PRACTICAL WIRELESS

APRIL 1966

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★The PW Reflex-2

A 2-transistor, 4-stage Pocket Receiver

Simple step-by-step assembly instructions

★SPECIAL FEATURE ARTICLE

A DIRECT READING
FREQUENCY METER
AND REV. COUNTER

R.S.C. (MANCHESTER) LTD.

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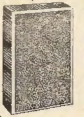
INTRODUCING A NEW RANGE OF HIGH FIDELITY LOUDSPEAKER UNITS

AUDIOTRINE PETITE
Size only 10¼ x 6¾ x 7¼in. Rating 3 watts R.M.S. Frequency range 45-20,000 c.p.s. Cabinet beautifully finished in Teak (light) or Walnut (medium). Fitted specially designed Heavy cast 5in. speaker with large pole pieces, extra long voice coil and plastic treated surround. Impedance 3 ohms or 15 ohms. Carr. 7/6. Or Deposit 27/- and 9 monthly payments of 17/10 (Total £8.7.6). **8 Gns.**

The AUDIOTRINE MINI-TEN
Size only 12¼in. High, 6¾in. Wide, 8¼in Deep. Rating 10 watts. Impedance 15 ohms. De-luxe Teak or Walnut finished cabinet acoustically lined. Heavy cast 5in. Bass speaker with extra high flux density ceramic magnet plastic treated surround and long voice coil giving low fundamental resonance. Choke/Capacity Cross-over and Tweeter. Really astounding performance. Frequency range 45-20,000 c.p.s. Or Deposit £2 and 9 monthly payments 27/9 (Total £14.9.0). **12½ Gns.** Carr. 8/6

The GLOUCESTER
Handsome "slimline" cabinet, acoustically lined. Size 24in. High, 20in. Wide, 6¼in. Deep. Finished light teak or medium walnut. 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. Or Deposit 36/- and 9 monthly payments of 24/8 (Total £12.18.0). **11 Gns.** Carr. 15/-



The BRONTE
Handsome cabinet of modern styling. Acoustically lined and finished Teak or Walnut. Size 22in. High, 15in. Wide, 7¼in. Deep. Fitted Wharfedale Super 8 RSDD Speaker, with Roll surround and dual cone. Rating 8 watts. Impedance 15 ohms. Or Deposit 39/- and 9 monthly payments 26/10 (Total £14.0.6). **12 Gns.** Carr. 15/-

The DORCHESTER
Attractive cabinet in luxurious Teak or Walnut finish. Acoustically lined. Size 24in. High, 15in. Wide, 8¼in. Deep. Incorporating specially designed 10in. Heavy cast speaker with massive 2in. pole pieces and dual cone with plastic treated surround. Frequency response 20-20,000 c.p.s. Rating 15 watts. Impedance 15 ohms. Or Deposit 48/- and 9 monthly payments 33/- (Total £17.7.3). **15 Gns.** Carr. 15/-

The STANWAY
Attractive contemporary styled cabinet finished Teak (light) or Walnut (medium). Acoustically lined. Size 24in. High. 20in. Wide, 8¼in. Deep. Fitted 12in. high flux Bass speaker with plastic treated surround giving extremely low fundamental resonance and high sensitivity. The smooth frequency response 20-20,000 c.p.s. is achieved by addition of high flux tweeter and cross-over unit. Rating 20 watts. Impedance 15 ohms. Or Deposit 3 Gns. and 12 monthly payments 32/6 (Total £22.13.0). **19½ Gns.** Carr. 17/6

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS HF1012. 10 watts rating. Where a really good quality speaker at a low price is required we highly recommend this unit with an amazing performance. Please state whether 3 or 15 ohms required. **£4.19.9**

AUDIOTRINE HF100D 10in.
15 Watt Hi-Fi Loudspeakers
Heavy cast construction. Dual cone. Plastic treated surround. Smooth frequency response 20-20,000 c.p.s. Outstanding performance Speech coil 3 or 15 ohm. **£5.15.0** Exceptional value at Carr. 5/9.

SCOOP PURCHASE OF HIGH QUALITY RECORD CHANGERS
Brand new Garrard 3000 L.M. Very latest model. Normal Retail price approx. £12.15.0. Heavy Turntable, Sonotone Low Mass Stereo/Mono cartridge. Fully guaranteed. **10 Gns.** Carr. 5/6

AUDIOTRINE HI-FI LOUDSPEAKER ENCLOSURES

All types of pleasing modern "slimline" design acoustically lined and in alternative finishes of light teak or medium walnut.

SE8 Designed for optimum performance with any Hi-Fi 8in. speaker Size 22in. high; 15in. wide; 7in. deep. Or deposit 18/- and 9 monthly payments of 12/8 (Total £6.8.3). **£5.15.0** Carr. 7/6

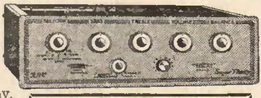
SE10 For 10in. High Fidelity Speaker with provision for tweeter. Especially recommended for use with Audiotrine HF100D speaker. Size 24in. high; 15in. wide; 7in. deep. Or deposit 31/- and 9 monthly payments 15/- (Total £7.16.0). **£6.19.9** Carr. 10/-

SE12 For outstanding performance with any 12in. Hi-Fi speaker but especially suitable for types with low fundamental resonance. A tweeter cut-out is provided. Size 24 x 20 x 7in. approx. Or deposit 27/- and 9 monthly payments. 17/10 (Total £9.7.6). Carr. 10/- **8 Gns.**

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

FULLY TRANSISTORISED 200/250v. A.C. Mains Operation.
OUTPUT 10 WATTS R.M.S. into 15 ohms.
OUTPUT 15 WATTS R.M.S. into 3-4 ohms.
Maximum Instantaneous Peak Power Output 28 watts.
PRINTED CIRCUIT CONSTRUCTION. LATEST MULLARD TRANSISTORS AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2.5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10 Kc/s.
BASS CONTROL: +12dB to —15dB at 50 c/s.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s. 0.35%. **HUM LEVEL:** —75dB.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. **10½ GNS.** Carr. 10/-
Or kit with Printed Circuit wired and tested 30/- extra or Deposit 72/- and 9 mthly pymts 22/6. (Total £13.14.6)
Attractive Walnut or Teak finished cabinet 5 Gns. or Deposit 17/- and 9 monthly payments 11/-. Total £5.16.0. Or unit factory built and tested, complete with cabinet and with our usual 12 months' guarantee. **18½ GNS.** Carr. 12/6.
Or Deposit £3.9.0 and 9 monthly payments £2. Total £21.9.0.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.
Send S.A.E. for leaflet.

WE PROUDLY INTRODUCE TWO COMPLETELY NEW UNITS WITH TECHNICAL SPECIFICATIONS COMPARING MORE THAN FAVOURABLY WITH SIMILAR AMPLIFIERS AT 2-3 TIMES THE COST.



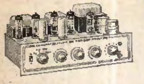
IMPORTANT NOTE. Rated output figures are given in R.M.S. and not speech and music or I.H.F.M., otherwise we could obviously quote much higher outputs.

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.
CONTROLS: 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. 12" Wide, 3" High and 8" Deep.
Attractive Fascia Plate and Matching Knobs. Neon Panel Indicator.
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 REGARDLESS OF THE COST. 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. **18 GNS.** Carr. 12/6
If required printed circuits can be supplied with appropriate components assembled, soldered and tested for £3.0.0 extra. Terms: Deposit 6 gns. & 9 mthly payments 38/6. Total £23.12.6. Attractive Walnut or Teak finished Cabinet 5 gns. or Deposit 17/- & 9 monthly payments 11/-. Total £5.16.0.
Or unit completely assembled ready for use housed in Cabinet. Or Deposit £4.12.0 and 12 monthly payments 48/-. Total £33.9.0. **29 GNS.** Carr. 15/-

R.S.C. STEREO 20/HIGH FIDELITY AMPLIFIER

PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL



SUITABLE for "MIKE", GRAM, RADIO or TAPE. Employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. Send S.A.E. for leaflet. FREQUENCY RESPONSE ±2dB. 30-20,000 c.p.s. HUM LEVEL 65dB down. SENSITIVITY: 5 millivolts maximum. HARMONIC DISTORTION (each channel) 0.2%. Output transformers are high-quality sectionally wound to required specification. Output matching for 3 and 15 ohm speakers on each channel. Complete set of parts with point-to-point wiring diagrams and instructions, or Factory assembled, tested and supplied with our usual 12 months' guarantee for 18 GNS. Carr. 12/6 Or DEPOSIT 57/- and 9 monthly payments 39/10 (Total £20.15.6).

13 Gns. Carr. 12/6

- ★ Four-position tone compensation and Input Selector switch.
- ★ Will amplify direct from Tape Heads.
- ★ Stereo/Mono switch.
- ★ Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls.
- ★ Neon Panel Indicator.
- ★ Handsome Perspex Frontplate.

R.S.C. A15 20 WATT R.M.S.

HIGH FIDELITY TRANSISTOR AMPLIFIER

With integral pre-amp tone control stages

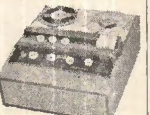
Output for 3, 7.5 and 15 ohm speakers. Kit of parts consisting of Printed Circuit and all components for same including 9 Mullard or Newmarket latest type semi-conductors. Heat sink and full wiring instructions or with printed circuit fully wired and tested £2 extra. Frequency Response ±1dB 20-20,000 c.p.s.

£6.19.9 Post 5/-

Harmonic Distortion 0.1% measured at 1000 c.p.s. Hum and Noise—80dB. Sensitivity 2mV. Bass Control +9dB to —14dB at 40 c.p.s. Treble Control +8dB to —13dB at 10 Kc/s. Suitable Power Pack Kit 39/6, Or ready built 59/6

AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.



Incorporating the latest Magnavox Tapedeck. The Audiotrine High Quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable Carrying Cabinet of latest styling and finished dark grey leathercloth with silver/chrome fittings, etc. Size 14½ x 17 x 8½in. high and circuit. Total cost if purchased individually approx. £35. Performance equal to units in the £50-£60 class. S.A.E. for leaflets. **TERMS:** Deposit 4gns. and 12 monthly payments of 42/-. (Total 28 Gns.). 4 Track Model 3 Gns. extra.

25½ Gns. Carr. 18/6

INTEREST CHARGES REFUNDED

ON H.P. ACCOUNTS SETTLED IN 6 MONTHS

LINEAR TAPE PRE-AMPLIFIER. Type LP 1. Switched Equalisation. Positions for Recording at 1⅞ in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier. suitable almost any Tape Deck. S.A.E. for leaflet. **9½ Gns.**

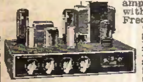
CORNER CONSOLE CABINETS

Strongly made. Beautiful polished walnut veneered finish. Pleasing design. **JUNIOR MODEL.** For up to 8in. speaker. Approx. 20 x 11 x 8in. Carr. 5/6. **49/9**

STANDARD MODEL. To take up to 10in. speaker. Size 37 x 18 x 18in. **5 Gns.** Carr. 7/6.

SENIOR MODEL. To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30 x 30 x 15in. (Recommended for use with Audiotrine speaker system.) Carr. 8/6. Terms available. **8 Gns.**

R.S.C. A10 30 WATT ULTRA LINEAR HIGH FIDELITY AMPLIFIER



A highly sensitive Push-Pull high output unit with self-contained Pre-amp./Tone Control Stages. Performance figures compare equally with most expensive amplifiers available. Hum level —70dB. Frequency response ±3dB 30-20,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All first grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Minimum input required for full output 12 millivolts so that **any kind of Microphone or Pick-up is suitable.** The unit is designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram, Radio or Tape. **Output Socket provides** 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. 50 c/s. A.C. Mains. Output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. **12 Gns.** Carr. 10/-. Supplied factory built with EL34 output valves and 12 months' guarantee for 15 Gns. If required perforated cover with carrying handles can be supplied for 21/-. Send S.A.E. for leaflet. **TERMS: Deposit 48/- and 9 monthly payments of 33/3 (Total £17.7.3).**

12in. HIGH QUALITY LOUDSPEAKERS

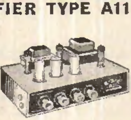
In walnut veneered cabinet. **10 WATT MODEL.** Gauss 12,000 lines. Speech coil 3 or 15 ohms. Carr. 5/6. **£4.19.6** Terms: Deposit 15/- and 9 monthly payments of 10/10 (Total £5.12.6).

