. The bias voltage is applied across the recording head, in parallel with the signal to be recorded. Bias is *only* applied during recording, it is not used during playback.

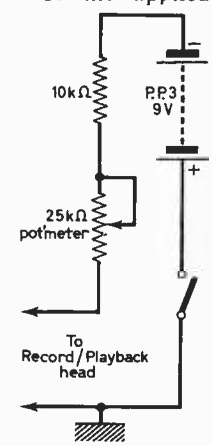


Fig. 5: The bias circuit.

ERASING SYSTEMS

The great advantage of magnetic recording is that unwanted material is capable of being instantly erased, and the tape or wire can be re-used indefinitely. The simplest method of erasure is by using a permanent magnet. If the magnet originally extracted from the headphone is brought up to the tape or wire during replay, it will be noticed that the signals disappear and are replaced by a slight "mush" sound. If desired, a further earphone electromagnet can be employed for erase purposes as shown in Fig. 6. The advantage of the electromagnet d.c. erase is that it can be simply switched off during replay, whereas a permanent magnet must be removed physically.

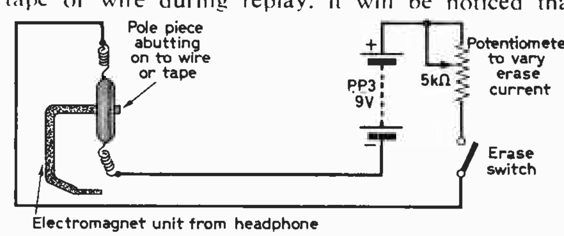


Fig. 6: The arrangement for switched D.C. erasure.

It will now be assumed that magnetic tape will be used in general, and although this has several advantages over the original wire systems, it does bring its own problems. The most important of these is concerned with the method to be employed to get the tape to traverse past the recording or playback head.

A SIMPLE TAPE RECORDER

The simplest method of tape transport is merely a development of the electric motor or turntable drive used in the experiments. Figure 7 shows how this is developed to provide a system commonly employed in the cheapest form of tape recorders and also in some "dictaphone" systems.

In this diagram the tape is stored on a 3in. spool shown on the left hand side of the diagram, the tape used being standard ¼in. plastic backed. In operation the tape is drawn off this spool past the tape head and on to the take-up spool shown on

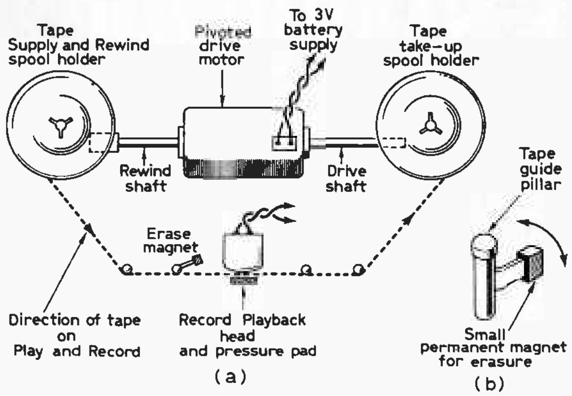


Fig. 7: The tape transport and erase systems.

the right of the diagram. The motor drive is fixed in a horizontal position on a central pivot, and has a double-ended drive. For recording or playing back the motor is swivelled so that the right hand drive-end engages with the small rubber turntable on which the right hand spool of tape rests. To rewind, the motor is swivelled so that the left hand drive-end engages with the left hand rubber turntable or spool holder. The "gearing" effect of the small-diameter shaft operating against the relatively large diameter of the spool holders results in a reasonable power drive function combined with an acceptable operating speed for the tape.

If desired, two motors may be employed for this purpose, any of the small model-driving motors are suitable. The swivelling arrangement can then be dispensed with. The power supply for this section of the tape recorder is usually 3-6 volts derived from the HP11 high power (1½V) type of battery.

To complete this simple type of tape recorder it is only necessary to connect the leads marked "to amplifier" to a modified form of the transistor amplifier mentioned above. It will be necessary to purchase a small record/play head, these are obtainable very cheaply on the surplus market. To ensure good contact between the tape and the head, a small sprung pressure pad, as shown in Fig. 7, is often used. This is not essential, however, and in fact on the best makes of recorder is not used.

ALTERATIONS TO AMPLIFIER

The necessary alterations to the basic transistor amplifier are shown in Fig. 8 and the operation of the circuit is as follows; when recording a signal on to the tape, this is fed from a mike, radio or gram to the transistor input microphone socket (M1). The signal is amplified through Tr1, Tr2 and two OC81 transistors (Tr3 and Tr4), working in push-pull. Any audible output signal could feed back into the microphone and cause howling, so the output is switched to an 8Ω resistor (R11) and the loudspeaker is out of circuit by means of S1c. The portion of the amplified signal which is required to feed into the recording head is tapped off from the primary of the output transformer (T1) via R12 and C6, and is fed into the head via switch S1b (record/play switch). The necessary bias is applied to the signal by tapping off from the negative line via R13.

At the same time, if it is desired to erase a previous recording from the tape, the permanent magnet is brought up to a parallel position with the record head on its left hand side; see Fig. 7 which shows the erase magnet in position.

For replay purposes, the erase magnet is moved back out of position, and by operation of the record/replay switch, the tape head is switched into the input section of Tr1. The signal is amplified via Tr2 which feeds into the push-pull output/stage, leading to the loudspeaker.

Simple additional refinements consist in the addition of a remote stop/start switch, and the control of the speed of the tape by the use of a rheostat in the electric motor line. (These devices were described by the author in P.W., April and May, 1967.)

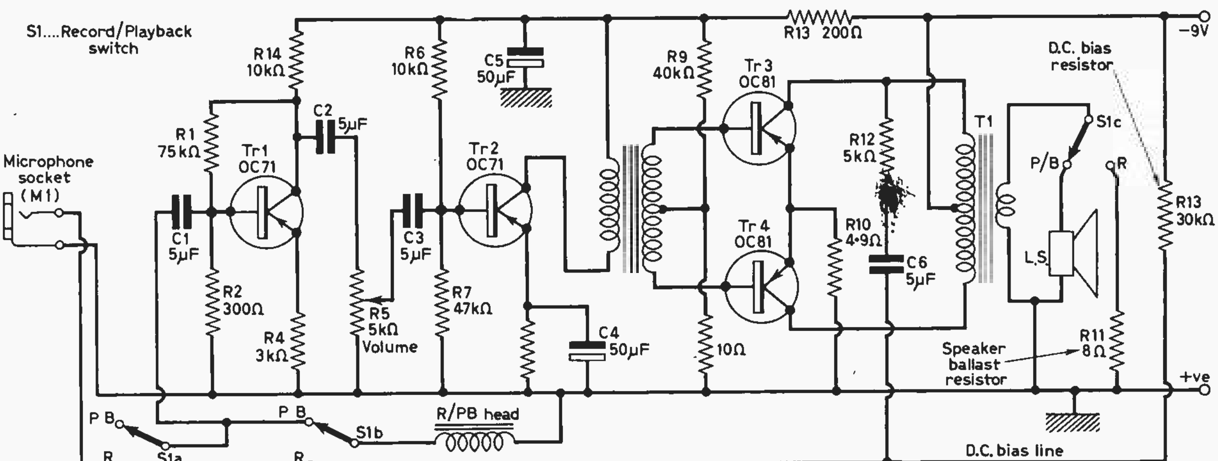


Fig. 8: A practical transistor tape recorder amplifier.

TO BE CONTINUED

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practically wireless commentary by HENRY

No. 53

Doer's Dilemma

AN ALMIGHTY snub has just been given to your favourite contributor. Thick as Henry's skin has become after years of being blamed by radio customers for every bleep of instability or burp of interference,

The grizzled warrior may not feel like it.

the stab of insult has this time cut even his pachydermatous hide to the quick.

A couple of months ago, I applied for upgrading to a certain learned radio Institute of which I have been an Associate for a number of years. And was refused!

Refused, I may add, with very few regrets. If ever you want a cure for big-'eadedness, try approaching the Hon. Sec. of your Society, Association or Institute for the accolade of a qualification that he thinks you do not deserve. That autocratic body, the Committee, take one look at your application, and shrug away our pretensions with all the aplomb of a securely entrenched party of gods on some Olympian hilltop.

You are given to understand that the only route upwards is the hard path they once trod. Take the examinations, they say, or submit a thesis for our approval. Fair enough. I am all for proving your worth; I go along with the aim to make qualifications mean a little more than the vellum they illuminate. But there were two points that applied in my particular case, and which I had been at pains to outline in my covering letter to His HonSecship.

First, a full-time day and a secondary occupation of bashing out literary epics precluded any time being found to study. Second, these epics included several books on the subject, and regular submissions to technical journals that would more than suffice as theses. If originality is the touchstone, one of the books was, and after a couple of years still is, the only manual of its kind in the library.

I can only believe that Mr. Hon. Sec. omitted to convey the substance of my letter. If my own experience of committees is relevant, he probably made formal acknowledgement in a sufficiently denigratory tone for the members to say: "*We leave it to you,*" and hurry off to their overdue lunch.

Before you take up those ever-willing pens to argue, think of all the other working chaps in similar circumstances. The younger man, entering the radio industry, may get time off, with pay, to attend a technical college. He gives up a couple of evenings as well, and must keep up with his homework. With his eye firmly on the polestar of promotion, and the probability of few family commitments, he spends a year or two studying hard and reaps the reward of his labours with a servicing certificate, a Guild pass, or some diploma.

Beside him at the bench is the grizzled warrior who studied as he went along, years ago, and has added practically to his knowledge since. He certainly could not sit an examination without some pretty crammed revision. He may not feel like going back to school. His alternative, the correspondence course, usually depends on masses of preliminary "kid-level" questions, which he is not allowed to skip before proceeding to the hard stuff.

I can still visualise those pens poised. Perhaps to tell me that, like the "Radio Ham" exam, the end is worth taking a little trouble for. But we are talking here of courses that, whether you like it or not, are designed to take you years to get to the grade you require, when your own belief is that a few months' hard revision should suffice.

More to the point, what should Henry, and other established radio engineers (sorry—mechanics, as one Society insists we remain) do to attain some qualification in the trade which has been their bread donor since leaving school? To carry the matter still further, why bother to add any qualification to the record of experience that most employers will regard with greater respect

His certificate a short-cut.

than an alphabet of diplomas? Except for the man who finds his certificate a short-cut to the all-important job interview, is such attainment worthwhile?

Henry has a vested interest, let's admit it. For certain technical contributions to learned journals, the odd diploma or two can carry some weight. Lecturing on behalf of the local education authority or the university demands a minimum status. Ironically, Henry's other qualifications are higher than those of the Institute that refused his application for upgrading. Which is one reason that he applied!

ON THE SHORT WAVES

Times GMT
Frequencies in kc/s

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS by CHRISTOPHER DANPURE

AT the start of a new year I suppose we all look back through our log books to the year just finished and hope we can do a lot better in the future. I suppose 1969 will be the year of new relay bases with Bonaire-Noord relays of *R. Nederland* to commence full schedule in March with two 300W short wave transmitters to beam to New Zealand, Australia and Pacific area, West, Central and East North America, Caribbean area, West, Central and South Africa, and Europe. Plus the start of transmissions to Africa in French. From the Pacific area comes news of about ten 250kW transmitters to commence relays of *Voice of America* from Tinang, Philippines. Also, *R. Australia* after many delays should start operating from Darwin, Northern Territory with the three 250kW transmitters.

So many people are beginning to think like me, before long all the low power DX we have been so used to hearing in the past will be swamped off the air by these high power transmitters. If you listen into the 19 m.b. at about 1600 GMT there are eighteen *Voice of America* transmitters totalling output of about 3,975,000 watts of power beaming to various parts of the world, the bulk of this to Europe. Then there is *R. Liberty* 500kW transmitters, *R. Free Europe* 250kW transmitters plus many Russians. But the Russians do the most damage to DX-ing with masses of jamming over *R. Liberty*, *R. Free Europe*, *Voice of America*, *BBC* and *R. Peking*. But I think the classic example of Russian deliberate interference is from 1500 each day. *R. Kiev* severely interferes with *R. Nederland* with only 10kW, Kiev is 100kW, both beaming to Europe. Many DX-ers have protested about this, both stations are unlistenable in their target areas, and still Kiev goes on ruining listening enjoyment from *R. Nederland*, who were on this channel years before Kiev was on the air. You can see this Russian interference in other ways, for during summertime *R. Kabul* was using 15,265Mc/s to Europe, Moscow was using 15,265Mc/s to the Balkans—result: either station is unlistenable in W. Europe or the Balkans.

So the sooner the Americans and Russians reduce power the better it will be for DX-ing, otherwise by the year 1980 all you will hear on the short wave broadcast bands will be *R. Moscow* and *Voice of America*. The hobby of DX-ing as we know it will be nearly dead, thanks to the greed of big stations who force their ideas on to others using the short wave bands and DX-ers to extend their influence. I would welcome your views on this, and any good points could be brought up in this column in the coming months. Now here are three of this month's propagation forecasts.

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; 1800-2400 15, 11, 9, 7, 6, 5 and 4Mc/s; 2400-0200 11, 9, 7, 6, 5 and 4Mc/s; 0200-0400 11, 9, 7, 6, 5, 4 and 3Mc/s; 0400-0600 9, 7, 6, 5, 4 and 3Mc/s 0600-0800 11, 9, 7, and 6Mc/s; 0800-1000 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 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 3Mc/s; 1800-2000 9, 7, 6, 5 and 4Mc/s; 2000-2200 7 and 6Mc/s; 2200-2400 7Mc/s only; 2400-0600 circuit closed; 0600-0800 17 and 15Mc/s.

West Coast of South America (North of Chile): 1200-1800 25 and 21Mc/s; 1800-2000 17 and 15Mc/s; 2000-2200 15Mc/s only; 2200-2400 11 and 9Mc/s; 2400-0400 11 and 9Mc/s; 0400-1000 9Mc/s only; 1000-1200 17 and 15 Mc/s.

Now here are this month's DX-tips.

AUSTRALASIA

Australia: Recent changes to *R. Australia* transmission schedule are as follows, 1800-2200 to Mid and South Pacific now on 11,840 (10kW), 11,810 (100kW) and 9,540 (100kW). A new transmission to the Mid-Pacific is from 2000-0830 on 15,180 (10kW); to the Mid-Pacific also from 2200-0030 on 11,840 (10kW). All the above are in English. The Vietnamese transmission now runs from 1230-1330 on 11,790. The evening English service to East Asia now runs from 0900-1000 on 15,140, and 11,810, 1000-1100 on 15,140; 1100-1200 on 15,140, 11,810 and 9,580; 1200-1215 on 15,140 and 11,810; 1215-1400 on 15,140. The evening English transmission to the Mid-Pacific is now on 7,190 from 0830-1215. An afternoon service to the South Pacific is heard from 0200-0800 on 15,240. During test matches of the West Indies *v.* Australia series, the commentaries are beamed to the British Isles from 0045-0545 on 15,405 and 0600—close on 11,710. The morning transmission to North America is now heard from 1215-1315 on 11,710 and 9,580, and the French service to Africa is now heard on 17,820 and 15,320 from 0500-0600.

EUROPE

Norway: *R. Norway*, Oslo, has sent out to many regular reporters a very nice colour picture calendar of Norway for 1969. The current schedule of *R. Norway*, Oslo, is now as follows. 0700-0830 on 25,900, 25,730, 21,730, 21,655 and 11,735; 1100-1230 on 25,900, 25,730, 21,655, 11,850 and 7,210; 1300-1430 25,900, 25,730, 21,730, 21,655 and 9,645; 1500-1630 25,900, 25,730, 21,730, 21,655 and 17,825; 1700-1830 25,900, 25,730, 21,730, 21,655 and 15,175; 1900-2030 25,730, 21,730, 15,175, 11,850 and 11,735; 2100-2230 on 11,860, 11,850 and 11,735; 2300-0030 on 11,850, 11,735 and 9,645; 0100-0230 on 9,645, 9,610 and 9,550; 0300-0430 on 9,645, 9,610 and 9,550. On Sunday and Monday mornings the last 30 minutes is in English, otherwise all the rest is in Norwegian.

Deadline this month is the 10th January, so good listening and 73's.

Litesold

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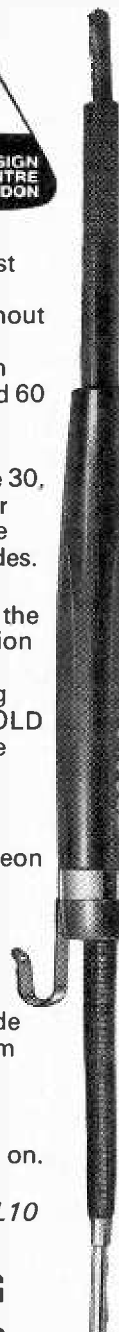

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THE AMATEUR BANDS by DAVID GIBSON, G3JDG

TEN metres comes back from the dead, pirates reported in PRACTICAL WIRELESS and LG5LG proved beyond doubt to be a highly desirable goodie. It's all been happening this last month. If you've got a beam aerial then you should have heard everything. If, like old JDG, you've only got a "bit of wire", then you've no doubt had to content yourself with mundane things like VK, ZL, CX and the like. It's getting so bad on the s.s.b. segments that it is almost fatal to take the cans off for fear of missing something special.

Early mornings, before 0900 seems to be the best time for wet string antenna types to listen for Oceania. Most of the VK/ZL activity appears about this time.

Although ten has been its now established patchy little self it has had its moods and some very good openings have peeped through.