20 WATT MODEL. 15 ohms. Size 18 x 18 x 10in. Terms: Deposit 24/6 and 9 monthly payments of 17/- (Total £8.17.6). Carr. 8/6. **£7.19.6**

30 WATT MODEL. 15 ohms. Carr. 10/- or Deposit 35/- and 9 monthly payments of 22/- (Total £11.13.0). **10 Gns.** Any of above in extra heavy rexine covered Cabinets, 21 extra.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP



Two input sockets with associated controls allow mixing of "mike" and gram, etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers, etc. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ±3dB 30-20,000 c/s. Six negative feedback loops. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.'s all types "mikes". Comparable with the very best designs. **For Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Output Socket** provides 300v. 30mA, and 6.3v. 1.5a for supply of a **Radio Tuner.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Kit complete to last nut. Chassis fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/6 extra). Metal covers with 2 carrying handles can be supplied for £1. **TERMS ON ASSEMBLED UNITS: Deposit 33/3** and 9 monthly payments of **24/1** (**Total £12.10.0**). Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Mikes, etc.

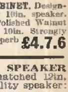
R.S.C. JUNIOR BASS REFLEX CABINET. Designed for any good quality 8in. or 10in. speaker. Acoustically lined and ported. Polished Walnut veneer finish. Size 18 x 12 x 10in. Strongly made. Handsome appearance. Superb reproduction. Carriage 5/-. **£4.7.6**

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER

A complete set of parts for the construction of a stereo amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. **8 Gns.**

Or supplied factory assembled with 12 months' guarantee for £11.7.6. **Terms:** Deposit 2 Gns. and 9 monthly payments of 24/2 (Total £12.19.6). Carr. 10/-

AUDIOTRINE HI-FI SPEAKER SYSTEMS Consisting of matched 12in. 12,000 line, 15 ohm high quality speaker: cross-over unit (consisting of choke, condenser, etc.). and Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. Carr. 5/6 **£4.19.9**



Or **Senior 20 watt,** £6.19.6. Carr. 7/6. Or Deposit 21/- and 9 monthly payments of 15/- (Total £7.16.0).

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 practically all "mikes". Separate Bass and Treble controls giving "lift" and "cut". Hum level 71dB down. Negative Feedback 15dB. H.T. of 300v. 25mA and L.T. of 6.3v. 1.5a, available for supply of Radio Tuner or Tape Deck Pre-amp. For A.C. mains 200-250v. Speaker output 3 ohms. Kit is complete in every detail with fully punched Hammer finished chassis, point-to-point wiring diagrams and instructions. Exceptional value or assembled ready for use 25/- extra, plus 3/6 carr., deposit 22/6 and 5 monthly payments of 22/6 (Total £6.15.0), for assembled unit. **£4.15.0**

TWEETERS Fane 3 ohm or 15 ohm 25/9.

R.S.C. BABY ALARM or INTERCOMM KIT. All parts with diagrams etc. In two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250v. A.C. mains. Fully isolated. Controllable at both units. A unit of this class would normally cost £20-£30. Only 89/6. carr. 5/-. Ready for use, 6 Gns.

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

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT

For lead, rhythm, bass guitar and all other musical instruments
For vocalists, gram, radio, tape and general public address

★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response. 4 Jack Inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".

★ Cabinets covered in two-tone Rexine/Vynair with gold trimming.

★ Separate Bass and Treble Controls giving 'lift' and 'cut'. Send S.A.E. for leaflet. Or call at one of our branches and compare with units at three times the cost.

49 GNS. Carr. 25/- Or deposit of £7.16.0 and 12 monthly payments of 81/6 (Total 54 gns.).

R.S.C. B20 MULTI-PURPOSE AMP. especially suitable for Bass Guitar

With Massive 15in. high flux loudspeaker. Rating 25 watts. Individual bass and treble controls. Two jack inputs separately controlled. Heavy cabinet attractively finished in Rexine/Vynair. Size approx. 24 x 21 x 11in. Send S.A.E. for leaflet. Carr. 17/6 **29½ Gns.**
Or deposit £4.14.6 and 12 monthly payments of 49/- (Total 32½ gns.).

R.S.C. G15 15 WATT AMPLIFIER for Lead or Rhythm Guitar, Mike, Gram or Radio

High-fidelity output. Separate bass and treble controls. Twin separately controlled inputs. Heavy Duty 12in. 20 watt Speaker. Cabinet covered in attractive Rexine/Vynair. Size approx. 18in. x 18in. x 8in. S.A.E. for leaflet. Carr. 12/6. **19½ Gns.**
Or Deposit 3 gns. and 12 monthly payments of 32/6 (Total £22.13.0).

JASON FMT1. VHF/FM Radio Tuner design. All parts inc. valves, tuning dial, escutcheon, etc. **£6.19.6**

TANNOY RE-ENTRANT LOUDSPEAKERS. For outdoor or factory use, 8 ohms, 8 watts. **27/6** Carr 4/6

TRANSISTORISED SOUND MIXER

Enables mixing of up to 4 standard jack inputs, i.e. mic., tape, gram, tuner, etc., into single output. Compact and completely self-contained, uses standard 9v. battery. **49/9**

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

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

MIDGET Clamped Type 2½ x 2½ x 2¼in.
250v. 60 mA, 6.3v. 2a 13/9
250-0-250v. 60mA, 6.3v. 2a 14/9

TOP SHROUDED DROP THROUGH
250-0-250v. 70mA, 6.3v. 2a, 0-5-6.3v. 2a 17/9
350-0-350v. 80mA, 6.3v. 2a, 0-5-6.3v. 2a 21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a .. 21/9
250-0-250v. 100mA, 6.3v. 3.5a, C.T. .. 19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 28/9
300-0-300v. 130mA, 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier 35/9
300-0-300v. 100mA, 6.3v 4a, 0-5-6.3v. 3a 28/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 28/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 37/9

FULLY SHROUDED UPRIGHT
250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a Midget type 2½ x 3 x 3in. 18/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9
300-0-300v. 130mA, 6.3v. 4a, C.T. 6.3v. 1a, for Mullard Amplifier 36/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 38/9
425-0-425v. 200mA, 6.3v. 4a, C.T. 5v. 3a 57/9
425-0-425v. 200mA (6.3v. 4a Twice), 5v. 3a 59/9
450-0-450v. 250mA, 6.3v. 4a, C.T. 5v. 3a 69/9

FILAMENT TRANSFORMERS
200-250v. 50 c/s primaries 6.3v. 1.5a, 6/6; 6.3v. 2a, 7/6; 12v. 1a, 7/11; 6.3v. 3a, 8/11; 6.3v. 6a, 17/6; 12v. 1.5a twice, 17/6.

OUTPUT TRANSFORMERS
Standard Pentode 5,000 Ω to 3 Ω .. 6/6
Standard Pentode 7,000 Ω to 3 Ω .. 6/6
Push-Pull 8 watts, EL84, or 6V6 to 3 Ω or matched to 15 Ω 9/9
Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 to 15 Ω 19/9
Following types for 3 and 15 Ω speakers:
Push-Pull 10-12 watts, 6V6 or EL84 .. 18/9
Push-Pull 15-18 watts, 6L6, KT66 .. 22/9
Push-Pull Mullard 510 Ultra Linear .. 29/9
Push-Pull 20 watts, sectionally wound 6L, KT66, EL34, etc 49/9

SMOOTHING CHOKES
60mA, 10H 400 Ω 4/11. 100 mA, 10H, 220 Ω 8/9
80mA, 10H 350 Ω 5/9. 150mA, 10H, 250 Ω 11/9

CHARGER TRANSFORMERS
All with 200-240-250 v. 50 c/s Primaries: 0-9-15v. 1½a, 12/9; 0-9-15v. 2a, 14/9; 0-9-15v. 3a, 16/9; 0-9-15v. 5a, 19/9; 0-9-15v. 6a, 23/9; 0-9-15v. 8a, 28/9.

AUTO (Step up/Step down) TRANS.
0-110/120-230/250v. 50-80 watts, 13/9; 150 watts, 27/9; 250 watts, 49/9; 500 watts, 99/9.

R.S.C. BATTERY CHARGING EQUIPMENT

Guaranteed 12 months

All for A.C. Mains 200-250 v. 50 c/s

Assembled 4 amps 6/12v. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12v. charging. Louvred steel case with stoved grey hammer finish. Fused and ready for use with mains and output leads and clips. **59/9**
Or Deposit 12/- and 5 monthly payments of 12/- Total £3.12.0. Carr. 4/6

Heavy Duty Charger Kit
6/12v. 6 amps., variable output. Consists of Main Transformer 0-200-230-250v.; FW (Bridge) Selenium Rectifier; Ammeter, Variable Charge Rate Selector Panels, Plugs, Fuses, Fuseholder and Circuit. Carr.5/6. **59/9**

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders, Grommets, panels, Heavy Duty Clips, circuit. Carr. 3/6
6v. or 12v. 1 amp. .. 22/9
As above with ammeter 28/9
6v. or 12v. 2 amps .. 25/9
6v. or 12v. 2 amps, inclusive of ammeter .. 35/9
6v. or 12v. 4 amps with Ammeter and variable charge rate selector .. 52/9

CHARGER AMMETERS 0-1.5a., 0-4a., 0-7a., 8/9 each.

EX GOVT. SELENIUM RECTIFIERS 12v. 15 AMP (BRIDGE) F.W. ONLY 19/9

R.S.C. GRAM AMPLIFIER KIT. 3 watts, output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis, Circuit, etc., supplied. Only 39/9. Carr. 3/9.

R.S.C. 4 WATT GRAM. AMPLIFIER KIT. Complete set of parts to build a good quality compact unit suitable for use with any record playing unit. Mains isolated chassis, separate Bass and Treble controls. Output for 2-3 ohm speaker. For 200-250v. A.C. **59/9**

HI-FI 12 WATT AMPLIFIERS

BRAND NEW EX-GUITAR AMPLIFIERS Carr. 7/6 **£7.19.9**

Manufacturers' discontinued Model. Push-pull output. Latest high efficiency valves. Dual separately controlled inputs for 'Mike' and gram. Separate Bass and Treble Controls. High Sensitivity. Output for 3 or 15 ohms speaker. Guaranteed tested and in perfect working order.

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Mullard OC71 2/11. OC45 3/11, OC44 3/11, OC72 2/11, OC81 2/11, OC171 8/9, AF117 6/9. Ediswan XA101 3/9, XA112 3/9, XC101A 3/9. Postage 6d. for up to 3 transistors.

INTEREST CHARGES REFUNDED ON H.P. ACCOUNTS SETTLED IN 6 MONTHS

R.S.C. (MANCHESTER) LTD.

Addresses Page 1010

R.S.C. COLUMN SPEAKERS

Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. Normally supplied for 15 ohm matching but can be supplied for 100v. line for 35/- extra.

Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42x10x5in. **12½ Gns.** Carr. 10/- Or deposit £2 and 9 monthly payments of 27/9 (Total £14.9.9).

Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **19½ Gns.** Or deposit 3 gns. and 9 mthly. pymts. 43/2 (Total 21¼ gns).

30 WATT HI-FI AMPLIFIER

For ELECTRONIC ORGAN, GUITAR, VOCAL or INSTRUMENTAL GROUPS

A Four Input, two volume control Hi-Fi unit with separate Bass and Treble 'cut' and 'boost' controls. Latest type valves. Strong Rexine covered cabinet. Attractive Black/Gold fascia plate. For 200-250v. A.C. mains. Output for 3 or 15 ohm speakers. Send S.A.E. for leaflet. Carr. 12/6 **17 Gns.** or Deposit £3 and 9 mthly. payments of 37/- (Total £19.13.0).