Africa is very prominent in the ten metre hit parade plus quite a fair showing from S. America. Europeans were heard most of the time with many stoking up ageing 807s. Why do they have to key the mains with those rigs? No prizes for guessing the prefixes involved, but food parcels might include a 32μF electrolytic.

Top prize must go to twenty for consistency. Early mornings brought VKs and there were still stations from that part of the globe to be heard as late as 1800. On fifteen metres the evenings have been pretty good most of the month. This band is proving to be a proper little hive of s.s.b. activity.

Forty metres has been, well, forty metres. Good selectivity in the receiver is virtually a must for this band. Although my rx lacks really good selectivity, stations in Europe were heard working JA, AP, FG7s and the like so the gravy is definitely there.

Topband has been going well. Nothing fantastic heard at the home QTH but while mobile one evening a QSO was heard involving G3XXF and G3QUK, the latter being located in Bristol. Location at the time was the A6 between St Albans and Harpenden.

CALLSIGNS

Having looked at conditions, let's look at the Jolly Roger brigade. A hasty screed from **James Lee** (Warwickshire) informs that my report of G3SWZ operating 1½ watts and working over 30 countries is, in fact, a report on a pirate. He reckons that the pirate calls himself John, near Peterborough. One point from this. If you want a really useful project, then how about a small transistor rx for topband, complete with ferrite rod plus socket for an external aerial. You can virtually d.f. the pirate types and it offers a useful portable plus a standby rx.

Regarding my observations of the callsign LG5LG. G3VRU sends official word (he has a QSL) that the station is at Morokulien and is located, as a separate state, between Sweden and Norway. **Per Gunderson** always found the time to help handicapped hams. The station is, in a way, a memorial to this man whose callsign was LA5LG. In order to keep up the good work and raise funds, the station QSL confirming a QSO "costs" 3 IRCs and is sent via the bureau (4 IRCs direct). If you have heard of the "Ham spirit", then these few inadequate words above give some small insight to just what it's all about.

LOGS

W. Smart (Hexham) 9R 59DE plus de luxe Joystick and joy match went s.s.b'ing on ten for—EP2KB, KV4AB, KV4AD, SVØWM, SVØWN, SMØBBR, VE3BAC, W2OYT, W3WIM/P2, W9LMX, 9K2CB.

J. de Camillis (West Hampstead) queries callsigns starting AJ3. He heard what appeared to be an r.f. bazaar on forty involving these stations sorting out the sale of radio gear and cameras. A listen on ten with an RA-1 plus 35ft. of wire raised—CR6JT, CT1UX, HGØHV, IS1MKD, K1OMC, LU8DEG, PY5ATU, VE1EI, WA4PTN, WA6QQW, W2LUN, W3TNQ, ZE1CB, 9G1DM, 9H1BE, 9J2RA.

S. Mummery (Bromley) went ear dangling on all three h.f. bands. Resultant r.f. earache from—CR6AN, CR7IC, CR7LK, FØCH/P/FC (Corsica), HM1BB, IT1PSG, JA5PK, MP4MBJ, OA5AY, OM1APJ, PX1BW, PY1CHA, PY2PA, PZ1DF, VK2ABZ/P, VK3AQJ, VK3AYT, VK3XT, VK4HR, VK5MF, VK9BN, VO1AQ, VP9FX, YV5BOA, ZL1AH, ZL1HA, ZL3FT, ZL4BO, ZC4HS, 3A2CP, 6W8DY, 7P8AR, 9K2BB, all on 20 s.s.b.

On 15 s.s.b.—CR6HAW, CR7IA, EA6AR (Balearic Is.), ET3USA, IT1XFI, JA1AEA, JA6DRQ, VK2FA, VU2SA, YA1FG, YV1WX, 5A3JR, 5Z4KO, 6Y5RA, 9H1R, 9Q5DG. These were all received on a B34 with 66ft. end fed, as were the following on ten—CR6AY, EI8AT, IS1GF, JA1LZR, JA1RFU, JA1WPX, KL7AAD, PY1CAD, PY2PA, VK2XT, VK6MS, nineteen Ws, XW8BS, ZS6AB, 9M2NF. You're all too late, I've already made him an offer for the B34.

G. Richards (Carisbrooke) is the proud owner of a GC-1U and confesses to hooking up a 120ft. long wire to it. Rewards for these labours on ten—FM7WE, FM7WN, HK3WO, I1CMD, IT1FVK, PY1AGP, W5KDI, W5VTM, W6JRA, W7RSP, ZE1AV, ZE2JA, 9H1BG—and these were all on a.m. Just shows what you can do with two sidebands.

The s.s.b. log for the same band reads—CE3PY, CE3RC, CE8AA, CR6GA, CT2AS, EP2BQ, HC1HV, HI8LC, K6OKW, K6SVR, K7ANG, KL7BCS, KV4AD, LU6DRB, TJ1AU, VE3EYN, VE5US, W2FHO/P/W7, W6CN, WB6FRD, W7ESK, WØBVV, ZS1GB, ZS5FF, 4A1OE, 5N2AAF, 7Q7RM, 8P6CA, 9G1FF, 9H1M, 9J2VX, 9X5AA, 9Y4MM.

Glynn reckons best times for ten metre openings are mornings and late afternoons while evenings are favoured for forty. On the latter band he logged—CT, DJØ, DL3, EA3, EA7, EP, GM, HB9, I1, IT1, OE, UA, 4X4 and 4Z4.

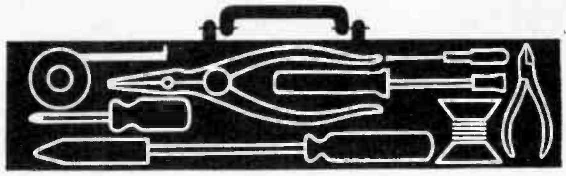
J. Baker (Liverpool) hopes to get his RAE soon (gd lk OM), meanwhile he keeps his PCR3 perking on fifteen metres with sigs from—CN8HD, CN8MJ, EA6BG, EA6BE, JA7MA, OD5CS, OD5FI, SVØWB, SV1BU, 9H1AV, 9H1BG.

—continued on page 786

repairing radio sets

PART 2 (Third Series)

This is the second of a three part series dealing with the repair of radio sets for which the reader has no circuit or details to work from. Last month Gordon King dealt with the theoretical side, this month we deal with the practical aspect of repairing such sets.



H. W. Hellyer

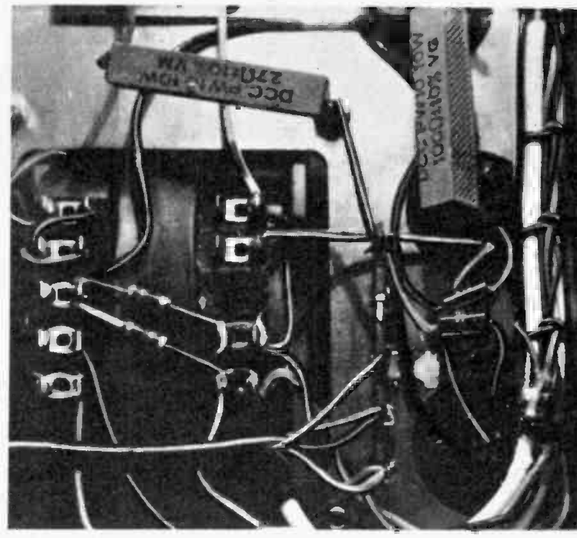
THE honour of closing this series has been left to me, and on reading through the final contribution by my esteemed colleague, Gordon J. King, my first thoughts were that there is very little left for me to say. He has dealt very fully with the problem of identifying the valved and transistorised receiver, making preliminary tests, then going on to deeper circuit-proving measurements without the aid of a diagram or any other information. This would appear to leave me with the paltry task of illustrating various components and set layouts, saying: "This is a valve, this is a transistor; behold ! a transformer, resistors, capacitors plain and pretty . . .", but I shall not insult you by reverting thus to square one. In this final article we shall take a look at a few of those things we were forced to skate over lightly during the previous parts, with particular reference to repairs that have to be carried out minus the aid of a service manual.

SWITCHING SYSTEMS

Everybody loves a mystery, but while the amateur, pottering about for fun, can afford to take his time in his investigations, the professional engineer has to charge for his time and must—often reluctantly—turn work away as a consequence. Hence, no doubt, his feeling that he resembles the conventional copper of the *"who-dun-it"*, plodding through his career while the amateur cuts straight through the servicing problems with panache. Hence also, these tales we hear too frequently of the man round the corner who did a simple job when the radio dealer refused (or failed) to do the repair. The refusal may have been because the "simple job" would have proved uneconomic.

Having got that off my chest, I should explain that it precludes an unconventional piece of advice—when tackling the unknown receiver, ignore the step-by-step approach and jump straight to the vital points. These are (a) power supply, (b) audio output, (c) post-frequency-changer signal amplifiers, (d) aerial circuits, in that order.

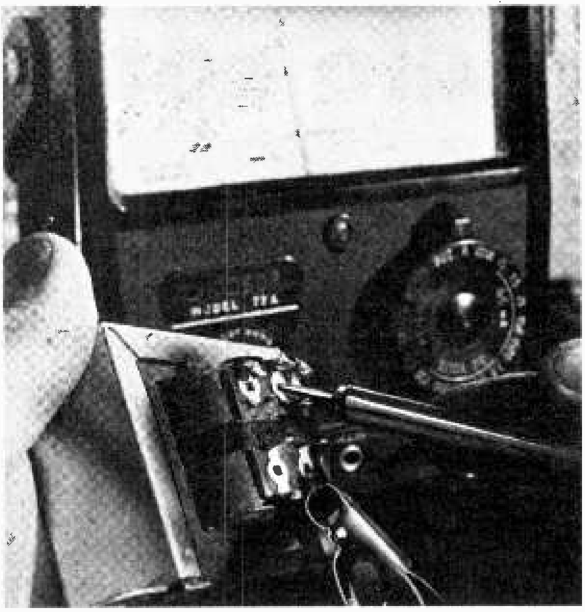
Of the power supply section, most likely weak link will be the on/off switch. Even if the fault lies deeper, attention to the switch is the first and easiest proving test. It is easily identifiable, generally accessible, and, whether mains or battery receivers are being considered, performs the same function—to interrupt the supply. Elementary, you say? But at this point we can make the first tests of a dead set. (Obviously, if the receiver shows signs of life, we jump straight to the next test.)



Test points around the power supply section are generally easy of access.

Where a single-pole switch is used, i.e. with only two connections, it is reasonable to assume that the other line of the supply goes either to the primary winding of the mains transformer, in the case of a.c. operated equipment, or to chassis in the case of a.c./d.c. or battery-operated equipment. Tests can be made "cold", using an ohmmeter or some form of continuity tester—provided we take care to ensure that the supply of the tester does not exceed the anticipated supply voltage of the equipment. With the switch "on" a continuity reading should be immediate for mains-operated equipment, the low-resistance winding of the mains transformer primary being almost a short-circuit.

A.C./d.c. sets will give a reading of anything from a couple of hundred to several thousand ohms, but there will still be a continuity. Battery-operated equipment, especially transistor radios, may not be so simple to check in this way as the resistance across the supply will be as high as the designer could make it, and unless the meter voltage is somewhere near the working voltage of the battery decoupling electrolytic, we shall not even get our preliminary "kick" of the meter needle to tell us all is well.



Transformer windings can be traced by their d.c. resistance. It is wise to make specimen tests on transformers from the spares box to familiarise oneself with these winding resistances.

POWER-ON TESTS

It is always best to make any tests under operating conditions. If we have already determined that the set is a mains-type, and have identified the mains transformer by its size and shape, we can apply our a.c. voltmeter or test lamp to the supply line where it enters the set, or to another convenient spot such as fuseholder, voltage selector, etc. It will be necessary to check by visual inspection which leads the switch is in. Usually, colour-coding is helpful. Having applied one probe to the neutral, put the other on the incoming connection to the switch. A reading will prove the mains wire, at least! With the set switched "on" and the probe now transferred to the other terminal, a similar reading will prove the switch to be in order—operating it once or twice will confirm that it is making and breaking.

Next, we can make a rapid proving test of the primary winding by putting the meter on each switch terminal with the switch "off". If we get a reading, there must be continuity, and we can dig a little deeper. No reading, and we can confine our investigations to the input circuit. Keep the "live" probe on

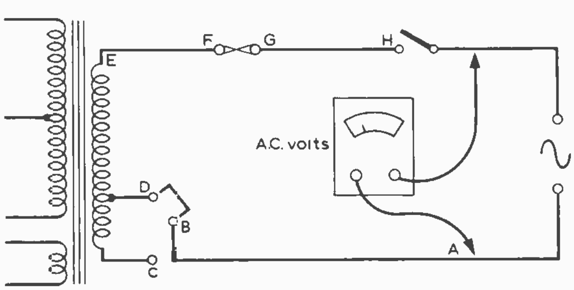


Fig. 1: By tapping along the circuit from a fixed point, in the sequence A–H, open-circuits are quickly revealed.

the incoming terminal and tap the other along the "neutral" line, point by point until the reading is lost. Figure 1 shows the procedure, postulating a receiver with the usual safety and adjusting bits and pieces.

A little thought now will show us that this could as easily have been done with a simple neon tester, by first checking the mains polarity, then connecting our set to the mains so that the "live" pole was fed—as it should always be—to the switch. If there is an open-circuit in the primary circuit, simple tapping along with a neon from H towards A very quickly reveals it at the point where the indication vanishes.

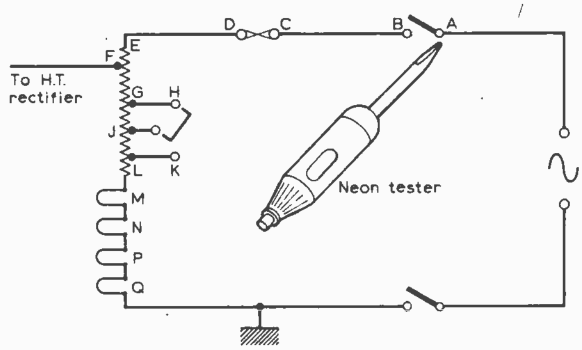


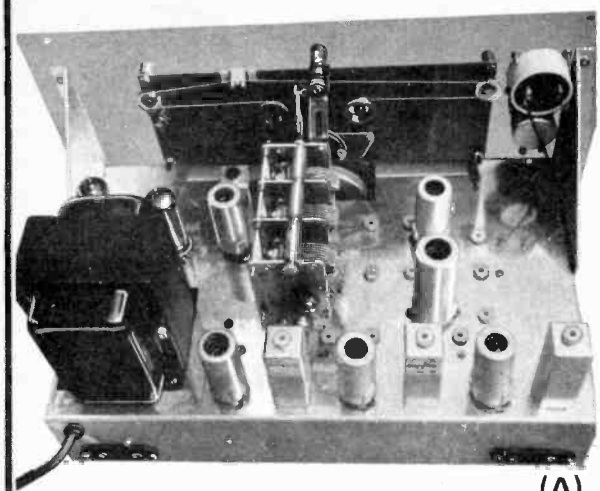
Fig. 2: The ubiquitous neon tester is useful for rapid continuity tests of AC/DC receivers, with the power applied in the correct polarity.

This is a quicker method of fuse testing, or heater chain testing of a.c./d.c. sets, than laboriously disconnecting various circuit points and making continuity tests—though there may be need to do this later. An example of this is the snap tester of the television engineer, faced with a "dead" set, who taps his neon on the c.r.t. heater and knows, if he gets a flash with the mains correctly connected that (a) the mains dropper and heater chain are intact, and (b) that the return half of the input switch, or the wiring, are open-circuited; a common fault. Even more common, as Gordon King has pointed out, is an open-circuit mains dropper series resistor and, here again, the neon tester can do all that is needed in the way of testing. We simply tap along the line from point to point as shown in Fig. 2 until we lose the neon's flash. It should hardly be necessary to stress that the foregoing assumes that there *is* a break in the circuit: no break, and one would naturally expect the voltages to decrease from live toward neutral.

We have already touched upon double-pole switches, and note in passing that the failure of one pole is an extremely common fault, certainly worth a "first test". Again, the neon will show this up immediately by application on the switch terminals themselves. With the mains connected correctly (red to live, black to neutral with standard colour-coded cable), a flash from one terminal only indicates the live pole open, and from three terminals, the neutral pole open. Such a test takes less time than typing this sentence.

BATTERY-OPERATED EQUIPMENT

One vital factor discriminates between mains and battery switches—and this, quite simply, is the supply voltage. Elementary again? Yes, but we must remember that when a switch handles a fairly large



(A)

Easy-to-build Projects

ALL IN NEXT MONTH'S ISSUE

(A) **PROGRESSIVE SUPERHET**

A receiver for the short-wave enthusiast to be detailed in six progressive stages . . . (1) Five Basic Stages (2) Additional Wavebands (3) R.F. Amplifier (4) Signal Strength Meter (5) R.F. and I.F. Gain Controls (6) Beat Frequency Oscillator. The receiver is operational at each stage, the further stages adding improvements.

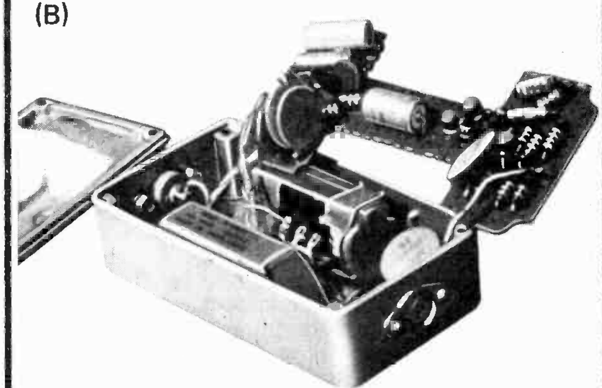
(B) **MICROPHONE PREAMPLIFIER**

3-transistor high-gain unit for boosting low level audio signals, designed for general amateur tape recording systems, indoor and outdoor, and to increase input from low output microphones.