18in. 60 WATT EXTRA HEAVY DUTY LOUDSPEAKERS

Famous make. Normal price over £25. Very limited number to clear fully guaranteed. Terms available. Carr. 15/- **17 Gns.**

LINEAR TREMOLO PRE-AMP UNIT

Suitable for use with any of our Amplifiers Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume and Switch. **4 Gns.**

SELENIUM RECTIFIERS F.W. (BRIDGED)

6/12v. 1a, 3/11; 6/12v. 3a, 9/9; 6/12v. 6a, 15/3; 6/12v. 2a, 6/11; 6/12v. 4a, 12/3; 6/12v. 10a, 26/9

COMPLETE POWER PACK KIT

Consisting of Mains Trans. Metal Rectifier. Electrolytics, smoothing choke, chassis and circuit. 200-250v. A.C. mains. Output 250v. 60 mA. 6.3v. 2a. Or with case in lieu of chassis 25/-. **19/11**

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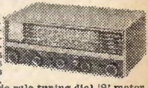
Type BM1. Battery eliminator. Size 5¼ x 4¼ x 2in. approx. Completely replaces batteries supplying 1.4v. and 90v. where A.C. mains 200-250v. 50 c/s is available. Complete kit with diagram 39/9 or ready for use 49/9.

COMMUNICATION RECEIVERS

RX 60 DE LUXE 4 BAND



220/240v. 50/60 c.p.s. A.C. mains operation. Frequencies covered. 535 Kc/s to 30 Mc/s continuous Integral PM. Speaker. Slide rule tuning dial 'S' meter. Phone Jack. Powerful built-in antenna for long range reception. Stand-by switch with terminal for transmitter. Other features are bandspread tuning. Noise limiter A.V.C., B.F.O. Size approx. 13¾ x 5½ x 8¾in. Handsome metal cabinet with chrome fittings. Brand new with full instructions. Usual guarantee. Or deposit £5 and 9 monthly pymts. 37/8 (Total £21.19.0). **19 Gns.** Carr. 10/-

MODELS FOR HOME, TEST AND WORKSHOP.
BRITISH HEATHKIT MODELS USE BRITISH COMPONENTS

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HI-FI AMPLIFIERS

DE-LUXE ALL TRANSISTOR STEREO AMPLIFIER AA-22U.
A quality British transistor amplifier with high power (20 + 20W) at a reasonable cost, capable of delivering full power at all frequencies in the audio band. Handsome fully finished walnut veneered cabinet available. Professional slim-line styling. Send for full specification. **Kit** (less cabinet) **£39.10.0** Cabinet **£2.5.0.** Accessories for panel mounting **£1.18.0.**

6W DE-LUXE STEREO AMPLIFIER. Model S-33H. An inexpensive stereo amplifier with high sensitivity. Suitable for use with Decca Deram cartridge. £21.7.6 Assembled **£15.17.6** Kit

TAPE RECORD/REPLAY AMPLIFIER KITS. Will operate with most tape decks. Send for details.
TA-IM (Mono), 19.18.0 Kit. **TA-IS** (Stereo), **£25.10.0** Kit.

STEREO CONTROL UNIT. Model USC-1. Ideal for use with MA-12 amplifiers. Kit **£19.10.0.** Assembled **£26.10.0.**

S-33

6W STEREO AMPLIFIER Model S-33. 3 w/ch. Inputs for radio, tape and gram. Stereo/Mono ganged controls. Sensitivity 200mV. **£18.18.0** Assembled **£13.7.6** Kit

TRANSISTOR MIXER, Model TM-1. A must for the Tape enthusiast. 4 channels, Battery driven. £16.17.6 Assembled **£11.16.6** Kit

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HI-FI MONO POWER AMPLIFIER. Model MA-12. Ideal for use with Models USC-1 and UMC-1, 0.1 THD at 10W. Wide frequency range. £15.18.0 Assembled **£11.18.0** Kit

18W STEREO AMPLIFIER. Model S-99. Ganged controls. Stereo/Mono gram. radio and tape record inputs. P/B selection. **£38.9.6** Assembled **£28.9.6** Kit

S-99

A range of R/players, T/Decks available.

Send for full spec. of any model

Prices quoted are Mail Order and include free delivery in UK.

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"OXFORD" LUXURY TRANSISTOR DUAL WAVEBAND RECEIVER. The ideal domestic or personal portable receiver. 10 Semi-conductors. Solid leather case. Send for full details. Incl. P.T. **£14.18.0** Kit

6 TRANSISTOR PORTABLE. Model UXR-1. Prealigned I.F. transformers. Printed circuit, 7in. x 4in. high flux speaker. Real hide case. Very easy to build. Incl. P.T. **£12.11.0** Kit

"MOHICAN" GENERAL COVERAGE RECEIVER. Model GC-1U. Excellent portable or general purpose receiver for "amateur" or short wave listening. See full spec. leaflets. Assembled £45.17.6 **£37.17.6** Kit

GC-IU

PA/GUITAR AMPLIFIERS

Model PA-1 (similar to PA-2 illustration) 50 watt output. Two 12" L.S. Variable tremolo, 4 inputs. Assembled £74 **£54.15.0** Kit legs or castors available (extras).

Model PA-2 (illustrated). **Starmaker 33.** All transistor 20 watt output, two 12" L.S. Variable tremolo, 4 inputs. Compact size. Assembled £59.10.0 **£44.19.0** Kit

PA-2

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50 watt Power Amp. MA-50 Assembled £27.18.0 **£19.18.0** Kit

HI-FI TUNERS

Model FM-4U. Tuning range 88-108 Mc/s. Tuning unit (FMT-4U) with 10.7 Mc/s. I.F. (£2.15.0 incl. P.T.). I.F. Amp. (FMA-4U) complete with cabinet and valves (£13.13.0). Total **£16.8.0** Kit

FM-4U

Assembly can be arranged.

AM/FM TUNER. Covers FM 88-108 Mc/s. A.M. 16-50, 200-550, 900-2,000 m. Tuning heart (£4.13.6 incl. P.T.), and I.F. Amp. (£22.11.6). Total **£27.5.0** Kit
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A large range, in kit form or assembled and finished, available to meet most needs. Illustrated details on request.
Prices from **£8.8.0** to **£46.4.0**

SPEAKERS FOR YOUR OWN ENCLOSURE
12" Heavy-duty Bass (Fane 122/12) **£7.7.0.**
2" Tweeter (Fane 301) **£3.1.6.**
(both as used in the Cotswold systems).
8" Goodman's General Purpose G8 **£1.8.6.**
Two Speakers + Cross-over, System SCM-1.
(As used in model SSU-1) with details for enclosure **£5.5.0.**

ELECTRONIC WORKSHOP KIT. Model EW-1. An outstanding experimental kit for children. **£7.13.6** incl. P.T.

A WIDE RANGE OF BOOKS ON ELECTRONICS AND RADIO. PLEASE SEND FOR LISTS AND PRICES.

American Heath Catalogue, price lists in £ s. d. and details of direct delivery scheme sent for 1/- p. paid.

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We have opened a showroom and retail stores at 233 Tottenham Court Road.
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Please send me FREE BRITISH CATALOGUE (Yes/No) Full details of model(s). Amateur Brochure (Yes/No), American Catalogue 1/- (Yes/No), Instrument Brochure (Yes/No)

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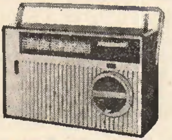
LASKY'S RADIO Offer the Finest Value and HOME CONSTRUCTORS

We consider our construction parcels to be the finest value on the home constructor market. If on receipt you feel not competent to build the set, you may return it as received within 7 days when the sum paid will be refunded less postage.

THE "SKYROVER" RANGE

GENERAL SPECIFICATION

7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. The SKYROVER and SKYROVER DE LUXE cover the full Medium Waveband and Short Waveband 31-94 M and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow stage by stage instructions.



A simple additional circuit provides coverage of the 1100/1950M. band (including 1500 M. Light programme). All components and detailed construction data.
Only 10/- extra Post Free
This conversion is suitable for both models that have already been constructed.

Data for Receiver 2/6 extra, Refunded if you purchase the parcel. Four U2 batteries, 3/4. extra. *All components available separately.*

NEW—The SKYROVER Mk 111

Now supplied with redesigned cabinet, edgewise controls, black and chrome plastic cabinet.
Size 10 x 6½ x 3¾in. with carrying handle.
Can now be built for £8.19.6 Post 5/-
H.P. Terms: 27/- dep. and 11 months at 15/9. Total H.P. Price £10.0.3.

NEW—The SKYROVER DE LUXE

Tone Control Circuit is incorporated with separate Control. In a wood cabinet, size 11½ x 6½ x 3in., covered with a washable material with plastic trim and carrying handle. Car aerial socket fitted.
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The "REALISTIC" Seven

★ 7-Transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board. ★ Full medium and long wave cover. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3½in., Blue/Grey or all Grey. ★ Socket for car aerial. ★ I.F. frequency 470 Kc/s. ★ Ferrite rod internal aerial. Operates from PP9 or similar battery. ★ Full data supplied. All coils and I.F.'s etc. fully wound ready for immediate assembly. An outstanding receiver.

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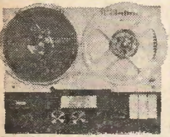
Post 4/6.
PP9 Batt. 3/9. Data and Instructions separately 2/6. Refunded if you purchase the parcel. All parts sold separately.

REALISTIC Seven DE LUXE

With the same specifications as standard model—PLUS a superior wood cabinet in contemporary styling with full vision circular dial. ONLY **£1** EXTRA



The Very Latest MAGNAVOX-COLLARO 363 TAPE DECKS

3 speed model—1⅞, 3¾, 7½ i.p.s., available with either ½ track or ¼ track heads. Features include: pause control; digital counter; fast forward and rewind; new 4 pole fully screened induction motor; interlocking keys. Size of top plate 13¼ x 11 x 5½in. deep below unit plate. For 200/250v. A.C. mains, 50 c.p.s. operation. New, unused and fully guaranteed.

LASKY'S PRICE with ½ track heads **£10.10.0**
LASKY'S PRICE with ¼ track heads **£13.9.6**
Carriage and packing 7/6 extra

SPECIAL for OVERSEAS CUSTOMERS—the new Magnavox-Collaro 363 Deck for 110/125v. 50 or 60 c.p.s. mains now available, prices as above. Post to any part of the World, 35/-

INTERNATIONAL TAPE

Famous American Brand—Fully Guaranteed

		s.	d.
3in.	Message tape, 150ft.	3	6
3in.	Message tape, 225ft.	4	11
3in.	Message tape, 300ft.	7	6
3¼in.	Triple play, 600ft., Mylar base	15	0
4in.	Tripleplay, 900ft., Mylar base	17	6
5in.	Double play, 1,200ft., Mylar base	16	0
5in.	Long play, 900ft., Acetate base	10	0
5in.	Standard play, 600ft., PVC base	8	6
5in.	Triple play, 1,800ft., Mylar base	35	0
5¾in.	Double play, 1,800ft., Mylar base	22	6
5¾in.	Long play, 1,200ft. Acetatebase	12	6
5¾in.	Standard play, 850ft., PVC base	11	6
5¾in.	Long play, 1,200ft., Mylar base	15	0
5¾in.	Triple play, 2,400ft., Mylar base	45	0
7in.	Standard play, 1,200ft., Acetate base	10	0
7in.	Standard play, 1,200ft. Mylar base	12	6
7in.	Long play, 1,800ft., Mylar base	19	6
7in.	Double play, 2,400ft., Mylar base	26	0
7in.	Long play, 1,800ft., Acetate base	15	0
7in.	Triple play, 3,600ft., Mylar base	68	0

P. & P. 1/- extra per reel, 4 reels and over Post Free.

SPECIAL PURCHASE! 7 TRANSISTOR RADIO CHASSIS

Superhet chassis, fully built—by famous British manufacturer—on printed circuit. Uses 7 Newmarket transistors giving 500 m/w push-pull output—3 I.F. stages; ferrite rod aerial. Covers full, long and medium wavebands—200/550M and 1200/2000M and switched band spread on 208M (Luxembourg). 4½in. speaker; fitted; volume control on/off switch, tuning dial and position for car aerial socket. Uses any 9V battery. Overall dimensions—7in. x 4½in. x 2in. Absolutely complete except for cabinets.