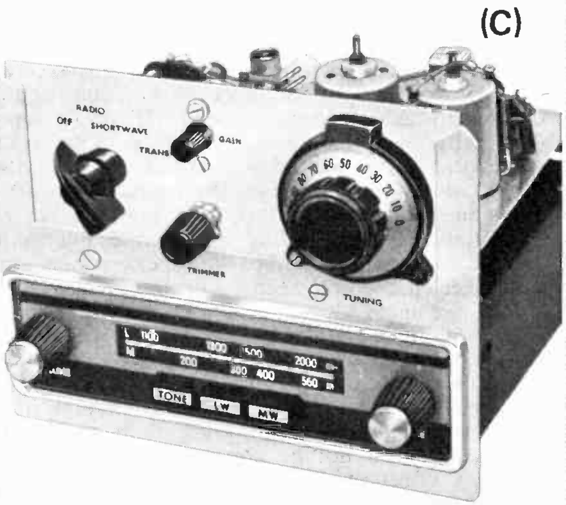
(C) **ONE-SIXTY SUPERVERTER**

"Top-band" converter covering 1·8–2·0Mc/s. For mobile working in conjunction with a 12V transistor car radio receiver.

(B)



(C)



Also:

WORKSHOP PRACTICE

First of a two-part feature written specially for the beginner to radio construction. It outlines the selection of a kit of necessary tools and tells you how to obtain components and materials economically.

PRACTICAL WIRELESS

MARCH ISSUE ON SALE FRIDAY 7th FEBRUARY

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current at a high voltage, some small contact resistance will be overcome by the power in the circuit. There may even be a little loss across the switch—sometimes the on/off switch of a mains radio or television receiver can get quite hot because of this loss, to the point of smelling, yet the set still goes on working. Battery-operated, low-voltage equipment requires near-perfect switch contacts. If your ohmmeter gives any reading at all across a switch that is ostensibly "closed" immediate attention is needed.

This observation is prompted by memories of the large number of battery receivers and tape recorders the author has had to service which have suffered from chemical action as a result of batteries having been left in the set too long. The corrosion may have been cleaned off and all may appear to be well but it needs only a very fine film on the blades or leaves of a switch which is often exposed (there being no danger, as with mains equipment). However, if the switch is of this "open" type, it becomes that much easier to clean.

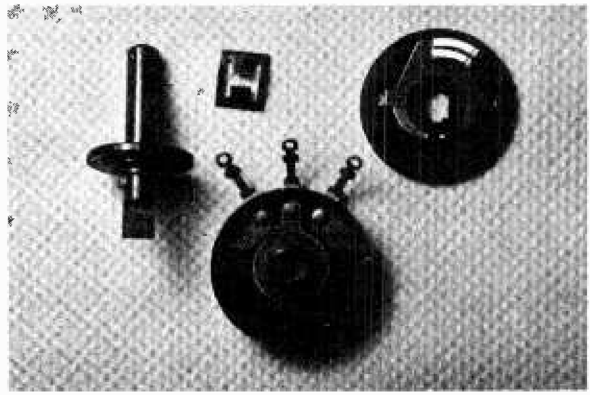
We have already dealt with the cleaning of switches, but there may be one or two practical points worth underlining. Ordinary switch-cleaner fluid has a certain "scouring" property, but relies for its efficiency on the wiping action of the switch contacts and is thus more effective with rotary or sliding switches. Very often, in small transistor radio sets, the switch consists of a plastic cam that presses one blade into contact with another. There are two points to watch here. First, as the blades "age" with use, the moving one will tend to sag at the root end and the temptation is to bend it. Take care, for the action of the cam may not then be enough to ensure a good, firm contact. Bend the fixed contact up towards the moving one a little, instead.

Secondly, the contact area is important, and quite often this is increased by the blades having been formed into spoons at their end. Any bending due to age or an effort to recover good contact, may reduce this area. Not so important on low-consumption equipment, it becomes very important with such things as car radios, where a higher current passes through the contacts.

VULNERABLE SWITCHES

Because of this low-current feature, quite simple switches will be found on transistor radios. On more than one model, the supply on/off is part of the wavechange switch printed slider, and the prime fault here is that the slider support runner eases with age, or heavy thumbing, and the spring contacts of the switch flatten. Repairing these is a matter of great patience and the use of a good pair of tweezers. An even more popular type is the small "block" slider, and a somewhat similar trouble can occur. Pressure will cause the bent clamps that retain the contact-blades support to "give" slightly, and intermittent contact results. A little careful pressure with a screwdriver blade may do the trick, but it is sometimes necessary to remove the switch and apply parallel pressure to top and bottom by clamping in a vice—lightly! When this kind of repair is carried out on a double-throw switch, it is helpful to wedge it in the central position. The slider blades bridge both contact fixed sets and there is no tendency to distortion as the two sets overlap more closely.

Leaving the supply section, we can remain with



Many radio components depend on spring pressure for electrical contact. This dismantled preset resistor shows the vulnerability of spring contacts, depending ultimately on the grip of a toothed clip.

switches for a moment because our next move, to the audio section, embraces one particular switch that causes more trouble than it is worth. This is the isolating switch often fitted on the earphone socket of a transistor radio or tape recorder. The use of phono or tip-and-sleeve jacks is widespread, and each has its drawbacks. There are two types of phono switch contact sockets, one using a wire which is simply pushed away by the inserted pin, and the other an angled blade end, similarly pushed away. With the earphone inserted, all is well. Remove it, and the set is dead. The trouble is quite obviously a faulty loudspeaker switch contact on the phono or jack socket. Unfortunately, when we come to test a dead set, we have usually left the earphone in the car, or the cat's basket, and we must then tackle the switch by temporarily short-circuiting the contacts. Please take care—if you short the wrong pair, the output transistors will object by going on strike!

OUTPUT SECTION

Having arrived at point (b), we can take a quick look at some tests on a completely unfamiliar mains receiver. We are assuming that the power supply is in order. The h.t. can be tested at any one of several points, depending on the layout of the set, but one point where there will always be the full high tension voltage, and which comes next in our list of test places, is the output transformer. On many receivers, it is used as part of the smoothing circuit, and h.t. drain will cause open-circuiting. If this happens, with tetrode or, more especially, pentode output stage, the valve will glow red-hot. This sympton should always direct one to the output transformer. Remember that a high resistance joint at the leadout wires of the winding may cause intermittent arcing, especially if the loudspeaker has been disconnected. A transformer thus damaged is not safe to use again.

On audio amplifiers, or any higher-powered equipment, great care must be exercised not only to avoid an open-circuited output but also to maintain correct loading. So a 15-ohm speaker, though it may be of better specification rating than the existing 3-ohm one, will not be correctly driven, and may not only effect no improvement but may result in positive damage.

TO BE CONTINUED

WIDE RANGE GRID DIP OSCILLATOR

R. G. LAMB

A GRID Dip Oscillator is invaluable to the radio constructor who would rather make his own coils, i.f. transformers etc. than buy them, in addition it can be used for calibrating transmitter and receiver dials, aligning receivers, measuring inductance and capacitance, etc. The circuit described is more refined than commercial instruments, having a very wide frequency range (from 170kc/s to 150Mc/s in 11 ranges), excellent stability, and facilities for modulating the r.f. and listening to the modulation of incoming r.f. signals. It should not cost more than £5 as there are no expensive parts. The transformer should cost about 10s. and the meter (which can be obtained on the surplus market) about 8s. Most commercial G.D.O.'s cost well over £10 and have fewer frequency ranges (some do not oscillate below 1Mc/s).

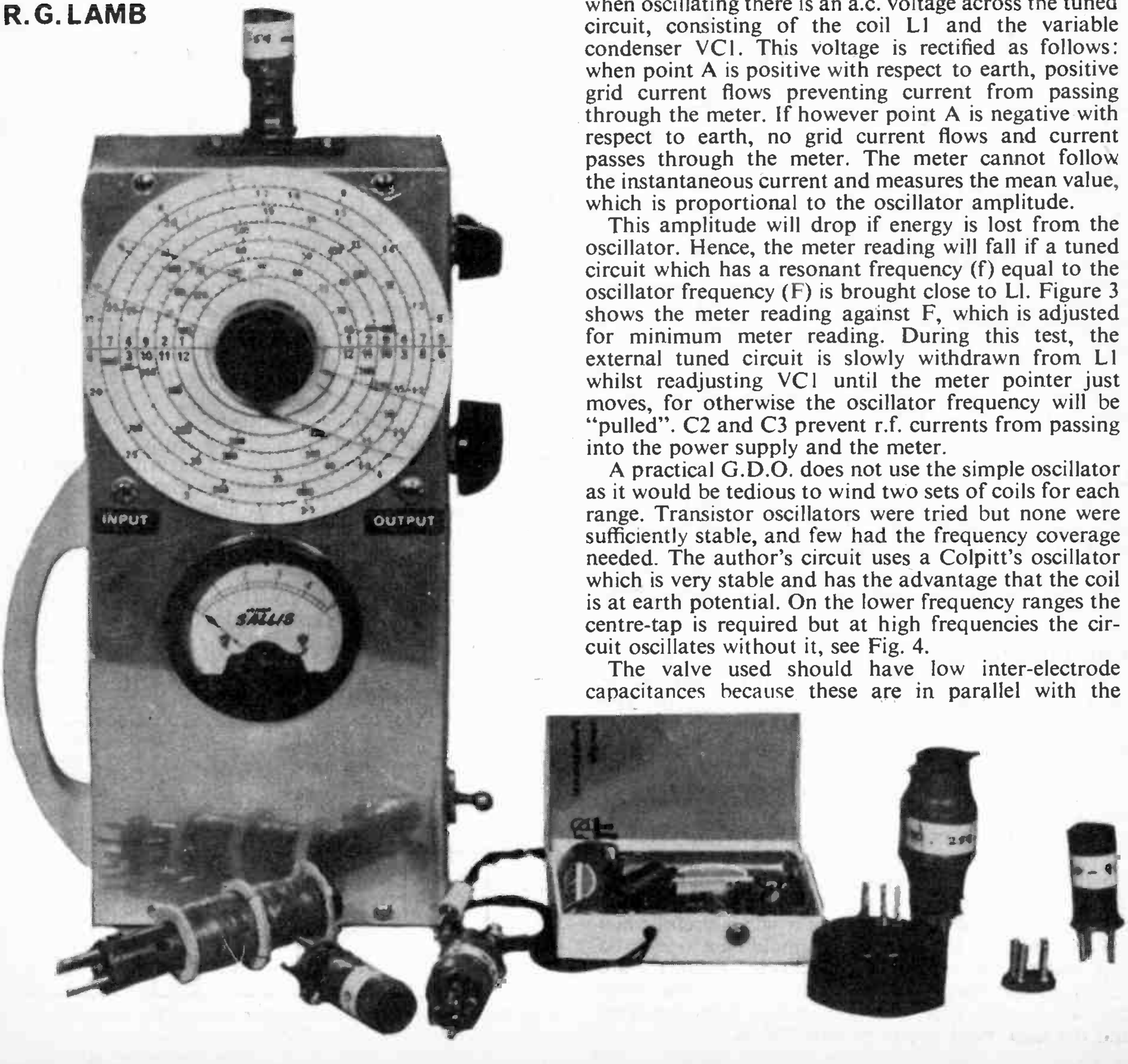
It should be pointed out that the reader must have access to an accurate standard for calibration—this may be either: (a) a communications receiver and v.h.f. receiver; or (b) an r.f. signal generator.

Basically a G.D.O. is an r.f. oscillator, which has its amplitude of oscillations measured by a micro-ammeter in the grid circuit, see Fig. 1. Note the meter polarity; when oscillating there is an a.c. voltage across the tuned circuit, consisting of the coil L1 and the variable condenser VC1. This voltage is rectified as follows: when point A is positive with respect to earth, positive grid current flows preventing current from passing through the meter. If however point A is negative with respect to earth, no grid current flows and current passes through the meter. The meter cannot follow the instantaneous current and measures the mean value, which is proportional to the oscillator amplitude.

This amplitude will drop if energy is lost from the oscillator. Hence, the meter reading will fall if a tuned circuit which has a resonant frequency (f) equal to the oscillator frequency (F) is brought close to Ll. Figure 3 shows the meter reading against F, which is adjusted for minimum meter reading. During this test, the external tuned circuit is slowly withdrawn from L1 whilst readjusting VC1 until the meter pointer just moves, for otherwise the oscillator frequency will be "pulled". C2 and C3 prevent r.f. currents from passing into the power supply and the meter.

A practical G.D.O. does not use the simple oscillator as it would be tedious to wind two sets of coils for each range. Transistor oscillators were tried but none were sufficiently stable, and few had the frequency coverage needed. The author's circuit uses a Colpitt's oscillator which is very stable and has the advantage that the coil is at earth potential. On the lower frequency ranges the centre-tap is required but at high frequencies the circuit oscillates without it, see Fig. 4.

The valve used should have low inter-electrode capacitances because these are in parallel with the



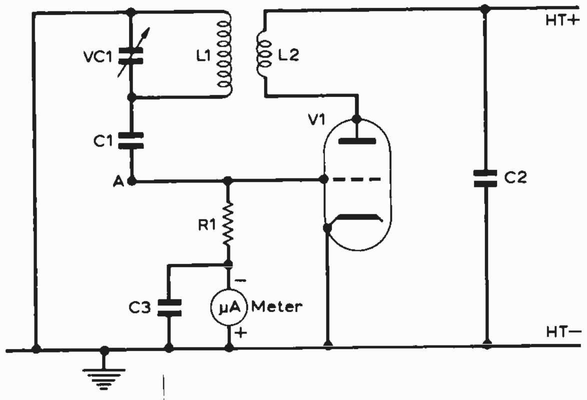


Fig. 1: A basic Grid Dip Oscillator circuit.

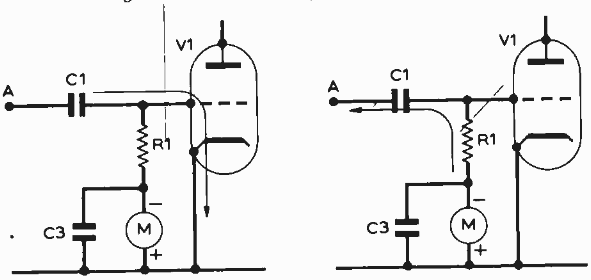


Fig. 2: Showing the flow of grid current.

tuned circuit. Valves tried, including EF80, ECC81, ECC82 and surprisingly ECC85, were found to drift quite considerably. The acorn triode type 955 was the most successful, and has the merits of small size, low heater current (0·15A at 6·3V) and low cost. Its maximum ratings are 200V anode voltage and 10mA anode current.

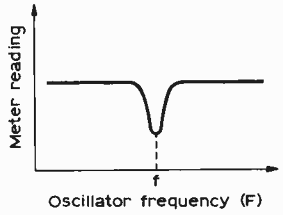


Fig. 3.

Circuit description

The author's full circuit diagram is shown in Fig. 5. This is considerably more complicated than the basic circuit of Fig. 1 to increase the versatility of the instrument. The circuit is divided into two sections: (a) the Colpitt's oscillator and (b) the stabilised power supply and modulator.

The Oscillator

VC1 is the calibrated tuning control whose value must be chosen according to the reader's needs. The author used 180pF each section and found that 11 coils were needed for a coverage from 170kc/s to 150Mc/s. If a higher value is used the oscillator would not work so well at v.h.f. If a smaller value is used more than 11 coils will be needed, and is not recommended unless the full frequency range is not required. The value of VC1 can be decreased by removing a number of moving vanes from each section; be careful not to bend the remaining vanes.

VC2 is a fine frequency control which is useful when tuning exactly to a frequency, it should have one static and one moving vane. The capacitors C2 and C3 are chosen so that they decouple r.f. but not a.f. The meter can be a surplus type as its calibration is unimportant and the f.s.d. need not be exactly 500μA.

There are 5 positions selected by the switch SW1 (one position remaining unused):

1. 170V are supplied to the oscillator by the stabilised power supply enabling v.h.f. coils to oscillate.
2. This is identical to position 1 except that the neon modulator is in operation.
3. 65V are supplied to the oscillator due to R4. The power of the oscillator is necessarily reduced because the grid current on the lower ranges exceeds 500μA with the switch in position 1. This position is normally used with all non-v.h.f. coils.
4. This is the same as position 3 except that the neon modulator is switched on.
5. The supply is disconnected allowing the oscillator section to be used as a field strength meter.

The output socket enables a.f. modulations to be heard by connecting to an amplifier—the transistor one of Fig. 6 is suitable. With SW1 in position 1 or 3, beats with a transmitter can be heard whilst if the switch is in position 5, the oscillator section acts as a receiver (as in a crystal set). The insertion of a jack plug disconnects the meter.

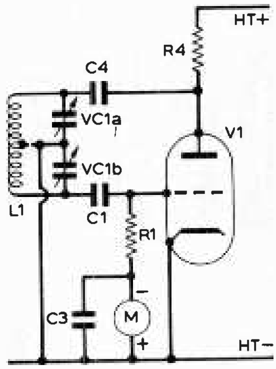


Fig. 4: The basic circuit used.

The Stabilised Power Supply and Modulator

The double-triode V2 performs both these functions. The stabiliser works as follows: The cathode of V2b is held at 65V by N1 and R9, which prevents neon starvation. If the output voltage suddenly decreases, this drop is passed on to the grid of V2b by the neons N2 and N3. The anode voltage of V2b is thereby increased, and by the cathode follower action of V2b so is the cathode voltage of V2a, partially counteracting the original change.

A stabiliser normally smoothes out a.c. ripples as well as d.c., but due to the filter (consisting of R6 and C5), a.c. voltages are not fed back. An a.f. signal injected at the grid of V2b is amplified and passed on at low impedance to the oscillator section. The internal modulator consists of N4, C9, and R13 forming a sawtooth generator. If C9 is increased the generator pitch decreases.

The neon is switched by SW1b, which shorts to earth its supply. R12 prevents sparking in the switch when C8 discharges. The oscillator pitch changes slightly with

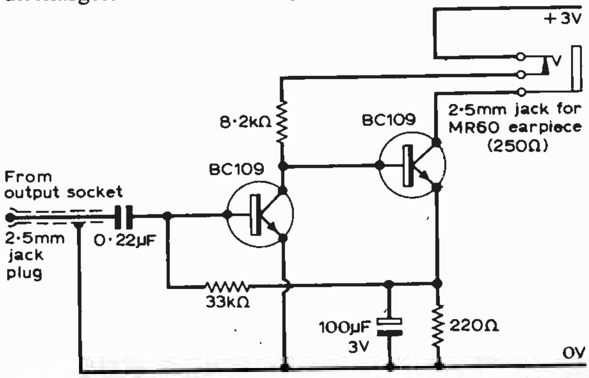


Fig. 6: A simple transistor amplifier suitable for use with the G.D.O.

★ components list

Resistors:

R1	22kΩ	R9	220kΩ
R2	6·8kΩ	R10	270kΩ
R3	68kΩ 1 Watt	R11	12kΩ
R4	15kΩ 1 Watt	R12	2·2kΩ
R5	220kΩ	R13	1MΩ
R6	330kΩ	R14	220kΩ
R7	220kΩ	R15	1kΩ 1 Watt
R8	470kΩ	R16	180Ω

Capacitors:

C1	100pF ceramic 500V
C2	2200pF ceramic 500V
C3	1000pF ceramic 500V
C4	100pF ceramic 500V
C5	0·1μF 250V
C6	32μF 64V electrolytic
C7	0·1μF 250V
C8	0·1μF 250V
C9	2000pF 250V
C10	32μF 350V electrolytic
C11	32μF 350V electrolytic
C12	4700pF 500V
VC1	180+180pF (see text)
VC2	5pF max. (see text)
TC1	3–30pF beehive
TC2	3–30pF beehive

Transformer:

T1 Mains output 200 or 250V 20mA and 6·3V ½A

Rectifier:

D1 Silicon rectifier 800p.i.v. 500mA (BY100)

Valves and Neons:

V1	Acorn type 955
V2	PCC84 (see text)
N1–4	Radiospares type neons

Sockets:

S1	All-dry battery socket (see text)
J1	2·5mm. jack
J2	2·5mm. jack

Switches:

SW1	2p. 6w. wavechange
SW2	Mains toggle s.p.

Meter:

M1 0–500μA (see text)

Miscellaneous:

Aluminium for case; B9A valveholder; Veroboard; knobs; perforated zinc; Perspex; plywood; handle; wire etc.

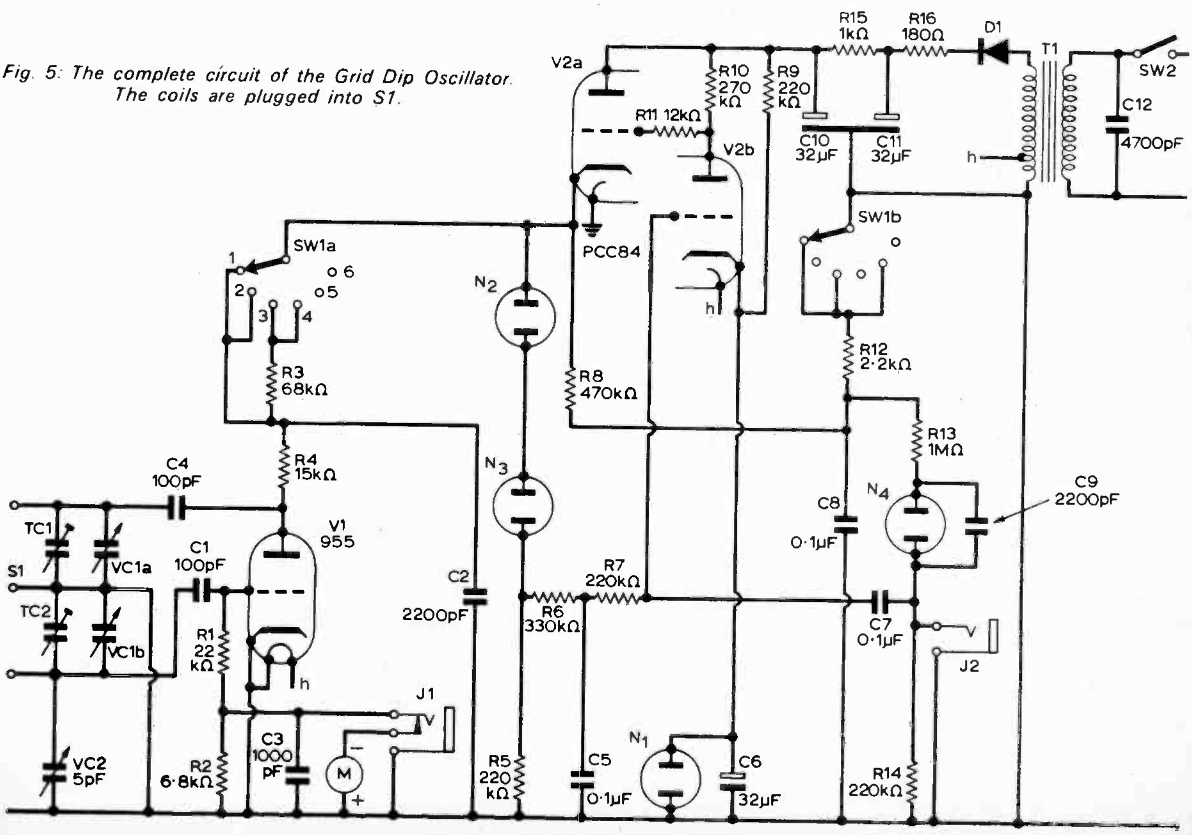
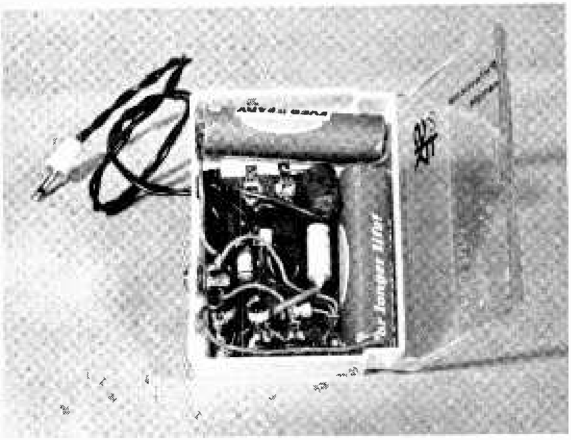


Fig. 5: The complete circuit of the Grid Dip Oscillator. The coils are plugged into S1.

stabiliser output variations, thus providing an audible indication of the stabilisation efficiency. R8 and C8 filter out any negative feedback of the modulation signal.

The input socket can be used for modulating the oscillator with an external signal. This must not exceed 4V r.m.s. or severe distortion results. It is best used when SW1 is in position 1 or 3.

The stabiliser valve used by the author is a PCC84 whose performance is quite satisfactory with 6·3V heater although it is normally rated at 7V. An ECC84 would be better but valves such as ECC81 and ECC82 were found unsuitable because the voltage dropped across them at 8mA anode current prevented adequate stabilisation.



The transistor amplifier can be easily built into a small plastic box.

The mains transformer must be capable of supplying 6·3V at ½A and 200 or 250V at 20mA. 250V is preferred for the h.t. but the author found 200V quite satisfactory. The transformer must be small to fit into the case. A silicon rectifier with a p.i.v. of 800V is used for h.t. rectification because of its small size and efficiency. The double capacitor (C10 and C11) should have a working voltage of 350V because surges reach at least 300V when switching on. The maximum diameter of this component in the plan is one inch. C12 prevents r.f. currents being transmitted along the mains, and should have an a.c. rating of at least 250V.

Constructional details

The two pieces of 18 s.w.g. aluminium 9 × 6¼in. are drilled and bent as in Fig. 7. The meter cut-out and VC1 mounting holes must suit the components to hand. Ventilation is important for a G.D.O. and thus a

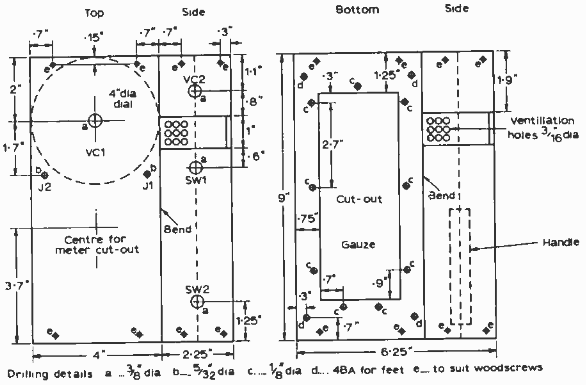


Fig. 7: Details of the aluminium case.

matrix of $\frac{3}{32}$in. holes is drilled in the sides as well as fitting perforated zinc to the underneath. A handle is fitted to one side as shown and serves for easy manipulation.

Three eighths inch plywood is used for the ends to fasten the aluminium and must be shaped to produce a good fit. One end is drilled for the mains transformer and the mains lead-in cable, and the other end takes the coil socket (S1). "All-dry" battery plugs are ideal but any plug and socket system with 3 connections will suffice.

The construction of the pointer for VC1 is shown in Fig. 8. For the dial a circle 4in. in diameter is cut out of thick white card and stuck on to the aluminium as shown in Fig. 7. If the mounting screws of VC1 are large, either a double thickness of card is used or the Perspex pointer cut away.

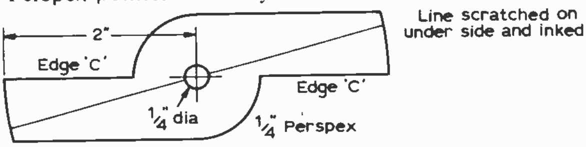


Fig. 8: The Perspex pointer.

The Veroboard for the modulator and stabilised power supply is shown in Fig. 9a, this avoids much wiring up in confined spaces. First the Veroboard should be cut to the required shape, the hole for the valve drilled and then the copper strips broken as in Fig. 9b. The components can now be wired—many have to be on end. The double capacitor (C10 and C11) should preferably be wire-ended but a can or prong type can be accommodated by drilling holes for its terminals and soldering each to a strip. The silicon rectifier's leads should be held with pliers during soldering.

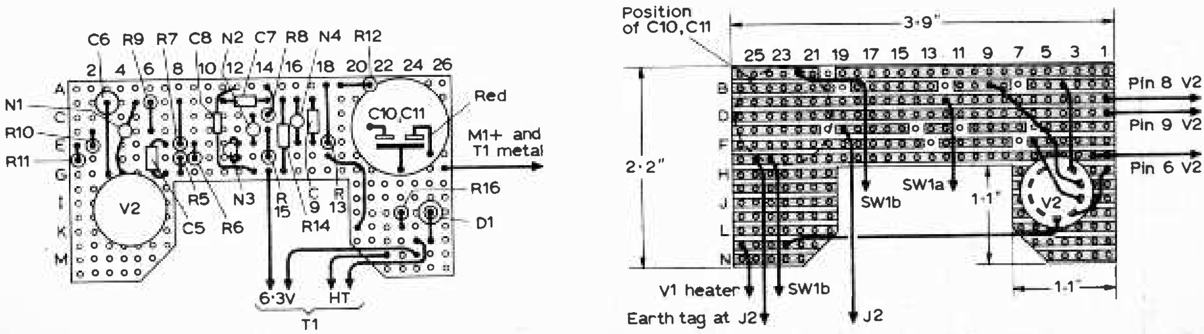


Fig. 9: The modulator and stabilised power supply are constructed on Veroboard; (a) shows the positioning of the components and (b) the underside wiring and copper strip interruptions

The oscillator section cannot be wired on Veroboard as all signal leads must be short for v.h.f. oscillation. The acorn is supported by its wiring and situated close to the ventilation holes. In Fig. 10 the switch and acorn are rotated through 90° for clarity. A word of advice when soldering the acorn—remove the soldering iron as quickly as possible for otherwise the short leads will conduct heat to the glass and break it.

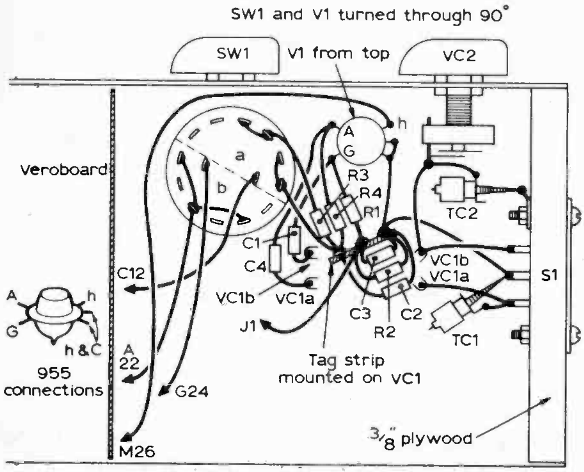


Fig. 10: The wiring of the Oscillator section.

When the separate sections are wired the connections are completed between the sections and T1, J1, J2 etc. At this stage all wiring should be carefully checked against the full circuit diagram of Fig. 5.

The instrument is now ready for switching on and carrying out the following tests:

1. Turn SW1 to position 5 and connect a voltmeter across C10. Switch on and the voltmeter should immediately rise to about 280V for a 200V winding and 350V for a 250V winding. If the voltmeter reads very different switch off at once and check the power supply wiring.
2. With SW1 still in position 5 measure the cathode voltage of V2a, this should be about 165V. If this is not observed a fault in the stabiliser is suspected.
3. Move the voltmeter to the anode of the acorn—the reading obtained should be approx.:
   Positions 1 and 2: 75V;
   Positions 3 and 4: 30V;
   Position 5: 0V.
4. Measure the cathode voltage of V2a as the switch is moved through its positions—the variations in meter reading provide an indication of the stabilising action.

The instrument probably works and it is now necessary to wind the coils.

Winding the coils

The author's method of coil construction is shown in Fig. 11. A trial coil of about 25 turns (not centre-tapped) is wound using 28 s.w.g. enamelled copper wire which should tune the G.D.O. in the 5–20Mc/s region. The coil is inserted into S1 and with SW1 in position 3 the meter should read about two-thirds of f.s.d. The multiplication factor (=maximum frequency ÷ minimum frequency) of this range must be found. The number of coils and the calibration accuracy depend on this factor, and the author found 2·5 reasonable. There are two methods of finding its value, (a) using a communications receiver with a short aerial; SW1 should be in position 4; (b) using an r.f. generator very loosely coupled to the coil.

SW1 should be in position 3 and the transistor amplifier of Fig. 6 used to listen to the beats. The frequency of the extremities can be found and TC1 and TC2 adjusted until the factor is 2·5. Beware of tuning to harmonics of the G.D.O.

For winding the other coils the easiest method is to use an r.f. generator (or another G.D.O.) and listen to the beats. Trial and error methods are used to adjust the number of turns on each coil—enabling the use of various wire gauges and formers.

For winding coils of lower frequency, the r.f. generator is left tuned to the lowest frequency of the range above. The number of turns on the new coil is then increased until the new range just overlaps the old. The same procedure is continued until the lowest required frequency is reached. The oscillator amplitude decreases as about 1Mc/s is reached, indicating that centre-tapped coils are needed for lower frequencies. For ranges less than about 600kc/s use coil formers fitted with ferrite cores and to minimise the self-capacitance of the coils below about 400kc/s use d.c.c. wire.

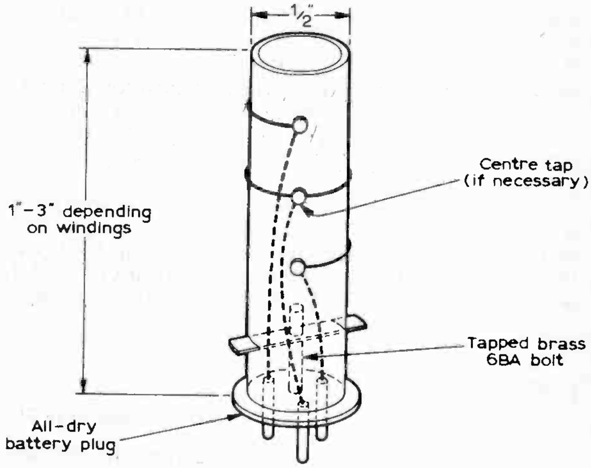
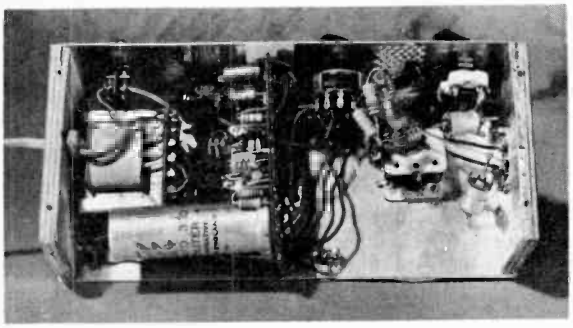


Fig. 11: The Author's method of coil construction.