LASKY'S PRICE 69/6 Post 5/-. Recommended battery PP6, 2/9 or PP7, 3/3 extra.

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GET 81, GET 85, GET 86, 2/6; 873A, 874P, 3/6; OC45, OC71, OC81D, 4/6; OC44, OC70, OC76, OC81 (match pair 10/6), 5/6; AF117, OC75, OC200, 6/6; OC42, OC43, OC73, OC82D, 7/6. OC201, OC204, 15/-; OC205, OC206, 19/6; OC28 24/6.

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7/6 EACH Post 6d.

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We stock the complete range of Sinclair Super-miniature Kits.

THE MICRO-6 pocket radio............59/6
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THE MICRO-FM tuner/receiver ... £5.19.6
THE X-20 Amplifier............£7.19.6
Ready built and tested £9.19.6
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See our Practical Wireless November '65 advertisement for details.

B.S.R. AUTOCHANGERS—BRAND NEW AT LOWEST EVER PRICES

Brand new and fully guaranteed—complete with cartridge and stylus.

UA14 4 speed mains model £4. 9.6
UA16 4 speed mains model............£4.19.6
UA16 9v. battery model............£5.19.6
UA20 4 speed mains model............£5.19.6
Add 5/- carriage and packing on each.

U.H.F. TUNERS

Only a few available. Complete with PC86 and PC88 valves. We regret no circuit or data is available. Knobs included.

LASKY'S PRICE 59/6 Post 2/6.

GARRARD AUTOCHANGERS

	£	s.	d.
Auto-Slim Mono	£4	19	6
AT6 Mono	£8	19	6
AT6 Stereo	£9	9	0
3000LM with stereo cartridge	£8	8	0
SP25 Mono	£8	19	6
SP25 Stereo	£10	19	6
AT60 less cartridge	£10	19	6
A70 less cartridge	£19	19	0
A30 less cartridge	£9	14	6
A1000 with GC8 cartridge	£6	6	0
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Postage on all above 5/-

GORLER UT 340 FM/VHF TUNING HEART

Permeability tunes—covering 87 to 108 Mc/s. For use with one ECC85 valve. In metal case, size 3 x 2¼ x 1¼ in. Circuit supplied.

LASKY'S PRICE 15/11
ECC85 valve 9/- extra. Post 2/-.

SPECIAL OFFER: GARRARD AT5 AUTOCHANGERS

4-speed mains model—brand new and fully guaranteed

LASKY'S PRICE With mono crystal cartridge **£5.19.6** With stereo cartridge **£6.9.6** Post 5/-

LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

SURBITON PARK RADIO

MARTIN AUDIOKITS & RECORDAKITS

F.M. TUNER UNITS Nos. 15, 16 and 17 .... Cash £12.17.6
Or Dep. 51/6 and 12 m. pymts. of 18/10 .... (H.P. Price £13.17.6)
TRANSISTORISED AMPLIFIER with 5 position input selector, pre-amp and controls, 10 watt amplifier and Power Pack
For 3 Ohm Speaker ...... Cash £14.5.0
Or Dep. 57/- and 12 m. pymts. 20/10 .... (H.P. Price £15.7.0)
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All above include Front Panels, Knobs and Instructions.
TWO TRACK RECORDAKIT AMP. (Valve) **FOR STUDIO DECK,** 6 valves, controls, self powered .... Cash £11.11.0
Or Dep. 47/- and 8 m. pymts. 25/6 .... (H.P. Price £12.11.0)
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TAPE PRE-AMP for Studio Deck, self powered.
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Or Dep. 34/- and 6 m. pymts. 25/8 .... (H.P. Price £9.9.0)
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Or Dep. 39/- and 6 m. pymts. 28/4 .... (H.P. Price £10.9.0)
All the above amplifiers are for the STUDIO deck which is no longer available. The Martin Recordakits will be modified for the new Magnavox deck in due course. Details will be forwarded to enquirers when to hand.
We are leading stockists for all Martin Constructional Kits.

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ARMSTRONG 221 10-10 watts Stereo, Mag PU and Filter
Cash £33.15.0
Or Dep. 135/- and 8 m. pymts. 49/6 .... (H.P. Price £36.9.0)
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ARMSTRONG 223 AM/FM TUNER Powered ...... Cash £28.15.0
Or Dep. 115/- and 12 m. pymts. 42/2 .... (H.P. Price £31.1.0)
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Or Dep. 106/- and 12 m. pymts. 38/10 .... (H.P. Price £28.12.0)
ARMSTRONG 127 STEREO as above Stereo amp .... Cash £37.10.0
Or Dep. 150/- and 12 m. pymts. 55/- .... (H.P. Price £40.10.0)
ARMSTRONG 227 MONO 10W amp. with AM/FM .... Cash £36.15.0
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ARMSTRONG 227 STEREO as above with Stereo Amp.
Cash £52.15.0
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ROGERS CADET Mk. 3 10-10 watt Stereo Amp. Mag. P.U.
Cash £29.10.0
Or Dep. 118/- and 12 m. pymts. 43/3 .... (H.P. Price £31.17.0)
CASE MODEL ROGERS CADET Mk. 3 .... £3.0.0 extra
LEAK STEREO 30 TRANSISTOR AMPLIFIER .. Cash £49.10.0
Or Dep. 198/- and 12 m. pymts. 72/7 .... (H.P. Price £53.9.1)

LOUDSPEAKERS Selection

FANE 122/10 Heavy Duty 12in. 20 watt .... Cash £5.17.6
WHARFEDALE SUPER 8/RS/DD .... Cash £7.0.0
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Or Dep. 47/6 and 8 m. pymts. 25/9 .... (H.P. Price £12.13.6)
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Or Dep. 34/- and 6 m. pymts. 26/- .... (H.P. Price £9.10.0)
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GARRARD LAB80 Push button oper., less cart. ... Cash £27.10.0
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GOLDRING G66 Mono Single Player .... Cash £11.11.0
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GOLDRING GL68 Less cart. Pickup lift .... Cash £19.10.6
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TERMS: C.W.O. or C.O.D. **ALL ITEMS CARRIAGE FREE**

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The series will be of exceptional value in training mechanics and technicians in electricity, Radio and Electronics.

WHAT THIS MONTH'S ENTHUSIASTIC READERS SAY

EVERY DAY WE RECEIVE LETTERS PRAISING THESE BOOKS, HERE ARE A FEW FROM THIS MONTH'S POSTBAG.

" *... I cannot tell you how delighted I am with them ...*" G.N., B.F.P.O. 64.

" *... I have been supplied with BASIC ELECTRICITY and BASIC ELECTRONICS, and needless to say I am delighted with them, and wish to congratulate you for publishing one of the best ever series dealing with this complex subject ...*" P.B., Worthing.

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Please send me **Without Obligation to Purchase,** Basic Electricity/Basic Electronics on **7 Days Free Trial.** I will either return set, carriage paid, in good condition within 8 days or send down payment of 15/- (Basic Electricity) followed by 6 fortnightly payments of 10/-. Down payment of 15/- (Basic Electronics) followed by 6 fortnightly payments of 12/6. Alternatively, I will send 68/- (Basic Electricity—5 parts), 81/- (Basic Electronics—6 parts) post free. This offer applies to United Kingdom only.
Tick against set required (*only one set allowed on free trial*).

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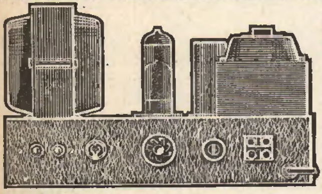
STERN-CLYNE ELECTRONIC CENTRES

HI-FI AND TAPE EQUIPMENT • RADIO • KITS • ELECTRONIC COMPONENTS

*Designs by MULLARD- Interpreted by STERN

Justly famous—superb Hi-Fi designs from the Mullard Applications Research Laboratory, meticulously executed by Stern and Veritone. Buy them as hand-built and tested units, or in Stern-Clyne's famous Homebuild Kit form. Either way provides performance per £ unequalled anywhere. If you are working to a budget, kits offer a real saving plus real building satisfaction. Each is absolutely complete and backed by comprehensive, easy-to-follow building instructions.

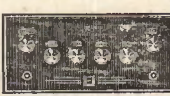


FIVE-TEN AMPLIFIER

One of the most famous amplifiers ever made—thousands are in service as the nucleus of high quality installations throughout the world. Check the phenomenal performance, unmatched by any other amplifier obtainable in this price range: Freq. response 5 c/s. to 30 kc/s. flat ± 1 db. Distortion 0.1% at full 10 watts output. Noise—85 db. below 10 watts. Input signal 40 mV. for 10 watts. Out. Imp. 3 or 15 ohms. Valves EZ81, EF86, ECC83, 2 x EL84. Size overall: 10 x 7 x 6½in. high. Incorporates mains outlet for gram and aux. supply of 250 v. at 45 mA. and 6.3 v. at 2½ amps. for pre-amp. tuner, etc. To full Mullard specification. Assembled and tested £13.10.0 Kit £10. *Carr. 8/6.* FIVE-TEN AMPLIFIER AND TWO-VALVE PRE-AMP. Assembled and tested £21.10.0. Kit 15 gns. *Add 8/6 carriage.* FIVE-TEN AMPLIFIER AND THREE-VALVE PRE-AMPLIFIER. Assembled and tested £25.10.0. Kit £19.10.0. *Add 8/6 carriage.*

TWO-VALVE PRE-AMPLIFIER

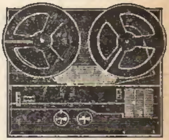
Specially designed for use with the Mullard series of 3, 10 and 20 watt amplifiers but entirely suitable for all Hi-Fi power units not requiring input of more than 250 mV for full output. Features include inputs for crystal and variable reluctance pick-ups with RIAA equalization, plus radio, sensitive microphone, and tape replay direct or from pre-amp. Controls include 6-position selector, volume and wide range bass and treble boost. Valves 2 x EF86, size 9¼ x 4½ x 2¾ in. high. Panel 10½ x 2¾ in. Requires 300 v. at 3 mA. and 6.3 v. at 0.6 amps. Assembled and tested £9.10.0. Kit £6.6.0. *Add 6/- carriage.*



THREE-VALVE PRE-AMPLIFIER

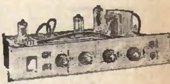
Specially recommended for use with the 5-10 amplifier, but also suitable for use with all Mullard series mono amplifiers and any high quality unit requiring an input of up to 250 mV. for full output. Features include: wide range Bass and Treble controls, high and low pass filters, auxiliary input and record output sockets, switched inputs for crystal or magnetic pick-ups, radio, tape playback and auxiliary. Power required 250 v. at 6 mA, and 6.3 v. at 1 amp. Valves 2 x EF86 and ECC83. Size 11 x 4½ x 4in. high. Panel 12 x 4¼in. Assembled and tested £13.13.0. Kit £10.10.0. *Add 5/- carriage.*

MAGNAVOX 363 TAPE TRANSPORTER



Manufactured to precise limits that permit recording and tape playback to the highest standards set by the Music Industry. Simple reliable design employs a single high-duty motor with heavy flywheel. Features include fast wind on and rapid rewind, pause control, 3-speed selection with interlock, built-in revolution indicator, piano key controls. Speeds 1⅞, 3¾ and 7½ i.p.s. Wow and flutter 0.15% on 7½ i.p.s.Max. spool size 7in. Playing time up to 120 min. per track from 1,200ft. standard tape. Size 13¾ x 11in. plus 5¾in. below mounting board. With ½ track heads, £10.10.0. With ¼ track heads. £8.10.6 *Add 10/- carriage and insurance.*

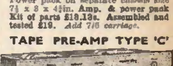
HF/TR3 TAPE AMPLIFIER



Easily the best complete tape amplifier available to the home builder. Supplied already matched for the Magnavox 363 tapedeck.

Features include: switched equalization for all speeds (CCIR standards at 7½ i.p.s.) Treble boost incorporated during Record. Bass boost during playback. speaker output matched for 3,7.5, and 15 ohms, additional outputs for extension speaker, phone monitoring on Record and Hi-Fi playback through existing systems, inputs for Mic. Pick-up, and VHF Radio. Valves: EF86, ECC83, EL84, EM81, EZ81. Size overall: 11 x 6 x 6in. (Panel 13⅞ x 3in.). Power pack on separate chassis size 7½ x 3 x 4½in. Amp. & power pack Kit of parts £18.13s. Assembled and tested £19. *Add 7/6 carriage.*

TAPE PRE-AMP TYPE 'C'

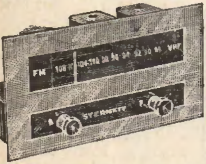


Specially developed by Mullard Laboratories for use with high quality replay systems, and supplied specifically matched for use with the Magnavox 363 tapedeck. Features include: ferroxcube pot core inductors for treble equalisation, push pull oscillator incorporating ferroxcube transformer, adjustable output for matching to existing high-quality amplifier systems, inputs for Mic., Pick-up, Radio, etc. Valves: 3 x EF86, EC92 and EM81. Totally enclosed in case size 11½ x 6¾ x 3¾in. high. (Panel 11¾ x 3¾ in.) Power supply of 300 vdc at 25 mA. and 6.3 v. at 1.5 A. is on separate sub-chassis size 6¼ x 4¼ x 4¾in. high to facilitate remote location from tape heads. Pre-amp and power pack Kit of parts £14. Assembled and tested £18. 10s. *Add 7/6 carriage.*

NEW PORTABLE TAPE RECORDER

Exceptionally low-priced, but actually a robustly made reliable instrument which can be used anywhere for note taking, idea recording, dictation, etc. Mechanism solidly built on to rigid steel chassis and housed in tough grey plastic case with carrying strap and clear plastic tape deck cover. Fitted with single multi-selector function switch and volume control. Hand microphone has Stop/Start thumbswitch for remote control of record and playback transcription. Complete with tape and spare spool, mike and miniature earpiece. Size only: 8 x 7¼ x 2¾in. high. £8.19.6. *Carriage 4/6.*

SUPERB NEW STERN-CLYNE FMI V.H.F. TUNER



Specially designed for the Amateur builder, a new, sensitive tuner unit that provides stable, interference-free reception of BBC FM transmissions. High quality output signal ensures optimum performance from any Hi-Fi audio system: superb styling makes for harmonious installation with existing equipment. Reliable easily aligned circuit employs RF stage, tuned-anode tuned-grid freq. changer, 2 IF's, noise limiter and ratio detector. Valves are 4 x EF91 plus 2 diodes. Input sens. 100mV for 40dB. Dist. less than 1% at full deviation. Power reqd. 200v. at 30mA and 6.3v. at 1.8A. Panel black and silver-grey, size 8 x 5in. Chassis: cadmium plated, overall depth 4½in. FM1 Kit of parts with Instruction Handbook, £7.9.6. *Carriage 4/-.* FM1 Assembled and tested, £10.9.6. *Carriage 4/-.* Optional Power Pack Type D, Kit of parts, £2.15.0. *Carriage 3/6.* Power Pack Type D, Assembled and tested, £3.10.0, *Carriage 3/6.* Handbook only, 3/- post free. Descriptive leaflet on request.

TEST 7 Pocket Multimeter 39/6

Carriage 2/-

A really versatile instrument that makes a handy, pocket size tool. Measures AC or DC voltage in three ranges of 0-15-150-1000 v. Resistance 0-100,000 ohms, and Current 0-150 mA. D.C. Size only: 3¾ x 2½ x 1¼in., with ingenious dial design, providing a clear, easily read scale. Complete with battery and test leads.

26½gn TAPE RECORDER for ONLY £19.10.

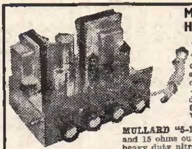
carr. 12/6

Bargain of the Year Offer —cancelled Export Contract

Famous manufacturers brand new unused and factory tested 2 speed, 3¾ and 7½ i.p.s. twin track tape recorder 3 Watt output. Tape position Rev.-counter, fast forward and rewind, take 7" reels, mike and gram input. Straight through amplifier facilities. Output sockets for ext. speaker, monitor or external amplifier. Super-imposed switching magic eye recording level and mains neon indicator. Volume and tone controls 7" x 4" speaker. Attractively styled cabinet with detachable lid mike and reel storage facilities. A.C. 200/250 volts operation. Complete with crystal mike, tape spare reel and screen lead etc.

MULLARD "3-3" & "5-10" HI-FI AMPLIFIERS

3 ohm & 15 ohm output



"3-3" Amp. 3 valve, 3 watt hi-fi quality at reasonable cost. Bass Boost and treble controls quality sectional output transformer, 40 c/s-25 kc/s +1 dB, 100mV for 3W, less than 1% distortion. Bronze escutcheon panel. Complete Kit only 7 gns. Carr. 7/6. Wired and tested £8.10.0.

MULLARD "5-10" AMPLIFIER. 5 valves 10W 3 and 15 ohms output. Mullard's famous circuit with heavy duty ultra-linear quality output transformer

Basic amplifier kit price **£9.19.6** Carr. and Ins. 7/6.
Ready built 11½ gns.

CONTROL PANEL KIT. Bass, Treble and Volume controls with 4-position selector switch for radio tape and 11in. x 4in. escutcheon panel.

AMPLIFIER KIT AND CONTROL PANEL KIT, £11.19.6. Ditto, really wired. £14.19.6.

2-VALVE PRE-AMP UNIT. Based on Mullard's famous 2-valve (2xEF86) circuit with full equalisation, with volume, bass, treble and 5-position selector switch. Size 9 x 6 x 2½in. Ready Built £7.19.6, Carriage 3/6.

RECORDING TAPE—Reduced Prices

Famous American Columbia (CBS) Premier Quality Tape at REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

	Standard	Long Play	Double Play
5in.	600ft. 13/-	900ft. 17/6	1,200ft. 31/6
5¾in.	900ft. 16/-	1,200ft. 19/6	1,800ft. 37/6
7in.	1,200ft. 21/-	1,800ft. 28/6	2,400ft. 47/6

P. & P. per reel 1/-. 6d. on each additional reel.

SPECIAL BARGAIN. 3in. Message Tape, 150ft., 3/9. P. & P. 6d. 3in. L.P. 225ft., 4/9., 3in. D.P. 30 ft., 6/6.

Plastic Tape Reels 3in., 1/3; 5in., 2/-; 5¾in., 2/-; 7in., 2/3
Plastic Spool Containers 5in., 1/9; 5¾in., 2/-; 7in., 2/3

Alumin. Chassis. 18g. Plain Undrilled, folded 4 sides, 2" deep, 6" x 4", 4/6; 8" x 6", 5/9; 10" x 7", 6/9; 12" x 6", 7/6; 12" x 8", 8/-, etc. **Alumin. Sheet.** 18g. 6" x 6", 1/-; 6" x 9", 1/6; 6" x 12", 12/-; 12" x 12", 4/6, etc.

Jack Plugs. Standard 3½" Igranic Type, 2/6. Screened Ditto, 3/3. Miniature scr. 1½", 2/3. Sub-min. 1/3. **Soldering Irons.** Mains 22/220V or 230/250V. Solon 25W Inst., 24/6. Spare Elements, 5/6. Bits, 1/3. 65W. 29/6, etc.

DE-LUXE RECORD PLAYER KIT

Incorporating 4 Sp. Garrard Auto-Slim unit and Mullard latest 3 watt printed circuit amplifier (ECL 86 and EZ 80), vol, bass and treble controls, with 8" x 5" 10,000 line speaker. Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue-relief. Size 17½" x 16" x 8". A stylish unit capable of quality reproduction. Circuit and const. details 2/6 (free with kit).

COMPLETE KIT £13.19.6

Carr. and ins. 12/6. Ready wired 30/- extra. Illuminated perspex control panel escutcheon, 7/6 extra. Four contemporary mounting legs 6in. 10/6; 9in. 11/6; 12in. 12/6 extra.

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s 9/16in. diam. first, second or third ..5/6
Osc. Coil M. & L.W. 9/16in. dia. 5/-
Midget Driver Trans. 9:1 .... 6/-
Midget Output Trans. Push-Pull—3 ohms 6/-

Elect. Condensers—Midget type 1 mFd.-50 mFd. ea. 1/9, 100 mFd. 2/-, 12V. Wkg.

Condensers 150 v. working: .01 mFd., .02 mFd., .03 mFd., .04 mFd. 9d.; .05 mFd., .1 mFd., 1/-; .25 mFd., 1/3; .5 mFd., 1/6, etc.

Midget Tuning Condensers. J.B. "OO" 208 pF and 176 pF, 8/6, ditto with trimmers, 9/6. J.B. 220 pF and 105 pF conc. slow motion 10/6. 365 pF single 7/6. Sub. min. ⅝in. Dilemin 100 pF, 300 pF, 500 pF, 7/- each.

FERRITE AERIALS, M. & L.W. car aerial coil 9/3.

Midget Vol. Control with edge control knob, 5 K/ohms, with switch 4/9; Ditto less switch 3/9.

Speakers: P.M.; 2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms, 13/6. 7 x 4in. Plessey 35 ohms, 23/6.

Ear Plug Phones—Min. Continental type 3ft. lead, jack, plug and socket. High Imp., 8/-. Low Imp., 7/6.

Phono Plugs, 9d. Phono Sockets (open), 9d. Ditto (closed), 1/-. Twin Phono Sockets (open), 1/3.

6 VALVE AM-FM TUNER UNIT

Med. and VHF 190m-550m, 88 Mc/s-103 Mc/s, 6 valves and metal rectifier. Self-contained power unit. A.C. 200/250V operation. Magic-eye indicator, 3 push-button controls, on/off. Med., VHF. Diodes and high output Sockets with gain control. Illuminated 2-colour perspex dial 11½" x 4", chassis size 11½" x 4" x 5½".

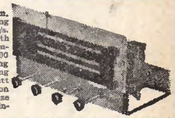
A recommended Fidelity Unit for use with Mullard "3-3" or "5-10" Amplifiers. Now available as complete kit as illustrated, inc. power unit. Carriage 7/6.

Ditto, but less power unit, £9.19.6, carriage 7/6.
Circuit and construction details, 4/6, free with kit.

£10.19.6
Carriage 7/6.

7 VALVE AM/FM RADIOGRAM CHASSIS

New 1965 Model now available



Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.
Three Waveband and Switched Gram. positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Phillips Continental Tuning Insert with permeability tuning on FM and combined AM/FM IF transformers. 400 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ x 6¼in. Height 7½in. Edge illuminated glass dial 11½ x 3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250v. operation. Magic-eye tuning. Circuit diagram now available. Aligned and tested ready for use £13.19.6. Carr. & Ins. 7/6. Comp. with Tape, O/P socket, ext. sp'k'r and P/U sockets and indoor F.M. aerial and 4 knobs—walnut or ivory to choice. 3Ω P.M. Speaker only required. Recommended Quality Speakers 10" R.A., 27/6. 13½" x 8" E.M.I. Fidelity, 42/6. 12" R.A. with conc. Tweeter, 42/6. Carr. 2/6.