When winding coils of higher frequency the r.f. generator is left tuned to the highest frequency of the range below and turns removed from the new coil until the new range just overlaps the old. Thicker enamelled wire should be used for v.h.f. coils and the last range is a short-circuit at the pins of the plug. When the meter reading is less than a third of f.s.d. over the complete spread of VC1, SW1 is turned to position 1. On the last range oscillation will probably not be sustained at the low frequency end of VC1.

A very similar method (but more tedious) utilises a communications receiver for the coils up to about 30Mc/s and a v.h.f. receiver for the higher ranges. In this case the output from the G.D.O. should be modulated (SW1 in position 4 for the low ranges and position 2 for the highest ranges). Most communications receivers tune from about 1Mc/s to 30Mc/s, and so below 1Mc/s harmonics must be tuned. A method of finding the fundamental accurately is to find out *roughly* the difference between two successive harmonics, and then divide the frequency of one by a whole number giving a result near the rough difference.

Above 30Mc/s a v.h.f. receiver must be used—the frequencies that a v.h.f. set can pick up (as harmonics if necessary) are: 27·3–36·7, 44–55. 88–110Mc/s. Unfortunately these bands do not comprise a continuous scale, but are sufficient for winding the coils as an exact amount of overlap is not important. The coils are now wound with adhesive tape to keep the windings in position.



Interior view of the completed G.D.O.

Six evenly spaced circles are inked on the 4in. diameter piece of thick card and each semicircle is used to calibrate a range. The outer circles allow for more accurate calibration and the reader should decide the layout of the dial. If an r.f. signal generator is available, the calibration is straightforward as harmonics do not have to be used (SW1 should be in position 1 or 3). Mark in pencil along edges "C" of the pointer frequencies not closer than ¼–½in. apart on the required semicircle and subdivide these when the scale is completed in indian ink.

In the absence of a signal generator, a communications receiver may be used to calibrate up to the limit of the receiver (SW1 should be in position 4). Above this a few bands may be calibrated by means of a v.h.f. set (SW1 in position 2). Luckily, due to the very small self-capacitance of the coils above about 15Mc/s, these scales are proportional, thus to complete the scales the remaining calibration marks can be made by calculation.

Having finished the scales in ink, the dial is covered with adhesive transparent plastic to protect it.

Uses

Measuring Inductance: The coil (L) is placed in parallel with a known capacitor (C) and the resonant frequency (f_1) found with the G.D.O. If the coil has only a few turns, the formula $f_1 = \frac{1}{2\pi\sqrt{LC}}$ can be used. If the coil's self-capacitance is large the resonant frequency (f_2) is found without C connected. The two equations obtained are:

$$f_1 = \frac{1}{2\pi\sqrt{L(C+C_x)}} \quad \text{and } f_2 = \frac{1}{2\pi\sqrt{LC_x}}$$

where C_x is the self-capacitance of the coils. Eliminating first C_x and then L gives:

$$L = \frac{\frac{1}{f_1^2} - \frac{1}{f_2^2}}{4\pi^2} \quad \text{and } C_x = \frac{C}{\frac{f_2^2}{f_1^2} - 1}$$

Measuring low capacitance: The G.D.O. is adjusted to the resonant frequency of a coil in parallel with a variable condenser (vanes closed). The unknown capacitor is connected also in parallel with the coil, and the variable condenser is turned until the circuit again resonates with the G.D.O. The scale of the condenser can be calibrated directly in pF.

Alignment of receivers: This can be effected by the same method as used with r.f. generators—remember to couple the G.D.O. loosely to the receiver especially when the front end is being tested. ■

F.M. TUNER

—*continued from page 753*

easier to wind the coils after mounting the formers rather than before.

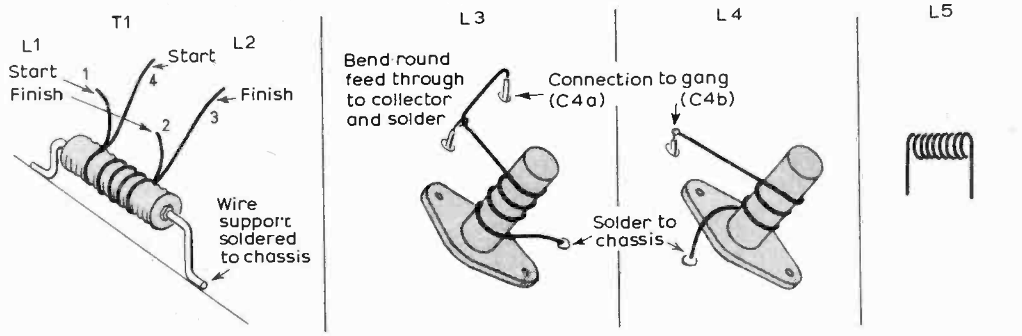
The aerial coupling transformer T1 is made on a Radiospares type A dust iron core. Primary and secondary are wound together (bifilar wound) to sit tightly in the threaded groove. It is mounted by passing a piece of stout wire through the hexagonal centre hole.

The windings of T1 can be cemented with polystyrene or balsa cement immediately after winding, as also can L5. L3 and L4 should not be cemented until the final tuning has been completed.

Coil details are shown in Fig. 6. ■

Wiring and alignment instructions next month.

Fig. 6: Coil details.



5+5 turns, 32s.w.g. enamelled, bifilar wound in groove of RS type A core.

3¼ turns, 22s.w.g. tinned copper, spaced approx. diameter of wire

2¾ turns, 22s.w.g. tinned copper, spaced approx. diam. of wire.

8 turns, 26s.w.g. enamelled, close wound ⅛in. diameter, self-supporting.

LETTERS...

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

Avoid 'em Mate!

Congratulations on your interesting "Audio Supplement" part one of which was published in the October 1968 PRACTICAL WIRELESS.

In the article you, quite correctly, 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.

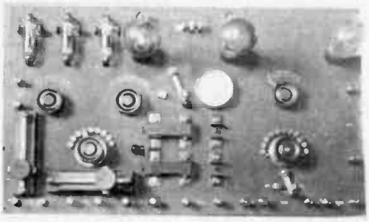
Some manufacturers include them on cheaper amplifiers as a sales gimmick but other manufacturers of high quality equipment include a loudness control out of a sincere belief in a misconceived theory. This theory states that because the sensitivity of the ear falls in the lower frequency range, some compensation 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** (*Warwickshire*).

Station 20Y

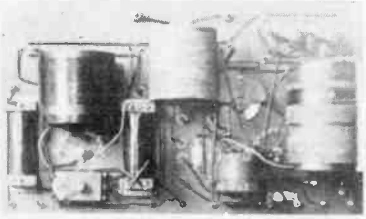
When I came across these photographs, long since thought lost during moving recently, it occurred to me that some of your readers might be interested to see a 1922 amateur "Ham" station, 20Y, which operated on 1,000 metres, and wavelengths up to 180 metres at that time and 440 metres instead of 1,000 metres shortly afterwards.

Station "20Y" was my own and was authorised by the GPO. It was also designed and built entirely by me, though some of the components were obtained from a store in Lisle Street. I had a small workshop including a 3½in. lathe, in which many of the components were fabricated.



The front panel of the transmitter-receiver

Internal view showing the 3½" coil formers



The top photo shows the transmitter-receiver panel with the receiver on the left, using V24 valves and an R valve for reception.

The internal view shows the inductances, all wound with Litz wire on 3½in. ebonite formers. The spindle of the variometer is visible between the top windings, all home made.

I forget the dimensions, but I think they were about 22 × 18 × 8in. and the panel was ⅜in. matt ebonite.

The aerial was a twin inverted L spaced 5ft., 35ft. high and 60ft. top. Radius of operation was about 130 miles with an aerial current of approx. 0·5 amp.

I shall be glad to answer questions and supplement the above data if desired. The station became 2JL India in 1924-8.

You may be interested to learn that I am now 77 and since I have retired I have kept my hand in with transistor sets and equipment.—**E. J. Hobbs** (72 *Eastbrook Road, London, S.E.*3).

Note from a SWL

I agree with J. Bennett of Nuneaton as I also enjoy listening to the Amateurs and by listening one can learn a few things from them. In reference to the Beginners' Licence I think it is a good idea. I think that some of the Class "A" could do with starting all over again, some of them do tend to use their rigs as telephones and sometimes keep the air cluttered up with lots of nonsense. I listen to the Amateurs on all bands and at present have been picking up the Americans on the 27Mc/s band and have enjoyed every minute of it. I have also picked up an American Police Radio Station on 27·3Mc/s "A" at 1700 hrs. GMT every night for a week. I get some real DX at times on the 15 and 10 metres. I own a CR-100/5 with a Codar PR 30 preselector. I use a 75ft. "L" type aerial, also a 66ft. indoor, diamond shape and sometimes I use a TV aerial. I have 56 countries and 21 zones and have over 500 QSLs altogether. I listen to everything there is on the air and think it is a grand hobby.—**A. Gavin** (*Cheshire*).

Solid State

In answer to Mr. Tomlinson's enquiry about "Solid State", I would like to explain what this actually does mean.

It is a term first evolved by Pye and an American concern for the Achoic Box Hi-Fi system, since then it has been applied to more equipment than it should have been.

When electrons flow in conventional equipment usually there is nothing to impede this flow, as in a valve there is a vacuum, or in the case of a transformer they travel between the poles in almost free air, so of course some of them are lost on the way, but in semiconductors the electrons travel through solid matter as in transistors, diodes etc., and an absence of valves or transformers, tuning gangs etc., can identify a piece of equipment as solid state. In other words the electrons pass through solid material throughout the circuit with no "gaps" for them to jump across, hence solid state. However since some equipments have mains transformers they cannot be truthfully referred to as Solid State.—**Michael Davison** (*Sunderland*).

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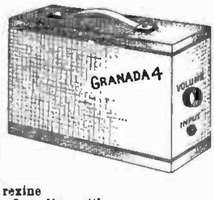

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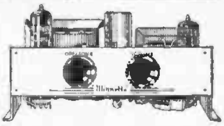

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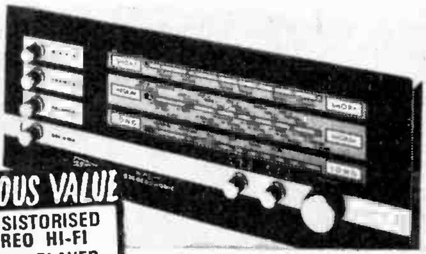

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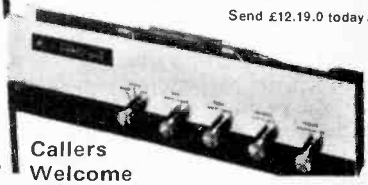

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LETTERS...

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Silent Mal-functions

Judging from correspondence in PRACTICAL WIRELESS October and December issues there must be a fair number of individuals busily making transistor projects that, when finished, are capable of a prolonged and unbroken magnificent silence, switched on or not. The operators obviously are not!

This is quite some achievement nevertheless, but not appreciated by Messrs. Trowbridge and Smith, who though deeply involved in solid state, frustration and/or "p type" invective for allcomers, appear to now have withdrawn from the semiconductor scene.

Both of these gentlemen have knowledge of construction of valve gear so one cannot attribute their non-success to faulty soldering or the trap of using much utilised components, one of which has finally given up the ghost! The root cause must be something much deeper. Perhaps they were frightened at sometime, maybe in a dream, by some monstrous IGFET or a creepy crawly MOST.

The switchover from valves to transistors does involve acquiring a new approach—a different "feel". The miniature components and low power used require more "finesse", more precise handling. In fact our critics may say, a "Lilliputian mentality". To be more serious, a factor to be contended with is that the transistors generally available in the home constructors market vary somewhat in performance under the same conditions. The experimenter must be prepared to substitute several of the same type for comparative results, and to vary the value of associated resistors for best performance—sometimes for any performance at all!

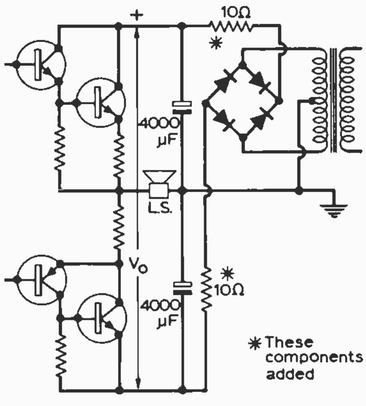
This could be Mr. D. Smith's problem with his "Reflex Front End Unit" where the reported motor-boating may possibly be cured by a higher value of resistor between the base coupling winding and the negative supply line. Alternatively, any deviation from the precise layout, coil windings or type of chokes would more than likely cause oscillation of this type. An approximate hook-up will not do for this type of circuit. The other possibility is an unsuitable impedance at the amplifier input. A suitable transistor amplifier would present as input a 5 to 10kΩ pot as volume control, e.g. the Pyramid Series Amplifier in September '68 PRACTICAL WIRELESS. Mr. Hamafords 3in. diam. coil and OA81 would in most localities bring in exactly what the BBC lays on for the bulk of the populated areas, i.e. "at least two powerful local programmes". But something a little more sophisticated is required to unravel one from the other! He at least has the satisfaction of knowing that his apparatus probably worked well, within its inherent limitations.

Personally, as a past disciple of the Fleming school of thought indulging in the "gaseous state". I one day took a long cool look at the surrounding scene and decided that thermionics are out and the solid state of semiconductors are with it. Out went the bottles and in came the nutty slack. I have never regretted the day.

Courage friends, perseverance can bring great reward—on the whole it's cheaper too!—**V. S. Evans** (*Wigan, Lancs.*).

Thumping good cure

I read with interest the causes and cures for the "audio thump". It would seem that several readers



have found that the cause is the output d.c. blocking capacitor charging through the loudspeaker.

I feel, however, that there may be another cause in some cases. I have an amplifier based on an RCA design, which uses a centre-tapped supply, thus eliminating the need for the output capacitor (see diagram). With this circuit the "thump" could not be caused in the manner described by several readers.

My own explanation (and I am not sure about this) is as follows: This amplifier is such that it will operate (and surprisingly well) on a much reduced supply voltage. There is hardly any noticeable reduction in output when operated at one-sixth the nominal supply voltage. When turned on the supply very quickly reaches the $\frac{1}{6}$Vo mark and the amplifier becomes capable of operating, and "sees" the rapidly increasing supply voltage as a signal, which is amplified as the "thump". The fact that these direct-coupled amplifiers have excellent low-frequency response probably makes the matter worse.

How to cure this is another problem. I have managed to reduce but not eliminate the "thump" by inserting low value resistors (10Ω) in the power supply. This is not very satisfactory for this particular amplifier as it is a rather high power one, requiring 2 amps at 80V for full output so that there is a large voltage drop across the resistors.

It could be, then, that in Mr. Pinder's amplifier the problem is, in fact, caused by the smoothing capacitors.—**A. G. Wood** (*Benoni, South Africa*).

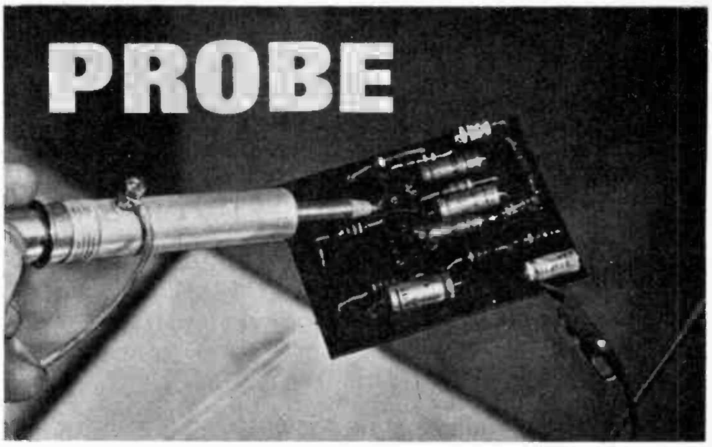
Current Conventions

I feel I must enlighten H. C. Loxley (November) on the conventions of current flow and the fact of electron travel. Current is "conventionally" considered to flow from a positive to a negative terminal although electrons are "known" to travel from negative to positive. If this convention is held I fail to see any ambiguity in the labelling of the polarity of any components in a given circuit.

In his example Mr. Loxley has delved into the centre of the circuit and thrashed his way out giving rise to his confusion. In the example given; the h.t. line must be labelled positive, then the lower end of the Load Resistor will be labelled negative by virtue of the volt drop across it. If this convention is applied throughout the circuit I fail to see any confusion.

In conclusion I would like to remind Mr. Loxley that his "*old* positive to negative current flow" will still persist for some time to come.—**W. J. Murphy** (*N. Ireland*).

HIGH IMPEDANCE PROBE



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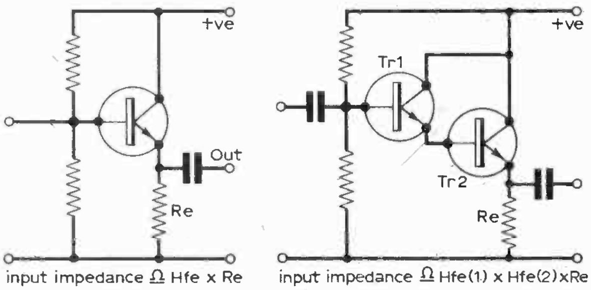

Fig. 1: A conventional emitter-follower and (a) a compound version with a higher input impedance.

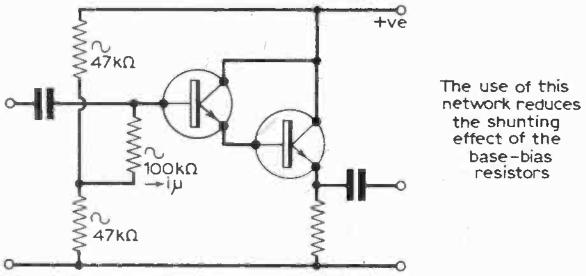

Fig. 2: A modification to Fig. 1a which reduces the shunting of the bias resistors.