Condensers—Silver Mica. All values 2pF to 1,000pF, 6d. each. Ditto Ceramics 9d. Tub. 450V T.O.C. etc. 0.001 mFd to 0.01 and 0.1/350V., 9d. 0.02-0.1/500V., 1/-. 0.25 Hunts 1/6, 0.5 T.C.C. 1/9, etc., etc. Close Tol. S/Micas—10% 5pF-500pF 8d. 600-5,000pF, 1/-. 1% 2pF-100pF, 9d. 100pF-500pF 11d. 575pF, 5,000pF, 1/6. **Resistors**—Full Range 10 ohms-10 meg. ohms 20% ¼ and ½W, 3d., ¼W, 5d. (Midget type modern rating) 1W, 5d., 2W, 9d. **Hi-Stab.** 5% ½W, 6d. (100 ohms-1 meg). Other values 9d. 1% ½W, 1/6 etc., etc.

JASON FM TUNER UNITS. Designer-approved kit of parts. **FMT1,** 5 gns. 4 valves, 20/-. **FMT2,** £7.10.0. 5 valves, 35/-. **JTV MERCURY** 10 gns. 3 valves. 22/6. **JTV2** £13.19.6. 4 valves, 28/6. **NEW JASON FM HANDBOOK,** 2/6. 48 hr. Alignment Service, 7/6. P. & P. 2/6.

TRIMMERS. Ceramic (Compression Type)—30pF, 50pF, 70pF, 9d.; 100pF/150pF, 1/3; 250pF, 1/6; 600pF, 1/9. **PHILLIPS.** Bee Hive Type (conc. air-spaced)—2-8pF, 1/-; 3-30pF, 1/-. **KNOBS**—Modern Continental types Brown or Ivory with Gold Centre; 1" dia., 9d. each; 1½", 1/- each; Conc. knobs ivory with Gold Centre 1½" dia. 2/9 per pair. Matching ditto 2/6 ea.
LARGE SELECTION AVAILABLE.
METAL RECTIFIERS, STC Types—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

TUB-ELECTROLYTICS-CAN
25/25v. 50/12v. 1/9; 8+8/450v. 4/6; 50/50v.100/125v.2/-;32+32/275v.4/6. 8/450v. 4/350v. 2/3; 50/50/350v. 6/6. 16+16/450v. 5/6; 60/250/275v. 12/6; 32+32/450v. 6/6;100+200/275v. 12/6

Volume Controls—5K-2 Meg. ohms, 3in. Spindles. Morganite Midget Type 1½in. diam. Guar. 1 year. LOG or LIN. ratios less Sw. 3/-, DP. Sw. 4/6. Twin Stereo less Sw 7/6 100k to 2M ohms with DP Sw. 9/6.
WAVECHANGE SWITCHES, 1 p. 12-way 2p. 2-way, 2 p. 6-way, 3 p. 4-way, 4 p. 2-way, 4 p. 3-way, long spindle, 3/6 ea.

BONDACOUST Speaker Cabinet Acoustic Wadding (1 in. thick approx.) 18 in. wide, any length cut, 2/3 per ft., 6/- per yard. **TINNED COPPER WIRE,** 16-22g. 4/- ½lb. **ERSIN MULTICORE SOLDER.** 60/40 4d. per yard. Cartons 6d., 1/-, 2/6 etc.

TYGAN FRET or Vynair, 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/-, etc.

EXPANDED ANODISED METAL Attractive gilt finish ⅛in. x ⅛in. diamond mesh 4/6 sq. ft. Multiples of 6in. cut. Max size 4ft. x 3ft., 47/6, plus carr. Do., finer pattern mesh 4/6 sq. ft., multiples of 12in. max. size 3ft. x 2 ft., 27/6 sheet.

ENAMELLED COPPER WIRE—½lb. reels 14g-20g, 3/-; 22g-28g, 3/6; 30g-38g, 4/9; 39g-40g, 5/-, etc.

TRS
Est. 1946

We manufacture all types Radio Mains Transf., Chokes, Quality O/P Trans., etc. Enquiries invited for Specials. Prototypes for small production runs. Quotations by return. Send for detailed bargain list, 3d. stamp.

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THO 2188. *Terms C.W.O. or C.O.D. Post and Packing* up to ¼ lb., 1/-; 1 lb. 1/9; 3 lb. 3/-; 5 lb. 3/9; 8 lb. 4/6.

Brand new individually checked and guaranteed VALVES

AC/HL	4/6
ACP4	6/-
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AL60	5/-
ARP3	3/-
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ARP24	3/6
AR8	6/-
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ATP7	5/6
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DD41	4/-
DET5	8/-
DET20	2/-
DET25	15/-
DF73	5/-
DF91	3/-
DF92	3/-
DF96	6/-
DH63	5/-
DK92	6/6
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E1415	30/-
E1524	12/6
EA50	1/-
E173	7/-
EABC80	5/9
EA91	3/6
EAF42	8/-
EB34	1/6
EB91	3/-
EBC33	6/-
EBC41	6/6
EBC81	5/-
EBF80	6/6
EBF83	7/6
EBF89	6/9
EC52	4/-
EC53	12/6
EC70	4/-
EC90	2/-
EC91	3/-
ECC81	4/-
ECC82	5/-
ECC83	6/-
ECC84	5/6
ECC85	6/6
ECC88	9/-
ECC91	4/-
ECF82	7/-
ECH42	9/6
ECH81	5/-
ECH83	7/6
ECL80	6/-
ECL82	7/6
ECL83	10/-
ECL86	10/-
EF36	3/4
EF37A	7/-
EF40	9/-
EF50	2/6
EF52	6/-
EF53	4/6
EF55	8/-
EF71	7/6
EF72	5/-
EF73	5/-
EF74	4/-
EF80	5/-
EF81	6/-
EF85	4/6
EF86	6/6
EF89	5/-
EF91	2/9
EF92	2/-
EF95	5/-
EF183	8/-
EF184	8/-
EHT1	300/-
EL32	3/9
EL34	10/-
EL36	5/-
EL38	17/6
EL41	7/-
EL42	8/-
L50	8/-
EL81	8/-
EL83	6/3
EL84	5/-
EL85	8/-
EL91	4/6
EL95	5/-
EL360	20/-
EM80	6/-
EM81	7/6
EM84	6/3
EN31	10/-
ESU74	80/-
ESU208	6/-
EY51	5/6
EY86	6/6
EY91	3/-
EZ40	6/6
EZ41	6/6
EZ80	5/6
EZ81	3/6
F/6057	5/-
F/6061	5/-
F/6063	4/-
FW4/500	6/6
FW4/800	8/6
G1/236G	9/-
G1/370K	20/-
G50/2G	5/-
G180/2M	15/-
GM4	45/-
GZ32	10/-
GZ34	10/-
H63	7/-
HK54	22/6
HL2K	2/6
HL23	6/-
HL23DD	5/-
HL41	4/-
HVR2	9/-
K3A	30/-
KT8C	22/-
KT32	8/-
KT33C	6/-
KT44	5/9
KT63	4/-
KT66	16/-
KT67	15/-
KY76	8/6
KT88	22/-
KTW61	4/6
KTW63	2/-
KTZ41	6/-
KTZ63	5/-
M8100	9/-
M8141	12/-
M8161	7/-
MH4	5/-
MHLD6	10/-
ML6	6/-
N78	15/-
NE17	7/-
OA2	6/-
OB2	6/-
OB3	7/-
OC3	5/-
OD3	5/-
OZ4A	5/-
PCC84	5/-
PCC89	10/-
PCF80	6/6
PCF82	6/6
PCF84	8/-
PCL81	9/-
PCL82	7/-
PCL83	8/3
PCL84	7/-
PCL85	8/6
PCL86	9/-
PEN25	4/6
PEN46	3/-
PEN200A	8/-
PFL200	17/6
PL36	7/6
PL38	16/-
PL81	7/-
PL82	5/-
PL83	6/-
PL84	6/6
PL500	15/-
PM24A	5/-
PT15	10/-
PT25H	7/6
PT25M	7/6
PX4	14/-
PX25	9/-
PY33	8/6
PY80	5/6
PY81	5/6
PY82	5/-
PY83	6/-
PY800	6/6
PZ1-35	9/-
PZ1-75	12/-
QP21	6/-
QP25	5/-
QP230	5/-
QS95/10	5/6
QS150/15	10/-
QS1202	9/-
QV04/7	8/2
R3	8/-
RG4/1250	60/-
RK72	6/-
SL30P	15/-
SL30	12/6
SP2	8/6
SP41	1/6
SP61	1/6
SP210	3/6
STV280/40	12/6
SU2150A	10/-
S11G12	10/-
T41	6/6
TDOX-20	70/-
TP22	5/-
TP25	15/-
TT11	5/-
TT15	35/-
TTR31	45/-
TZ0520	4/-
TZ20	16/-
U81	30/-
U12/4	8/-
U17	5/-
U18	6/-
U25	11/-
U26	11/-
U27	8/-
U50	4/6
U52	4/6
U191	11/6
U801	18/-
UABC80	6/-
UAF42	9/-
UBC41	6/-
UBF80	5/6
UBF89	6/6
UBL21	11/-
UCC85	6/6
UCH42	8/-
UCH81	6/-
UCL82	8/-
UCL83	10/-
UF41	7/-
UF89	6/-
UL41	7/6
UL84	5/6
UU5	7/-
UU9	8/6
UY21	7/6
UY85	5/-
V1120	4/-
V1507	5/-
V1924	20/-
VMP45	12/-
VP23	3/-
VP133	9/-
VR99	8/-
VR105/30	5/-
VR150/30	5/-
VU33A	4/-
VU39	6/-
VX3256	4/-
VX8122	5/-
VX8124	5/-
W21	5/-
W118	8/-
W119	8/-
X66	7/6
X118	8/-
X145	8/-
Y63	5/-
Y65	4/-
Y66	8/-
Z800U	20/-
Z801U	10/-
1A3	8/-
1A5GT	5/-
1B22	30/-
1C5GT	6/-
1D8GT	6/-
1E7G	7/6
1F2	3/-
1G6GT	8/-
1L4	2/6
1LA6	6/-
1LC6	7/-
1LH4	4/-
1N21B	4/-
1N43	4/-
1N70	4/-
1R4	5/-
1R5	3/6
1S4	5/-
1S5	4/6
1T4	2/-
2A3	5/-
2B26	3/-
2C26	7/-
2C26A	3/-
2C34	2/6
2C45	22/6
2C46	30/-
2C51	13/-
2D21	5/-
3A4	4/-
3A/108A	20/-
3A/46J	35/-
3A/167/M	25/-
3B7	5/-
3B24	5/-
3D6	4/-
3E29	50/-
3Q4	6/-
3Q5GT	7/-
3S4	4/-
3V4	5/9
3X2	3/-
4C27	35/-
4D1	4/-
5A173G	5/-
5A174G	5/-
5B251M	25/-
5B/233M	15/-
5B254M	40/-
5B255M	35/-
5R4GY	9/-
5T4	7/-
5U4G	4/6
5V4G	8/-
5X4G	8/6
5Y3G	4/-
5Y3GT	5/-
5Y3WGTB	9/-
5Z4G	6/6
5Z4GT	8/-
6AB6	4/-
6AC7	2/-
6AG5	2/6
6AG7	6/-
6AH6	10/-
6AJ7	2/-
6AK5	5/-
6AK7	6/-
6AL5	3/-
6AL5W	7/-
6AM5	2/6
6AM6	4/-
6AQ5	7/-
6AQ5W	9/-
6AS6	4/-
6AS6W	9/-
6AS7G	20/-
6AT6	3/6
6AU6	7/-
6AX4	8/-
6B7	6/-
6B8G	2/6
6BA6	4/-
6BA7	5/-
6BE6	4/3
6BJ7	7/-
6BQ7A	8/-
6BR7	9/-
6BW6	9/-
6C4	2/-
6C5G	2/6
6C5GT	6/-
6C8	4/-
6C8G	3/-
6C8G	3/-
6CH6	4/6
6C21	30/-
6CL6	9/-
6D6	3/-
6E5	6/-
6F5G	5/3
6F5GT	5/9
6F6G	4/-
6F7	6/-
6F8G	6/6
6F12	4/6
6F13	5/-
6F14	5/-
6F32	4/-
6F33	3/-
6G6G	2/6
6H6M	1/6
6J4WA	10/-
6J5	6/-
6J5G	2/-
6J6	3/6
6J6W	6/-
6J7G	5/-
6J7M	8/-
6K6GT	5/6
6K7G	2/-
6K7GT	4/9
6K8G	8/-
6K8GT	8/3
6K8M	6/6
6L5G	6/-
6L6GA	7/6
6L6M	11/-
6L7G	4/-
6L34	4/6
6LD20	5/6
6N7	6/-
6N7G	5/9
6P25	12/6
6Q7G	6/-
6R7	5/6
6SA7	7/-
6SA7GT	6/6
6SK7GT	4/-
6SC7	7/-
6SC7GT	5/-
6SFGT	5/6
6SH7	3/-
6SJ7	5/-
6SJ7G	6/6
6SK7	4/6
6SL7GT	5/6
6SN7	3/6
6SQ7GT	6/-
6SS7	2/-
6U4GT	9/6
6V6G	5/-
6V6GT	7/6
6V6M	8/-
6X4	3/6
6X5G	5/-
6Z5GT	6/3
6Y6G	8/-
6-30L2	10/-
6Z4	5/-
7B7	7/6
7C5	10/-
7C6	7/-
7C7	6/-
7H7	7/3
7Q7	7/-
7V7	5/-
7Z4	4/6
8D2	2/6
9D2	3/-
9D6	3/6
10F9	9/-
12A6	2/6
12AH7	5/-
12AT7	4/-
12AU7	5/-
12AX7	6/-
12AY7	10/-
12BA6	5/-
12BE6	7/-
12BH7	7/-
12C8	3/-
12H6	3/-
12J5GT	2/6
12J7GT	6/6
12K7GT	2/-
12K8M	10/-
12Q7GT	3/3
12SA7	7/-
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7GT	8/-
12SN7GT	5/9
12SR7	5/-
12Y4	2/-
12L7	7/-
15D2	6/-
19E2	15/-
19G3	10/-
19G7	5/-
19H1	6/-
19M1	5/-
20P4	13/-
21B6	9/-
25L6GT	5/-
25Y5	6/-
25Z4G	6/6
25Z5	7/6
25Z6GT	8/6
25D7	6/-
30	5/-
30C15	9/6
30F5	6/6
30FL1	10/6
30P12	10/-
30P19	15/-
30PL1	8/-
35L6GT	7/-
35T	17/6
35W4	5/-
35Z3	10/-
35Z4GT	6/-
35Z5GT	6/-
37	4/-
38	4/-
215SG	6/-
50L6GT	8/-
53A	7/6
57	6/-
58	6/-
59	6/-
75	5/6
76	5/-
77	6/6
78	5/-
80	5/6
81	9/-
83	8/-
84	8/-
85A2	8/-
210VPT 7-pin	2/6
220PA	7/-
220TH	4/-
225DU	9/-
307A	5/6
310C	25/-
350B	8/-
357A	7/-
368A	5/-
393A	15/-
446A	8/-
703A	30/-
705A	10/-
715B	60/-
717A	8/-
724A	15/-
801	6/-
803	22/6
807	8/-
808	8/-
811	22/6
813	65/-
815	35/-
829B	50/-
830B	4/-
832A	45/-
832	16/-
843	5/-
866A	14/-
884	10/-
954	4/6
955	2/6
956	2/-
957	5/-
958A	4/-
1612	5/-
1616	3/-
1619	5/-
1625	6/-
1626	8/-
1629	4/6
2051	5/-
4043C	13/6
4060	8/-
7313C	30/-
5704	9/-
5726	6/-
6060	5/-
6064	7/-
6065	6/-
6080	22/-
7193	1/9
7475	2/-
8013A	25/-
8020	8/-
9001	3/-
9002	4/6
9003	6/-
9004	2/6
9006	2/6
C.R. Tubes	
CV1596 (09J)	55/-
E4504/B/16	28/-
VCR97	28/-
VCR138	30/-
VCR138A	40/-
VCR517	36/-
VCR517B	40/-
VCR517C	40/-
3FP7	45/-
3EG1	40/-
5PC1	30/-
5FP7	12/6
88D	44/-
Photo Tubes	
GS16	12/6
931A	55/-
6097	350/-
Special Valves	
ACT6	£8
K301	£4
KRN2A	£3.10.0
1B24	25/-
2J22	£2.10.0
2J54	£3
417A	30/-
3J/92/E	£37.10.0
714AY	£4
725A	30/-
726A	19/-
Transistors	
OC16	20/-
OC22	23/-
OC25	12/-
OC44	6/-
OC45	5/-
OC71	4/6
OC72	6/-
OC73	10/-
OC81M	7/-
OC82	10/-
OC122	16/-
OC200	10/6
XC141	10/-
XC142	15/-
XC155	20/-
XC156	22/6
2N502	47/-
2N247	9/6
2N585	10/6
2N1090	20/6
2N1091	29/-

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. All U.K. orders below £1, P. & P. 1/-; over £1, 2/-; over £3, P. & P. free. C.O.D. 2/6 extra. Overseas Postage extra at cost.

H.R.O. SENIOR TABLE MODEL TYPE 5A with "S" meter and crystal filter in excellent fully checked and tested condition together with set of 8 general coverage coils and mains P.S.U. **£33.** Carriage and packing 30/-. **Ditto, but model "M" £28** Carriage and packing 30/-.

INSET MICROPHONE for telephone handset 2/6. P. &. P 2/-.

DUMONT MODEL 241 OSCILLOSCOPE in fully working condition **£22.10.0.** P. & P. 30/-.

CR.150/2. Frequency coverage 1.5-22 Mc/s in 4 bands. Price **£31.** Carriage 30/-.

P.C. RADIO'S mains P.S.U. for above, **90/-.**

VARIOMETER for No. 19 set, **17/6.** P. & P. 3/-.

MARCONI TF 868 UNIVERSAL BRIDGE. Capitance 1pS to 100μS, inductance 1μH to 100H, resistance .1 ohm to 10m ohms. Q .1 to 10. Power supply 115/230v A.C. In new condition with instruction book, **£65.** Carriage 30/-

EVERSHED MEGGER CIRCUIT TESTER. 2 ranges 0 to 1,000Ω, 100Ω to 200,000Ω. With test leads, leather carrying case. Tested **£4.19.6.** P. & P. 3/6.

PANEL METERS (round)

500mV	3½"	DC	32/6
500mV*	3½"	DC	35/-
500mA*	2½"	DC	22/6
500 microamp	3½"	AC	22/6
500 microamp*	2"	DC	19/-
0-500 microamp	2½"	DC	22/6
25-0-25mA	2½"	DC	45/-
150-0-1500mA	3"	DC	29/-
0-500mV	3½"	DC	32/6
0-15V	2"	AC	17/6
0-50V	2½"	DC	28/-
0-150V	2½"	AC	24/-

*Projection type.

MARCONI SIGNAL GENERATOR TYPE TF 801B/3/S. Frequency range 12–485 mc/s in five ranges. Directly calibrated frequency dial. Output waveform: CW sinewave A.M., pulse A.M. (from ext. source only). Internal modulation frequency 1,000 c/s. Output: A normal—continuously variable directly calibrated from 0.1μV–0.5v. b. high; up to 1v. modulated or 2v. unmodulated, output impedance 50 ohms. Fine frequency tuning control, carrier on/off switch, built in crystal calibration for 2 mc/s and 10 mc/s. Stabilised voltage supply. In excellent "as new" condition, fully checked and guaranteed. **£115.** Carriage 30/-

P.C. RADIO LTD
170 GOLDHAWK ROAD, W.12.
Shepherd's Bush 4946
Open 9-5.30 p.m. *Thursday* 9-1 p.m.

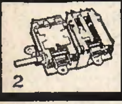
THERMAL PLUS MECHANICAL CIRCUIT BREAKER FOR A.C. & D.C. Current 1 amp. Protects against shorts (instantaneous cut-out at approximately) 8 amps) and against overloads: 1.8 amp 30 second, 2.1 amp 15 seconds, 2.5 amp 8 seconds. Delayed cut-off may be adjusted to different currents and times. Separate pair of contacts to indicating device. Dimensions 3½ × 1⅝ × $\frac{7}{16}$ in. Price 12/6. P. & P. 2/6.

SEMI-AUTOMATIC BATTERY CHARGER "Baby Esstron". Initial charging rate 3.5 amps DC automatically reducing to 1.5 or lower (depending on specific gravity of battery acid). As the battery receives the charge indication lights indicate visually the high current or when incorrectly connected. Meter incorporated. For 6 or 12v. batteries. Mains voltage 200/240v. A.C. Price **£3.** P. & P. 4/6.

AR88D RECEIVERS Fully reconditioned, **£55,** rebuilt models **£85.** Carriage paid U.K.

TELEPHONE HANDSET. Standard G.P.O. type, new, 12/-. P. & P. 2/-.

WIRELESS SET No. 52 (CANADIAN) Complete station consisting of Transmitter. Receiver, supply unit for 12v. All contained in special carrier. 1.75–16 mc/s in 3 bands. 813 as output valve. 45–75w. phone and MCW, 70-100 watts CW, M.O. or crystal. Receiver includes crystal calibrator. Tx. can be exactly tuned to Rx. frequency. Noise limiter Sidetone. Loudspeaker on receiver with on/off switch. All brand new with accessories. Export. Price on application. **Ditto,** but Receiver only (without cabinet), **£8.10.0.** Carriage 20/-.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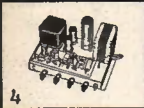
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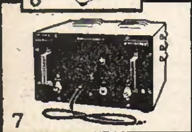
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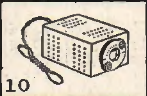
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1. **MOTOR** $^{1}/_{4}$ **H.P.** 1440 revs., **£2.10.0.** $^{1}/_{3}$ **H.P.** 1440 revs., **£2.19.6.** P. & P. 10/-. These have been removed from equipment but are fully guaranteed.

2. **CYLDON AM FM PERMEABILITY TUNERS FOR ALL TRANSISTOR OPERATION.** Size 2¼ x 2¼in. approx. By famous manufacturer. A.M. I.F. 470 Kc/s, F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1620 Kc/s-525 Kc/s. F.M. coverage 108 Mc/s-88Mc/s. Circuit diagrams 2/6. FREE with Tuner, 1st, 2nd and 3rd A.M. I.F.'s, 1st, 2nd, 3rd and 4th F.M. I.F.'s V.H.F. Osc. choke, A.M. I.F. trap. All the above are the R.F. end of an A.M./F.M. receiver car radio etc. The above items **£2.10.0.**

3. **AMPLIFIER KIT.** 3 to 4 watt Ampifier Kit. Comprising chassis 8½ x 2½ x 1in. Double wound mains transformer, output transformer, volume and tone controls, resistors, condensers etc. Valves 6V6, ECC81 and metal rectifier. Circuit 1/6, free with kit, **29/6 plus 4/6 P. & P.**

4. **8-WATT 5-VALVE PUSH-PULL AMPLIFIER & METAL RECTIFIER** Size: 9 x 6 x 1½in. A.C. Mains, 200-250v. 5 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes Output 8 watts at 5 per cent total distortion. Separate bass and treble lift control. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. **£3.19.6.** P. & P. 8/-.

5. **MAGNAVOX COLLARO.** Set of three Tape Deck Motors. These are made for 110v but suitable auto transformer is supplied. Three motors **39/6.** P. & P. 6/-.