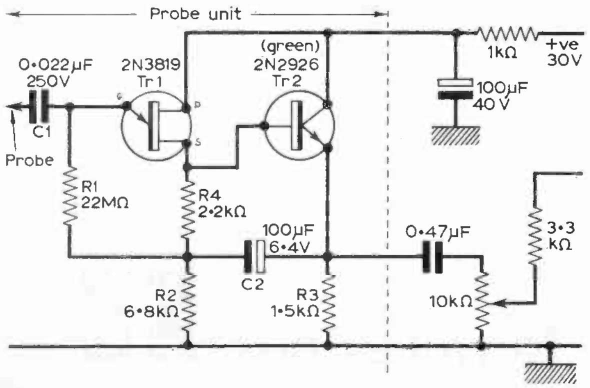

Fig. 3: The final circuit of the probe, using an f.e.t. in the first stage.

THIS probe was designed to be simple, light, have a linear input/output transfer characteristic, and at the same time present a very high input impedance. Its value can be realised when one considers that a 3ft. length of coaxial cable has a capacitance of about 60pF; if this is used as an input lead to an a.c. millivolt meter of high input impedance, a shunting effect will be imposed and the apparent input impedance lowered. This will be more noticeable at high frequency.

At 20kc/s, a 3ft. length of coaxial lead has a reactance of

$$\frac{1}{2\pi FC} = \frac{1.10^{12}}{2\pi.20.10^{5}.60} \simeq 132\text{k}\,\Omega$$

so at this frequency, the apparent input impedance is only 132k Ω even though the test meter may have an input impedance in the order of 10M Ω. A probe with a high input impedance and low output impedance would therefore be highly desirable.

Bipolar transistors offer very high gain, good high frequency characteristics, but have the inherent disadvantage (in this case) that they are current operated, and therefore low impedance devices. There are ways of improving the situation, however, which will be described.

A circuit such as shown in Fig. 1 would have an input impedance of approximately $h_{fe}R_e$, provided that there are no other shunting effects to be considered. Thus, R_e and H_{fe} should be as large as possible. If R_e is to be very large, a high line voltage will be needed, and this presents transistor breakdown problems.The use of compound emitter follower techniques, as in Fig. 1a, allows smaller R_e values to be used, since the emitter current of the first transistor is the base current of the second. This gives the input impedance as $h_{fe_1}h_{fe_2}R_e$.

These types of circuit require that the gain of transistor 1 be maintained down to very low values of collector current, hence special devices are frequently quoted.

Shunting effects of base-bias resistors may be reduced by the use of networks such as in Fig. 2, but the upper limit on the input impedance is about 1M Ω by this means.

Another familiar technique is the use of bootstrapping, which employs a capacitor to induce a phase-shift, and provide negative feedback to obtain a high input impedance. Bootstrapping lowers the apparent input capacitance of the circuit, but owing to the small but important presence of the storage or

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transit time of the circuit, this is not to be attempted at high frequency, as the phase of the feedback signal will lag on that of the input signal, and the bootstrap effect will no longer operate.

There is a much more attractive solution, however, of using an f.e.t. in the first stage. This device exhibits a very high input impedance at low frequencies and closely resembles, in fact, the characteristics of a valve. A commonly available type is the 2N3819, which is also reasonably cheap to buy.

As will be seen from the circuit, Fig. 3, the gate of the f.e.t. is biased from the source resistor chain, in order to obtain a degree of a.c. feedback. This has the effect of raising the input capacitance, while still maintaining the thermal stability of the circuit.

The f.e.t is directly coupled into a high-gain transistor, type 2N2926 (green). The gain spread here is 250–500, and devices of lower gain than this are not recommended. Bootstrapping is applied from Tr2 emitter to Tr1 source. This lowers the total gain, but since the probe is not intended for use above 200kc/s, there is no problem.

Output is taken from Tr2 emitter to ensure a low output impedance. Losses in the output cable are thus minimised.

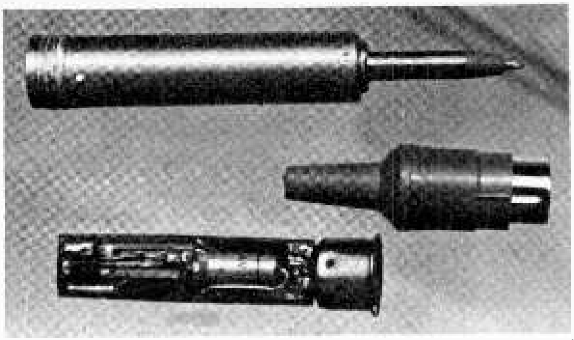
A two-core screened cable is used to connect the unit to the main equipment, for an earth, power supply and signal line are required.

Decoupling is achieved in the main unit, where the supply voltage originates. Signal decoupling is also in the main unit. Care should be taken that the resistance terminating the cable is not too low, so the attenuator system shown should be adopted.

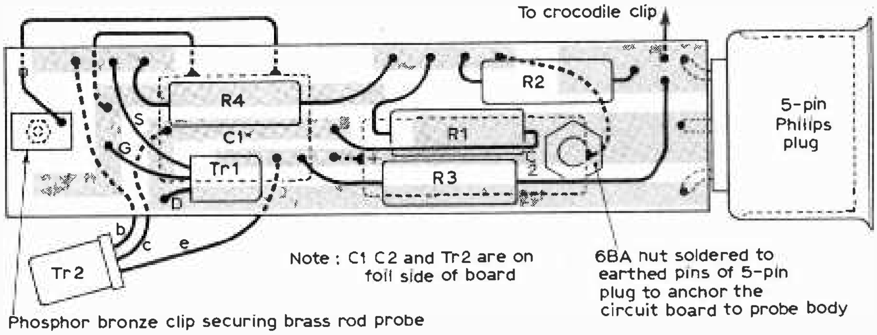
The resistors R4 and R2 should be chosen so that the drain current of the f.e.t. is around 700μA. The values quoted are for the particular 2N3819 used, but R2 may vary anywhere between 1·5k Ω and 10k Ω. The factor which determines that value of R2 is I_{dss}, which is easily measured by the circuit Fig. 4. The value of I_{dss} for the device used was about 2·8mA.

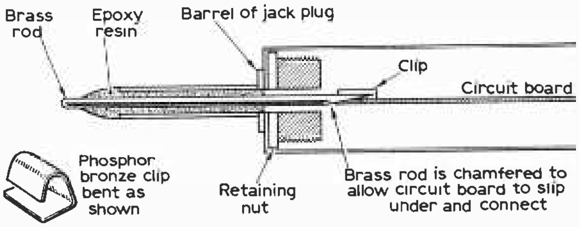
The way to find out the values required is to switch on and try various values in for R2, until 700μA drain current though the 2N3819 is attained.

The total current used is about 3·8mA, and is almost independent of voltage applied, though the circuit may start to limit signals of large amplitude if less than 15V is used. The circuit works best on about 30V, and will then accept up to about 2V of signal without undue non-linearity or distortion. It is important that the input capacitor C1 is a low leakage type of fairly



The probe, case and printed circuit board with socket attached (above). The lower pair of diagrams show the construction of the board and probe tip.





high voltage working. Of course, the size limits the maximum value which can be used.

CONSTRUCTION

In view of the size, some ingenuity has to be exercised in the construction of this probe, and it is realised that some of the components described here may not be available to constructors. However, a few indications will be given.

The tube in which this was made originally held ⅛in. drills made by the International Tool Company (INTAL), and was obtained from a local hardware shop. This tube is just the right diameter to fit a five-pin DIN plug in the open end. A hole is drilled in the other end, and the barrel of an old jack plug screwed in and held with a nut from a volume control, filed down to a circular shape from its original hexagonal form. A piece of brass rod is fitted into the hole in the barrel, and cut to length, then cemented with Araldite. (A clamp is used to hold the rod while the cement sets.)

The end of the rod inside the casing of the probe is chamfered to facilitate location into the clip on the circuit board. This clip is a piece of bent phosphor-bronze from a battery, held in place with a 10BA nut and bolt.

The circuit board is made conventionally, using

—continued on page 786

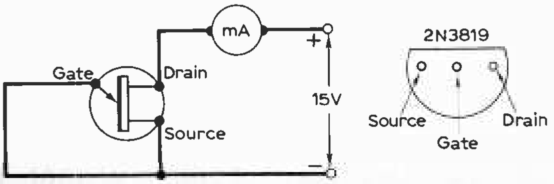


Fig. 4: The method of measuring I_{dss} of an f.e.t.

THE SOLID STATE

by I. R. SINCLAIR

PART 2

LAST month we described the basic principles of semiconductor device operation, including how junction diodes and transistors work. This month we shall cover some of the less well-known but nevertheless important semiconductor devices now in use.

LIGHT-EMITTING DIODES

If electrons crossing from an n region over the junction of a diode into a p region spend a long time in a heavily doped p region before reaching the metal contact to the semiconductor, the chances are that these electrons will encounter some holes. Now a hole is a gap into which an electron can fit providing that it loses some energy, and these electron-hole recombinations therefore lead to energy being emitted. If the semiconductor is transparent, this energy can be detected as infra-red radiation, and in some semiconductors the recombination energy is so high that the energy is visible as light. Suitable transparency and recombination energies are found in gallium arsenide (infra-red) and in gallium phosphide (visible light) and such diodes are now readily available.

TUNNEL DIODES

The *tunnel diode* works on a principle not mentioned up to now. If a large number of electrons are gathered round a junction which is reverse biased, some appear on the other side even though the bias would appear to make this impossible. This process is called *tunnelling* and is explicable in terms of quantum mechanical theory. In a normal diode, conduction does not take place in the reverse direction and only takes place in the forward direction when the forward voltage is about 0·3V. In the tunnel diode both the p and n portions are very heavily doped so that with reverse bias some electrons from the p region tunnel through to the n region, causing the diode to conduct. With forward bias applied electrons tunnel from n to p and the tunnel current reaches a maximum at about 0·15V. Above this the tunnel current decreases and normal electron-hole flow takes over so that the junction ceases to act as a barrier; no barrier, no tunnelling. With suitable construction the tunnel current and the normal current can be separated so that there is a dip in the current between the two, as in the characteristic shown in Fig. 14. For a portion of

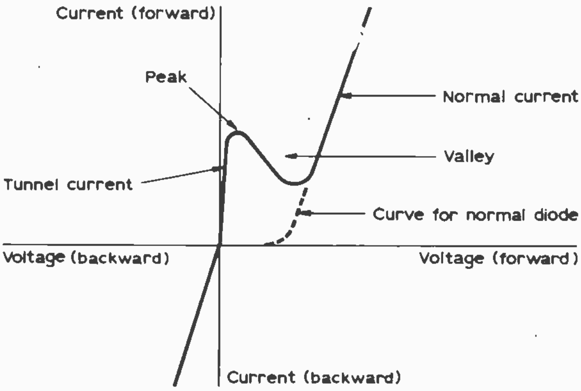


Fig. 14: Tunnel diode current-voltage characteristic.

this characteristic the current is decreasing as the voltage is increasing. This behaviour is the opposite to that of a resistor; it is called negative resistance and is used in all oscillator circuits. Tunnel diodes have been used as oscillators and as switches but have never achieved the great range of uses that was hoped for at one time.

VARACTOR DIODES

Varactor diodes are diodes with a large junction area. In a reverse-biased junction we have the situation of a conductive n region, a conductive p region and a nonconducting region between. Any arrangement of two conductors with an insulator between is a capacitor, so the reverse-biased junction diode has an appreciable capacitance. As the reverse bias is increased the electrons and holes retreat farther from the junction. This is equivalent to separating the plates of a capacitor, so decreasing its capacitance. Varactors are used for voltage controlled tuning, for a.f.c., and for parametric amplification in which the capacitance of a tuned circuit is varied by a local oscillator signal to cause frequency changing and very great amplification.

FIELD EFFECT TRANSISTORS

Field effect transistors make use of majority carriers only. Junction transistors depend for their action on carriers passing through the base or region in which they are in a minority. For example in an n-p-n transistor the carriers in the base region are electrons which are in a minority and liable to be trapped by holes. In a f.e.t. electron current carriers move through n-type material (or holes in p-type)

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and so many of the difficulties of transistor operation are avoided. We have already seen that the reverse biasing of a junction causes the current carriers to back away from the junction. Imagine current passing (Fig. 15) through a thread or *channel* of n-type material surrounded by p-type material. If the p-type connection (the *gate)* is now reverse biased, electrons and holes will move away from the junction so that the area of n-type material still able to carry current is much less. The conductivity of the n-type material is thus being altered by the bias on the p-n junction and small changes in bias can cause large changes in conductivity if the n channel is narrow. This type of f.e.t. is called a junction f.e.t.

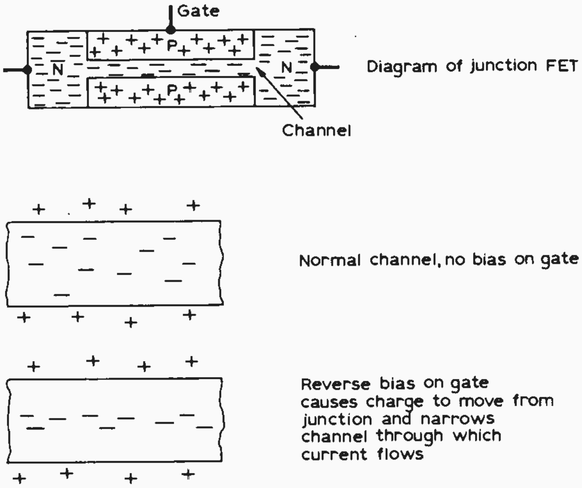


Fig. 15: Principle of the junction-gate field effect transistor.

Another type of field effect transistor which has become more prominent recently is the m.o.s.f.e.t. In this type the n channel is a thin film. Over this is deposited a film of insulator and over this in turn is laid a film of metal. Since there is no junction there can be no current flow from metal to the n film, but the voltage on the metal can affect conditions in the film to a great extent, causing the normal conduction of the n film to be greatly reduced because of electrons becoming bound by the charge on the metal. This is described as a depletion-type m.o.s.f.e.t., a device in which conduction takes place normally at zero bias on the metal gate but in which conduction is reduced as the bias on the gate is increased positively. More common now

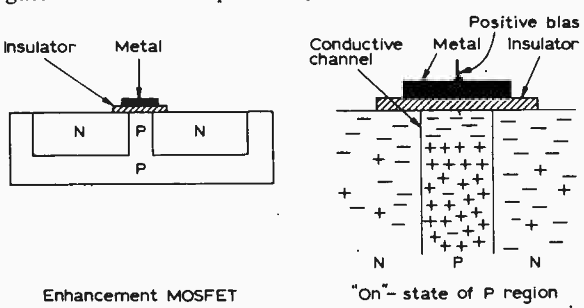


Fig. 16: Principle of the enhancement-mode insulated-gate field effect transistor (m.o.s.f.e.t.).

is the enhancement m.o.s.f.e.t. (Fig. 16) in which highly conductive n regions are made close to each other in a block of p material and an insulating film is deposited on top covering the gap, with a metal gate layer on top of that. With no bias on the gate this arrangement is almost nonconducting, but a positive bias on the gate attracts electrons in the p region to form a channel between the n regions thereby causing conductivity. Compared to the more usual types of transistors m.o.s.f.e.t.s have extremely high input resistance, their collector current is very much less dependent on the collector voltage and the feedback from collector to gate is negligible so that one m.o.s.f.e.t. can be coupled to another without interference between them.

THYRISTORS

Thyristors are made with four layers forming three separate junctions (Fig. 17). When the p junction at one end is forward biased with respect to the n junction at the other, electrons and holes move away from the central junction so that there is no con-

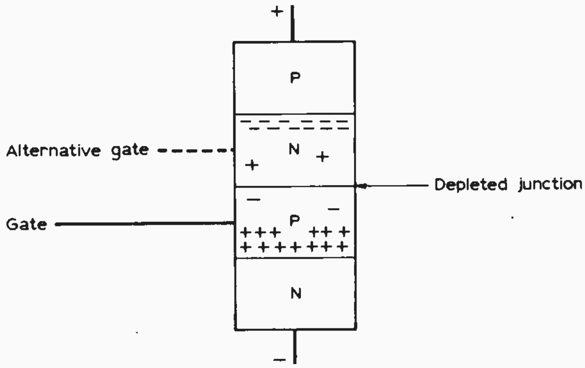


Fig. 17: The thyristor is a four-layer device with three pn junctions.

ductivity. If a bias in the forward direction is now applied at the gate connection to one of the intermediate regions the central junction is made conducting so that current passes steadily. Once conducting, the junction cannot be made non-conducting again except by removing the forward bias across the device and starting again.

UNIJUNCTION TRANSISTORS

A unijunction transistor consists of a piece of lightly doped n-type silicon to which two connections are made, one at each end: the silicon behaves as a resistor. Between these connections a junction to heavily doped p-type silicon is formed. The p-type region is known as the emitter and the two connections to the n-type region as base 1 and base 2. When current is passed between the base 1 and base 2 connections there will be a voltage between the two and the voltage at the emitter junction will depend on its position between the base contacts, just as the voltage of the tap of a potentiometer depends on its position. The emitter is usually connected so that this voltage at the emitter reverse biases the junction. When a voltage is applied to the emitter no current flows across the emitter junction while it is reverse biased, but as the voltage is raised the emitter eventually becomes forward biased and conducts. When this happens a large number of holes are transferred into the n region between the emitter and the conducting base so that the resistance between junction and base is very low and a large current can pass. This current is limited only by external resistance and will flow until the voltage between emitter and conducting base (usually base 1 connection) reaches a value called the turn-off voltage, between 1 and 2V. Figure 18 shows an oscillator circuit using this

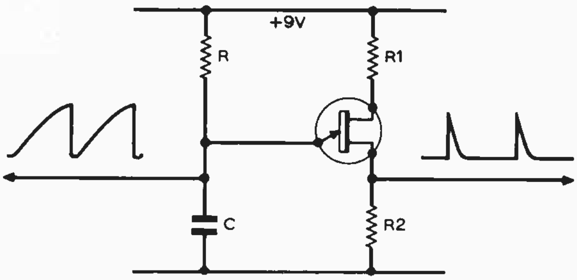


Fig. 18: Simple unijunction oscillator circuit.

principle. Capacitor C charges via R until conduction starts between the emitter and base 1, then discharges until the voltage across R2 equals the voltage across C less the turn-off voltage, then starts to charge again.

FUTURE DEVELOPMENTS

There is every indication that we are at the same stage in our understanding of solid state physics as we were with atomic physics forty years ago; there must be very much more to come.

Already there are signs that the idea of mobile electrons moving among vibrating nuclei is not sufficient to explain superconductivity, and that much remains to be discovered by studying this loss of resistance at low temperatures. Already a new device, the Josephson Junction, which is a sandwich of insulator between superconducting metals, looks like having a vast range of applications; so vast that a complete article would be required to describe them. Several recently announced semiconductor devices combine the effects of electrical fields, light and sound waves in a crystal. For example the SALS (Solid-state Acoustic Light Scanner), invented in the Bell Laboratories where Shockley first announced the discovery of the transistor, uses a sound wave to generate light from a set of junctions which are reverse biased. This device can also be used the other way round, and the sound wave can be used as a scanner which produces pulses of voltage at each junction in turn according to the light falling on each junction.

EDUCATIONAL NEEDS

Such new devices can be explained in terms of solid state theory, though in some cases they may lead to the theory being revised, but are totally incomprehensible to anyone knowing only ordinary school physics. It is for this reason that the elements of solid state physics should be taught now rather than waiting until the subject has moved on so far that catching up becomes almost impossible. ■

THE AMATEUR BANDS

—continued from page 763

Mike Crawshaw (Ormskirk) informs that 8P6AZ operates as net controller in a West Indies Caribbean DX net. This is active on Tuesday evenings around 14,192. Try from midnight on if you're keen. Mike has managed to swap his PCR3 and HAM-1 for a SR600 triple conversion s'het and a Sommerkamp FR-100-B. (Like I suddenly went green, man.). He feeds this lot with a 130ft. wire at 25ft. Heard whilst nonchalantly poodling round twenty—CP1AP, CT1TZ, KC4USM, LA2PH/MM, OA2BH, OM2AG, PJØMM, PJ2CU, PY2NM, PY4AJD, PZ1AP, TI2BF, TU2BA, YV4UA, VO1AQ, VE1AGH, VE3BSJ, VE6ADY, VE7BQF, ZF1EP, 4A2YP, 6Y5DB, 8P6AH, 8P6AZ, 8P6CV.

J. Moxham (Glastonbury), Drake 2A, '5RV at 20ft. plus ten metre GP. Ten—CR6LF, CR7JC, CX2CN, FM7WA, PAØMDG/P, PY3AHG, SVØWM, ZD8JL, ZS5OB, ZS6BAG. On twenty metres John raised—EA8ET, HM5BF, JA4OK, JA6AD, JA8NU, KL7MF, OA6OH, TI2IFR, VK2OQ, VK3AUK, VK4FID, VK6AQR, VR2EK, VS9FB, W6JY, ZE1ATK, ZL4JI, ZL4BX, ZL6OJ, 9G1DG.

Please remember that the deadline for logs is such that they must reach me before the 20th of the month and, please slaves, in alphabetical order—Ta!

A HIGH IMPEDANCE PROBE

—continued from page 778

shellac resist agent and ferric chloride etchant. A 6BA brass nut can be seen on one face, soldered to one of the earthy resistor leads. This is to hold the board inside the tube while the probe is in use, and also to provide an earth tag.

In conclusion, a method of measuring the input impedance of the circuit must be mentioned (see Fig. 5).

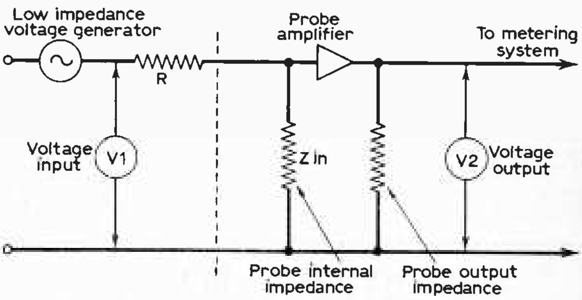


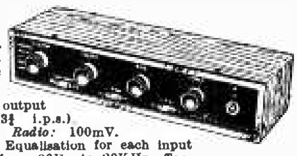
Fig. 5: Measuring the input impedance of the probe.

If a series R is placed between a low impedance voltage source and the probe input, the output from the probe to the metering system will be reduced. The attenuation so produced is such that a 3dB drop is observed when the value of R is the same as that of the internal impedance.

This test is best performed at approximately 1kc/s or lower, as capacitive and inductive effects will then be minimised.

It can thus be seen that this device could be a useful addition to the experimenter's test equipment. ■

THE CLASSIC



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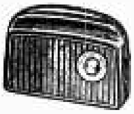

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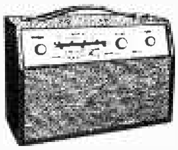

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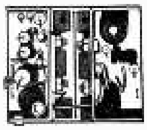

Specifications: *RMS Power Output* (into 3 ohms speaker): 10 watts continuous (sine wave), 13 watts music power. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 micro-amp). *Total Distortion at* 1KHz: at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *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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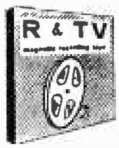

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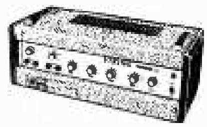

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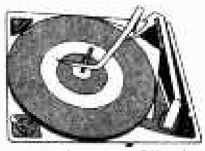

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7″ to 10″ or 12″. Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself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

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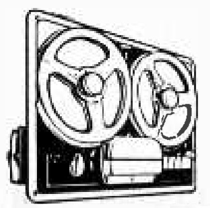

3 Speed 2 track Tape Deck complete with heads, takes 7in. spool.

Incorporating 3 motors.

A.C. mains, 240 volts, listed at £21.0.0.

Our Price £9.19.6, plus 10/- P. & P.

Multi Purpose Neon Test Unit. Robust, useful and instructive, tests insulation, capacity, continuity, resistor, volume controls, also acts as signal injector and L.T. fault finder, kit comprises neon indicator, 4-way wafer switch, ebonite tubes, resistors-condensers, terminals, etc., with diagram, only 9/6, plus 2/- post and insurance.
5 Push Switch. One push operates mains on/off switch, the other four operate various on/off and change-over switches, **2/6.**
A.E.I. Fractional H.P. Motor. 200/250 v. 50/60 c.p.s. enclosed, continuous rating 1/40 h.p., ex. equip. Perfect order, **19/6,** plus 4/6.
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Neon Mains Tester, 1/3 each, **12/-** doz.
Flood Lamp Control. Our dim and full switch is ideal for controlling photo flood lamps; it gives two lamps in series, two lamps full brilliance and lamps off. Similar control of other appliances can be arranged where used in pair or where circuit can be split exactly in half. Technically the switch is known as a double-pole change over with off. Our price **4/6.**
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White Circular Flex. Ideal for lighting drops, twin made by BICC. Usually 8d. yd., 100 yd. coil for **30/-,** plus **6/-** postage.
Edgewise Control. Morganite, as fitted many transistor radios, 2K or 5K with switch, **2/6** each or 24/- per dozen.
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Silicon Rectifier. Equiv. BY100 750mA 400V., 10 for **20/-.**
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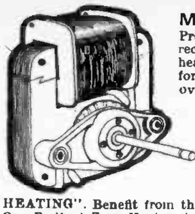
Compression Trimmers. Twin 100pF, **1/-** each; 9/- per dozen.
3in. PM Loudspeaker. 3 ohm, **12/6;** 80 ohm, **13/6.**



MAINS MOTOR

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

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Many readers will have found to their dismay that the loft, garage or shed, which they so carefully converted into a workshop, is just a refrigerator in the winter—it can't be used, because it never gets warm until it is time to finish. The answer is "RADIANT ZONE HEATING". Benefit from this type of heating is immediate and low in cost. Our Radiant Zone Heaters (made by the famous Philips Company) are internally mirrored glass tubes with built in 500 watt heat and light elements. Four of these over the average size bench is all you need and will cost only about 4d. an hour to run. Ideal also under typists' desks. Keeps legs and knees warm, no matter how mini the "mini". Price is **27/6,** post and insurance 4/6 on one or any quantity.

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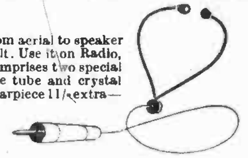
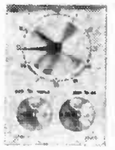
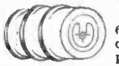
Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **29/6**—twin stethoset instead of earpiece 11/- extra—post and ins., 2/9.



ELECTRIC CLOCK WITH 25 AMP. SWITCH

Made by Smith's these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **39/6,** less than the value of the clock alone—post and insurance 2/9.





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6V-500mA hr.—size $2\frac{1}{4} \times 1\frac{1}{4}$in. dia. really powerful will deliver 1 amp for $\frac{1}{2}$ hour. Regular price **65/-** each—our price **29/6,** new and unissued.

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Rotary Cam Operated Switch. 12 positions each of which close a separate pair of contacts except the last which leaves them all open. Contacts rated at 250V 16 amps. **15/- each.**
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Printed Circuit Board, Edge Connector, solder terminations. 32 contacts, standard spacing for veroboard, etc. 6in. long but easily cut. **7/6** each, **80/-** doz.
1,000W Fire Spiral. replacement for most fires. **1/3** each, 12/- doz.
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1 Meg Miniature. Pot-meter Morganite standard $\frac{1}{4}$in. spindle 1/- each: 9/- per dozen.
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100K Pot-Meter. Miniature type with double pole switch and standard $\frac{1}{4}$in. spindle, by Morganite. **2/-** each: 18/- per dozen.
Blanketstat Glass. Enclosed. normally closed. Circuit will open should blanket overheat, **4/6** each.
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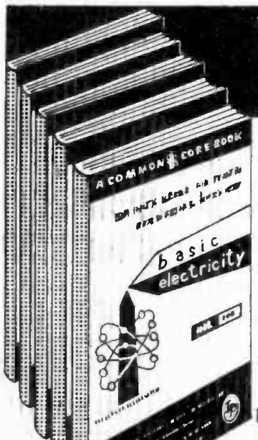
Siemens High Speed Relay. Twin **1,000 ohm** coils. Platinum points changeover contacts—Ex equipment, **8/6** each.
Toggle Switch Bargain. 10A 250V normal one hole fitting **2/9** each: or 30/- per doz.
Electric Lock. 24V coil, but rewindable to other voltages, **4/6** each.

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

ELECTRONICS (CROYDON) LTD

Dept PW 266 London Road, Croydon CRO-2TH



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THE MW COLUMN

STATIONS in the Maritime Provinces of Canada —Newfoundland, Nova Scotia, New Brunswick— are the most likely North Americans to be logged by the newcomer to the m.w. band. During the winter months broadcasters in this area are often audible from midnight (GMT) onwards and many Europeans have closed down for the night by this hour leaving clear patches for the DXer. After *Paris 2* (1070) has gone off, CBA in Sackville N.B. may be heard on the same frequency though it may not peak up till 0100. This station is owned by the Canadian Broadcasting Corporation and operates under the call "CBA Maritime". CHER (950) in Sydney N.S. is an easy one after midnight when *Radio Intercontinental* (953) is off. CBN (640) St. John's Nfld., another CBC station, is often strong at 0300 when QRM from 638 has subsided.

Other stations to look for are CJON (930) St. John's, CKCM (620) Grand Falls and CJOX (710) Grand Banks, all in Newfoundland; CBH (860), CJCH (920), CHNS (960) in Halifax N.S.; CKBW (1000) Bridgewater N.S.; CBD (1110) Saint John N.B.; CKEC (1320) New Glasgow N.S.; CKBC (1360) Bathurst N.B.

Anyone trying m.w. DXing for the first time should not be discouraged if North America is not logged at the first attempt. Fadeouts do occur on this path but they seldom last longer than a few days. When conditions are favourable the stations listed above should be audible up to 0300 when QRM from Eastern Europe starts to become troublesome.

Latin Americans are to be heard most nights after 0100 at this time of year. The following were extracted from the writer's log for the period up to 0230: SRS (725) Surinam; CX16 (850) *Radio Carve*, Montevideo; PRA3 (860) *Radio Mundial*, Rio de Janeiro; LR3 (950) *Radio Belgrano*, Buenos Aires; XEOY (1000)Mexico City; YVRS (1020) *Radio Marguarita*, Venezuela—a new station; CX28 (1090) *R. Imparcial*, Montevideo; PRE3 (1180) *R. Globo*, Rio.

Senegal (764) is easy from 2230 till midnight every evening except Saturday when Sottons is late closing down. Conackry, Guinea, (1403) is also regular except on Saturdays. *Radio Atlantico*, Tenerife (620) closes down at 0100 along with a new Portuguese station on the same channel, with *R. Atlantico* the stronger of the two. Tangiers (1233) has been heard at 0005. Further east Batra, Egypt (620) 0300 and Riadh, Saudi Arabia (647) 0110 have been strong.

Pyrgos Radio, a privately owned Greek station is back on the air again on 1434kc/s and can be heard with local music and English announcements after the close down of *R. Luxemburg* (1439). Before it ceased broadcasting in 1966, Pyrgos had a weekly request programme for DXers. At the moment it closes down at 0300 with announcements in Greek, French and English. This station QSLs, the address is Pyrgos Radio, Ilias, Western Peloponnese, Greece. *Athens 2* (1385) is on the air all night with news in French at 0130 and in English at 0200.

CHARLES MOLLOY

CORRIGENDA

DECEMBER ISSUE—MINI-3

Transistor type NKT152 is no longer generally available: type OC44 is an equivalent. Not all earpieces are suitable. We recommend type ER250 available from Henry's Radio. This miniature type has an impedance of 1,000 Ω.

P.W. GUIDE TO COMPONENTS

PART 3

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

INDUCTORS and transformers are used as energy storage and transfer devices in electronic circuits. They use magnetic fields as the storage medium, as capacitors utilise electric fields. In both inductors and transformers the primary function is to convert electrical energy into magnetic energy. The magnetic energy storage capability of an inductor is determined by its inductance, the unit for which is the Henry (H). Inductors are available having inductances of a few microhenrys (μH or 10^{-6}H) to a few hundred henrys. The circuit symbol for an inductor (L) and transformer (T) is shown in Fig. 1.

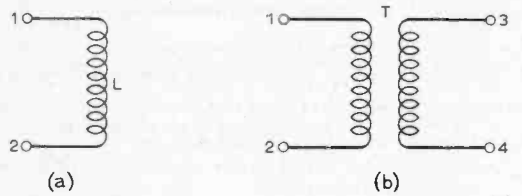
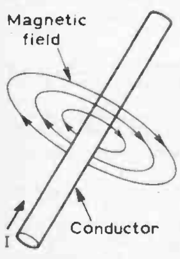


Fig. 1: Circuit symbols. (a) Inductor. (b) Transformer.

Although transformers and inductors utilise conversion of electric to magnetic energy as their principle of operation, they are used for different circuit functions. The inductor has a single winding and purely stores energy, whilst the transformer has two windings, using magnetic flux to link the two windings and convert energy from one winding into electrical energy at the second winding. The inductor, therefore, is a two terminal device, and a transformer a four terminal device.



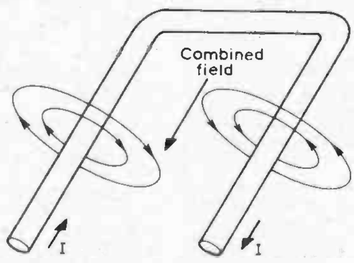


Fig. 2 (left): Magnetic field around a current carrying conductor.

Fig. 3 (right): If the conductor is wound as a coil the magnetic fields combine as shown.

Now all conductors which carry current are surrounded by magnetic fields as shown in Fig. 2. Thus all wires have the property of inductance, but in a single wire this inductance is very small ($\mu\mu$H) and is therefore insignificant in most applications. If, however, the conductor is wound in a coil as shown in Fig. 3 the magnetic fields combine together to give an increased inductance. If again the coil is surrounded by a magnetic material, then the magnetic flux immediately surrounding the coil is greatly increased, resulting in a corresponding increase in inductance. This property of magnetic material to attract the magnetic flux through the material rather than the surrounding air is called its relative permeability (μr). Steel has a relative permeability of 700. Thus to increase the inductance, inductors and transformers are wound as coils and often surrounded by magnetic material to further increase the inductance.

We have seen that to increase the inductance the conductor is wound as a coil, but herein lies the difficulty of coil design, for this increases the conductor length and thereby the resistive losses. The coil size is determined by the size of wire and number of turns. Coil design therefore is always a compromise between size and performance.

Similarly the introduction of magnetic materials introduces losses. These fall into three categories known as leakage losses, eddy current losses, and hysteresis losses. Leakage losses are caused by flux leakage away from the coil. Eddy current and hysteresis losses are due to losses of energy when the magnetic field is varied by alternating currents. The eddy current loss is due to eddy currents being set up in the magnetic material, and hysteresis losses are due to incomplete magnetic changes in the material.

By careful design the leakage losses are minimised by ensuring an efficient magnetic circuit for the magnetic flux; eddy current losses are reduced by laminating the magnetic material in a large number of thin sheets insulated from each other to deprive the eddy currents of a conducting path; hysteresis losses are minimised be selecting magnetic materials with low hysteresis losses.

The construction of a high inductance coil is shown in Fig. 4. The coil is wound on a bobbin, and the iron laminations interleaved around the bobbin. A clamp

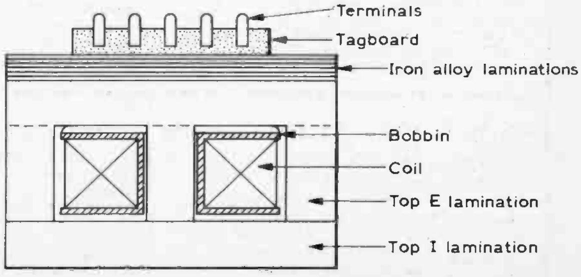
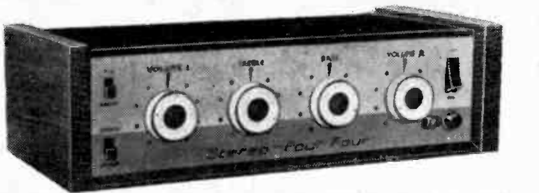


Fig. 4: Basic coil construction.

BARGAIN OPPORTUNITIES FROM TRS

TRS STEREO 4-4 a bargain in quality amplifiers



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4 prs DIN plugs and sockets if purchased separately, 15/-.
Complete kit inc. cabinet/power pack DIN plugs and socket.
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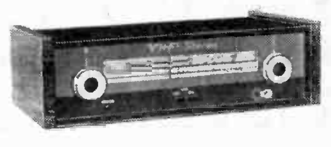
MAKE YOUR OWN BOOKSHELF SPEAKER

With a set of matched speakers and cross-over from TRS. Comprises modern style high efficiency 5in. bass unit with special cone assembly, X-over and 2½in. tweeter for mounting into your own cabinet or baffle system. Smooth response from 80 to 20,000 Hz. Loading up to 6 watts. Made by a world-famous manufacturer. A genuine bargain for only **79/6** (carr. 5/-).



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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-in Stereo Unit (p.p. 2/6)	**10 gns.**
Power Unit (p.p. 2/6)	**£2.5.0**
Simplex Cabinet (p.p. 2/6)	**£1.17.6**

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LM3000 Record Player with 9T.A. Stereo Cartridge. £10.15.0
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Brand new in makers' cartons. Packing and carriage on any one of above 7/6.
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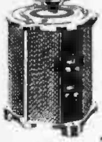

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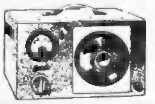

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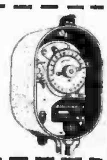

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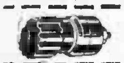

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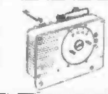

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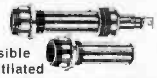

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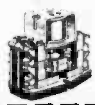

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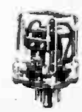

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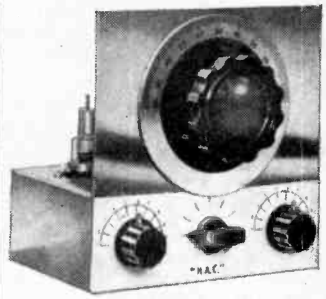

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holds the laminations in place and provides the mounting for the whole coil. The coil ends are terminated at terminals on a tag board and the whole coil is varnish or resin impregnated and potted. High quality coils are also totally screened by mumetal or metal cases.

It is now necessary to examine the exact function and action of inductors and transformers in circuits, for the multitude of varied constructions are all dependent on the circuit requirements.

An inductor is used to store and release magnetic energy but will only be effective when the current through it is changing, for when the current increases the impedance and voltage drop across the coil increase to oppose the increase in current. Hence the current through an inductance cannot change instantaneously. If the current decreases then the magnetic energy decreases and provides energy into the coil which opposes the reduction in current. A coil therefore has a high a.c. impedance whilst its d.c. resistance is low. Inductors are in consequence used as a.c. impedances in r.f. loads, smoothing circuits and tuned circuits. The reactive impedance of an inductor is given by:

$$X_L = 2\pi f L \qquad (1)$$

where X_L is the reactive component of impedance in ohms, f the frequency in c/s and L the inductance in Henrys, and π is approximately 3·14.

The impedance (Z) of a coil is given by:

$$Z = \sqrt{R^2 + X_L^2} \qquad (2)$$

where R is its d.c. resistance in ohms.

The reactance and therefore impedance increase directly with frequency. In consequence smaller inductances are required to have the same impedance effect at high frequencies. The inductance required to give h.t. smoothing at mains frequency is often 1–50H and the resulting coil is often $2 \times 3 \times 3$in. whilst at r.f. smoothing is achieved by a 100μH coil ½in. long and ¼in. in diameter.

Transformers are also useful only in a.c. circuits since their purpose is to link two electrically isolated windings together by magnetic flux. A change of flux in the circuit is initiated by the input or primary winding voltage changing. The flux links with the output or secondary winding, and because it is changing induces a voltage across the secondary winding. The flux generated by the primary voltage change is given by equation 3 and the induced voltage by equation 4:

$$\Phi = \frac{1}{N_1} \int v dt \qquad (3)$$

$$V^- = -N_2 \times \frac{d\Phi}{dt} \qquad (4)$$

where Φ is the magnetic flux, N_1 the number of primary turns, $\int v dt$ the sum of voltage change with time, V^- the induced voltage in secondary winding, N_2 the number of secondary turns and $\frac{d\Phi}{dt}$ the rate of change of flux.

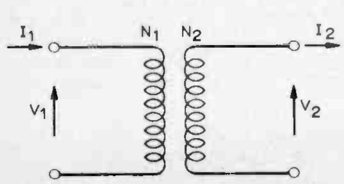

Fig. 5: Transformer action.

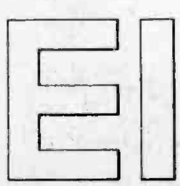
Fig. 6: Lamination outline.

Now as Φ is dependent on the number of turns of the coil it can be shown that for the transformer shown in Fig. 5

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1} \qquad (5)$$

where V is the a.c. voltage across the winding, N the number of turns, I the a.c. current in the winding. $_1$=primary circuit and $_2$=secondary circuit.

It can be seen that by winding more turns on the secondary coil an increased output voltage results, though the current reduces so that the power output cannot exceed the input power. In fact due to losses the output power is between 4 and 10% less than the input power.

The limiting factors for a given size transformer are voltage breakdown of insulation between turns on one winding and also between windings. This limits the maximum voltage output which can be achieved. Power dissipation limits both the maximum current and maximum power. Saturation of the magnetic core is also a limiting factor and this occurs when the flux increases to saturation point. At saturation the relative permeability drops rapidly to unity which results in a reduction in inductance. The impedance therefore reduces which results in an effective short-circuit across the primary. The fall in permeability with increased input voltage at saturation is utilised in the design of constant voltage transformers.

For these reasons the power is directly related to the volume of a transformer and for mains transformers the power rating can be judged by experience directly from its physical size. At this point it is worth noting that occasionally one sees efficiency circuits which purport to increase the output voltage for the same output current, thereby doubling the transformer rating. This is usually achieved by a voltage doubling circuit and dire results on the transformer may result. Examination of equation 5 shows the impracticality of these circuits in terms of transformer dissipation. It is only as a result of extremely conservative power ratings in transformer design that these circuits appear to work. Generally speaking the design will cope for between 125 and 200% of the rated power.

Let us now examine the construction, design limitations, and usages of the various types of inductor and transformer that are commonly available to the circuit designer.

Iron Cored Coils

This type of coil utilises iron or other magnetic material with high relative permeability. As the permeability is high a high inductance coil results which makes this construction particularly useful at very low frequencies.

The construction was shown in Fig. 4, and this is the general form of construction for low frequency transformers and inductors. The coils are wound of enamel coated copper wire of a gauge dependent on the current which the winding will have to carry. Wire size normally varies from 40 s.w.g. for low current windings to 16 s.w.g. for windings of several amperes. Generally the coils are wound on the plastic bobbin by coil winding machines but may be hand-wound. The finer wire gauges, which would usually have a large number of turns from several hundred to a few thousand, are difficult to hand wind and do not lend themselves to modification. The thicker gauges consist of fewer turns and can be easily rewound to give modified characteristics.

Table 1: Comparison of Mains Transformers

Type	*Power Rating (W)*	*Size*	*Volume (in^2.)*	*Weight (lb.)*	*Cost*
Low voltage Multi-turn	1	$1{\cdot}12 \times 1{\cdot}06 \times 0{\cdot}81$in.	1	0·15	15s. to £2
Low voltage Multi-turn	23	$2{\cdot}62 \times 2{\cdot}37 \times 1{\cdot}93$in.	11·5	2	5s. to £4
Low voltage Multi-turn	90	$4{\cdot}25 \times 4{\cdot}75 \times 3{\cdot}62$in.	73	7	£4 to £10
Auto transformers	150	$3{\cdot}75 \times 3{\cdot}12 \times 3{\cdot}75$in.	44	$4\frac{3}{4}$	£2 to £5
Variable auto transformers	250	3in. dia. $\times$ 2·5in.	—	—	£4 to £20

After the coil is wound the laminations are interleaved around the bobbin. Many shapes and thicknesses of laminations are used and the shape shown in Fig. 6 is typical. The E and I are alternated to give a minimum air gap in the magnetic circuit. The lamination thickness depends largely on the frequency for which the coil is required. At frequencies of 50c/s a thickness of $\frac{1}{32}$in. is not unusual, whilst at 20kc/s or higher the thickness is reduced to 2–20 thou (thousandths of an inch). The laminations are usually made of an alloy of which iron is often the predominant constituent. Many types of magnetic alloy are manufactured to give different magnetic characteristics and the type chosen for coil cores has a high saturation point and low hysteresis loss.

Quality coils are usually impregnated with lacquer or resin and enclosed in a metal casing. Transformers often have electrostatic shields between the primary and secondary winding and these are connected to the earth terminal on the terminal strip. Another form of transformer construction is the C-core type which is used in high quality transformers. The principles are the same in the construction techniques but the core construction is superior.

By far the greatest application of iron core transformers is as mains transformers and inductors. As the frequency range is low and designed for 45c/s to 65c/s the laminations are usually thick and of the order of $\frac{1}{32}$in. Inductors are commonly available from 1mH in high current circuits to 100H in high voltage circuits. The transformer primary winding is usually wound for 230V 50c/s operation, but tap adjustments are often provided. The number of turns on the primary winding is normally several hundred. The secondary windings vary considerably but for transistor power supply circuits have relatively few turns and can usually be rewound to give special requirements. The circuit of a typical mains transformer is shown in Fig. 7, the electrostatic screen (dotted) and magnetic core being indicated by the normal circuit symbol.

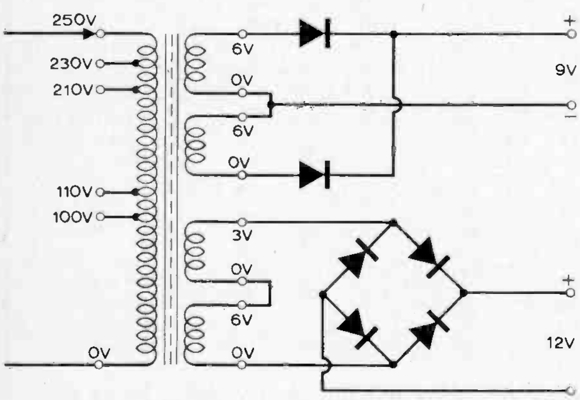

Fig. 7: Multi-turn transformer with rectifiers.

Mains transformers are usually ordered directly by input and output voltages and current only. Usually one or more output windings are available, and each is specified as to its voltage, current and power rating. Most manufacturers provide a prototype service which will provide any transformer required; however the price is necessarily high, between £12 and £30 for a 25VA type. Commonly, therefore, standard transformers are used by designers, and these are often multi-winding types which allow a variety of voltages to be built up.

Auto transformers are a modification of two winding transformers in that they operate by tapping directly across the primary winding. As a result, the power rating for a given size is considerably higher, but as the output is electrically connected to the input a number of serious limitations result. They are, therefore, mainly used for boosting or lowering mains supplies. The variable mains transformer is a continuously variable form of auto transformer.

The circuit symbol for an auto transformer is shown in Fig. 8. A comparison of size and rating for various mains transformers is given in Table 1 and from this it can clearly be seen that power is directly related to volume.

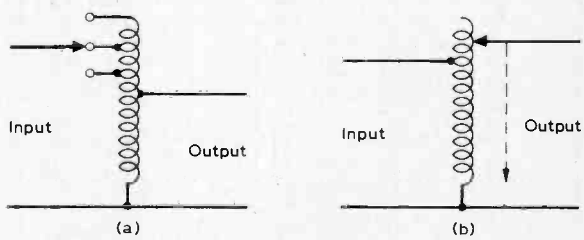

Fig. 8: Auto transformers. (a) Fixed tapped. (b) Variable.

Audio frequency transformers such as driver, output, speaker and isolating types are usually iron cored. As the frequency range over which they are required to work is 20c/s to 20kc/s the laminations are considerably thinner and are between 1 and 20 thou thick. The transformers capable of the full frequency range are fairly large, have thin laminations and thousands of turns to give high inductance.

As the power transfer in audio circuits is usually fairly low and rarely exceeds 10W audio transformers are small. The construction is similar to the mains transformer shown in Fig. 4. The cost of these transformers varies from 5s. to £3 depending on type and quality. Driver transformers are usually specified in terms of turns ratio with a centre tapped or two secondary windings. Typical size is $0{\cdot}75 \times 0{\cdot}5 \times 0{\cdot}5$in. with printed circuit mounting connections instead of terminals and screw fixing. Power rating is usually 1–100mW. Output and speaker transformers are larger than driver transformers and a typical $\frac{1}{4}$W transformer with printed circuit fixing is $1\frac{1}{4} \times 1 \times 1\frac{1}{2}$in. They are commonly specified in terms of turns ratio to match either 3Ω or 15Ω speakers, and power rating.

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6Y6G	8/-
6Y7G	12/6
7A7	12/6
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7B7	7/-
7C6	6/-
7D6	15/-
7H7	5/6
7R7	12/-
7S7	20/-
7V7	5/-
7Y4	6/6
7Z4	4/6
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PC88	9/6
PC95	8/3
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AC128	2/-
AC154	5/-
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BC115	3/-
BC116	5/-
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BF185	8/-
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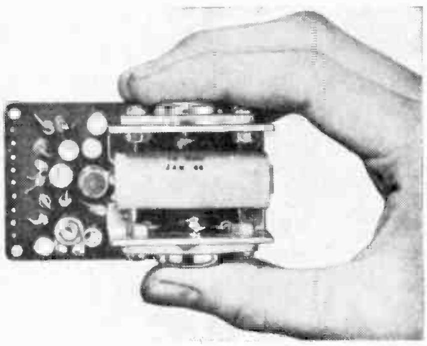

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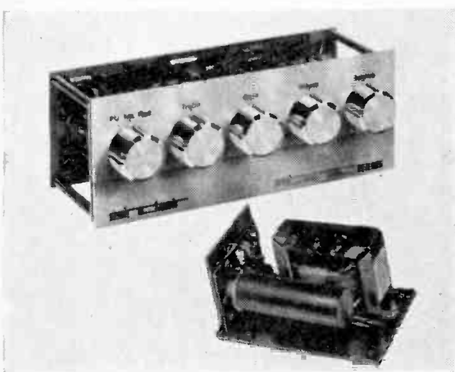
89/6



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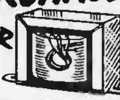

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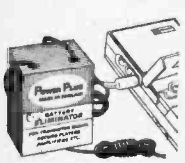

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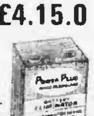

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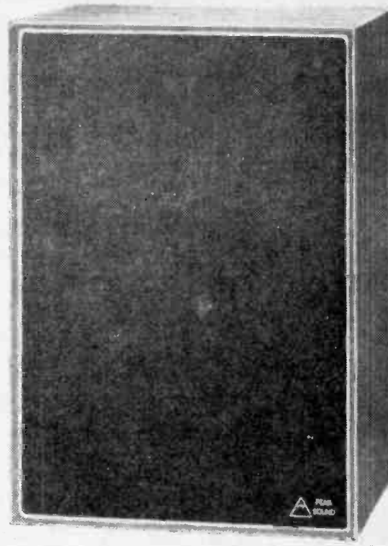

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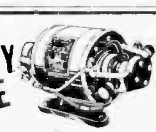

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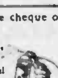

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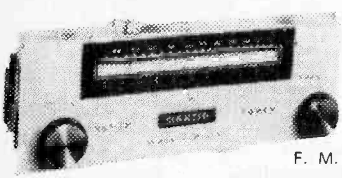
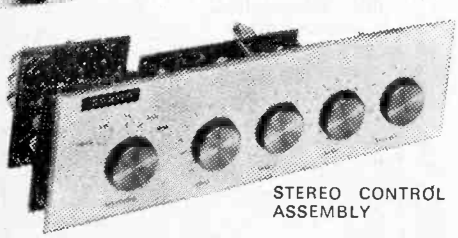


F. M. TUNER



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PW2

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