6. **OSCILLOSCOPE for D.C. and A.C. APPLICATIONS.** Push-pull X amplifier; Fly-back suppression; Internal Time-base Scan Wave form available for external use; pulse output available for checking TV line O/P Transformers, etc. Provision for external—I/P and C.R.T. Brightness Modulation. A.C. mains 200-250v., **£18.18.0.** P. & P. 10/-. **FULL 12 MONTHS' GUARANTEE INCLUDING VALVES and TUBE.**

7. **FIXED FREQUENCY SIGNAL GENERATOR.** Crystal controls in metal case, size 10 x 6 x 6in. Incorporating two FC13 valves, mains transformer, metal rectifier, choke, indicator, lamp, crystal and numerous components. Modulated and unmodulated output socket. Originally used for I.T.V. frequencies. Brand new. **39/6, plus 7/-** P. & P. A.C. mains 200-250 volts.
SILICON RECTIFIERS. 250v. P.I.V., 750mA. Six for **7/6** post paid.

8. **POCKET MULTI-METER.** Size 3½ x 2½ x 1⅛in. Meter size 2¼ x 1⅛in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1,000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test prods, battery and full instructions, **42/6.** P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter.

9. **CHANNEL TUNER I.F.** 16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—PCF80 and PCC84 (in series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker, **10/-,** P. & P. 3/-.

10. **POWER SUPPLY KIT** in metal case, size 3½ x 2½ x 2in. incorporating mains transformer, rectifier and condensers. 230/250 A.C. mains Output; 9v., 10mA. **10/6 plus 3/- P. & P.**

11. **B.S.R. MONARCH UA16 WITH FULL FI HEAD,** 4-speed, plays 10 records, 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12½ x 10½in. Space required above baseboard 4⅝in., below baseboard 2⅝in. Fitted with full Fi turnover crystal head. **£4.19.6.** P. & P. 7/6.

12. **FIRST QUALITY PVC TAPE**

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

P. & P. on each 1/6. 4 or more Post Free.

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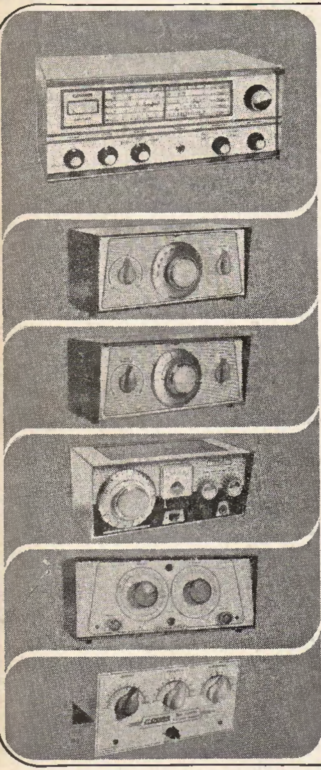

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PRACTICAL WIRELESS

APRIL 1966

VOL 41 NO 710

LAW OF THE JUNGLE

SOME readers take us to task for disapproving of pirate radio stations. A common accusation is that we are "against pop music"; that, teetering on the brink of senility, we cannot appreciate the prodigious talents of the Top Tenners. Such thrusts are wild indeed, for they completely miss the point!

Whether they churn out pop music, symphony concerts, language tuition or talks on advice to the lovelorn is beside the point; they should not be on the air at all.

Aircraft are not allowed to land and take off just where they fancy, flights must be controlled and scheduled—even though some of our critics claim that "the air is free for all to use how they like". Cars are not allowed to be driven at 100 mph in the wrong direction down a one-way street. This complex modern society insists that "liberty" must often be subjected to judicious control. And broadcasting is no exception.

Years of co-ordination and planning have made the jig-saw of the m.w. band fit together reasonably well. Frequencies, sites, power allocations have been arranged to the best mutual advantage. But the pirates burst in with a lofty disdain for law, order and the rights of other people to listen. Consequently protests have come from Sweden, Yugoslavia, Czechoslovakia, etc., concerning reception ruined by pirate stations.

Pirates also evade the Copyright Act, to the financial detriment of authors, composers and musicians. There is no control of programme or advertisement content. There is nothing to stop undesirable elements setting up their own pirate station. Unless . . .

The Government has, by implication, shown that the position of the pirates is indefensible. They are breaking international radio law. They are specifically contravening legislation signed last year by the Council of Europe—which other signatories have already used to shut down their pirates. Then what is the PMG waiting for—could it be a General Election!

Let him no longer tolerate the law of the jungle in broadcasting.

CONTENTS

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world.

The MAY ISSUE WILL BE PUBLISHED ON APRIL 7th

A New P.W.?

I READ PRACTICAL WIRELESS with great interest and would like to see you enlarge it. I would also like to see a PRACTICAL WIRELESS Annual (similar to the *Practical Motorist Annual*).

One other thing I would like to see is the revision of the *Practical Wireless Circuits* book, as I think this is very out of date—the coils and components being almost impossible to obtain.

I would like to see a licence for Novice Amateurs on 160m using 10W, as I think it would make use of a band which is dead most of the time.

J. Savage.

London,
S.E.11.

★ ★ ★

[PRACTICAL WIRELESS will be "going up in size" from the May, 1966 issue onwards, and *Practical Wireless Circuits* is, at the moment being revised and will contain up-to-date circuits using up-to-date components. It will be on sale in a few months time.]—Editor.

Correspondents' Club?

I HAVE noticed that there are several enthusiasts about my own age (14) who have written to P.W. asking for correspondents. I am sure that we could all get together and have regular correspondence, writing say, each month or fortnight to each in turn. By doing this, we would gain the experience of others and also offer our own experience. some, like me, no doubt are preparing for the R.A.E. and would certainly benefit from corresponding with other enthusiasts.

Another idea I had was to swop components for stamps or other articles with enthusiasts in India, Ceylon, etc., who find it difficult to obtain electronic components and issues of P.W.

If anyone is interested would they please write to me. I will then write to all the members giving the the names and adresses of the other members to start the "Pen Club" off. I would welcome any other ideas on the subject.

S. V. Odgear.

111 The Hollow,
Corsley,
Warminster,
Wiltshire.

NEWS AND...

P.W. AND P.TV. FILMSHOW

Friday, 4th February, was the date of the P.W. Filmshow. Once again this year, the meeting was well attended by readers from all parts of the country.

In the absence of Mr. Stevens, the Editor, Mr. A. T. Collins, the Managing Editor of the Practical Group took the chair. After his opening speech, Mr. Collins introduced Mr. Ian Nicholson, of Mullard Ltd., the speaker of the evening.

Mr. Nicholson then introduced the first film, entitled "Electromagnetic Waves—Part 2". After this film there was an interval of 25 minutes during which refreshments were served.

During the second half of the programme, Mr. Nicholson gave a talk on Servicing Transistor Receivers. After this, there followed a film entitled "Thin-Film Microcircuits". The evening ended with a question and answer session during which Mr. Nicholson answered questions put to him by members of the audience.

The photograph shows Mr. A. T. Collins (left) and Mr. Ian Nicholson discussing a thin-film microcircuit.

AIRBORNE RADIO AIDS FOR EAST AFRICAN VC-10s

Three Super VC-10 aircraft on order for East African Airways are to be completely equipped with Marconi Sixty Series airborne radio navigation and communication aids, including the Doppler Navigator, which will form the primary en-route navigational system in the aircraft.

Each aircraft will be fitted with dual installations of the AD160 v.h.f. communications system, AD260 v.h.f. navigation system, AD360 automatic direction finder and the aircraft selective calling system, Selcal. Also in each aircraft will be the Marconi Doppler navigator, type AD560.

The AD560 Doppler navigator is currently in operation with BOAC, Qantas Airlines, Ghana Airways and Air New Zealand and will be fitted in new aircraft for Iraqi Airways and Pakistan International Airways in addition to the Anglo/French Concorde supersonic airliner.

..COMMENT

ARCOLECTRIC RELEASE NEW CATALOGUE

Arcolectric Switches Ltd., Central Avenue, West Molesey, Surrey, announce their 1966 catalogue, No. 136. It describes their current range of switches, neon indicators, and signal lampholders.

Many new products are featured in this catalogue including the "27" and "28" range of lever and semi-rotary switches.

Copies of this catalogue are readily available upon request to Arcolectric Switches Ltd.

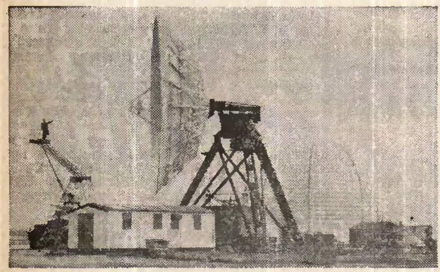
HARLOW MOBILE RALLY

The date of the Harlow and District Radio Society's Annual Mobile Rally will be Sunday, 25th September, 1966. Further details available from Hon. Sec., G. O'Donald, G3TLJ, "Great East", Harlow Road, Roydon, Harlow, Essex.

PETO SCOTT AMENDS NAME

Peto Scott Electrical Instruments Ltd. has changed its name to Peto Scott Ltd. It is thought that the former title gave a too restricted view of the wide range of activities now carried out by the company. The field of operation now extends through black and white and colour studio and professional television installations, professional tape recording, video tape recording, sound systems, functional music machines, Eidophor large screen television projection, language laboratories, teaching machines, schools TV equipment and overhead projectors.

SPACE ORDER FOR MARCONI



Marconi Co. Ltd., is currently building three space communications stations which are to provide the first British military satellite communications system. These stations are to take part in a joint project with the American military authorities, using a series of near-synchronous satellites launched by America.

This photograph, taken at one of the Marconi Company's experimental sites near Chelmsford, shows the 40ft. diameter dish aerial for the second station. It is seen here, fitted on a temporary mounting for test purposes. The white dome in the background is the 60ft. high inflatable radome into which the aerial will shortly be moved. The radome will provide full weather protection for the aerial, its fully steerable mounting, and for some of the associated equipment.

more News and Comment on page 1060

The Meaning of Amateur

I HOPE the attitude of Mr. Davidson, G3FG (page 939, March issue) is not typical of the majority of radio enthusiasts.

I fully endorse the remarks of your Birmingham correspondent who G3FG criticises and would suggest that G3FG is being narrow-minded. It is, I think, possible to distinguish two separate hobbies (closely connected, I admit) i.e. set construction and DX (be it ham or broadcast DX). I myself could not really care who or what constructed my set as long as it gives me some DX. I know that some friends of mine will willingly construct a set and "home brew" it but once they get it working and calibrated, give no thought to the matter, take the set to pieces and start on a different circuit.

As to the meaning of "amateur" I hardly think it is relevant to either hobby. The thing that disturbs me most, from what I read of your correspondence, is the unwillingness of some—not many—to accept newcomers, novices not versed in the habit of set construction.

P. Charlton.

Middlesbrough.
Yorkshire.

Single Circuit Panels

I WAS intrigued by W. Groome's approach to the problem of assembling printed circuits without messy chemicals. (P.W. Feb., 1966). I wonder why he assumes that copper cladding *has* to be used?

I, as an "old timer" faced by this modern chassisless age—have found a simpler approach!

I use 22 s.w.g. copper wire! What's more, on top of the board *my* essemblies *look* identical. Just as small and just as neat.

The only special tool needed is wire-bending pliers, to put neat loops on the ends of each link. The wires can run point-to-point by judicious use of bits of sleeving (though they needn't).

It's a lot easier to perform mods and de-bug new designs!

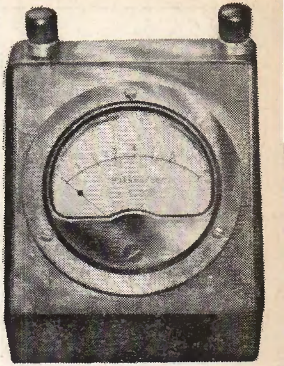
When finished, a layer of lacquer holds all in place . . . (Most times, surplus flux does all that is needed).

R. G. Young.

Peacehaven,
Sussex.

A Direct Reading

Frequency Meter



★ Described by K. Royal

THE device about to be described commenced life in the author's laboratory for the measurement of the pulse repetition frequency of an oscilloscope's timebase in terms of a direct reading analogue on a milliameter. This simply means that the milliameter is scaled directly in terms of frequency instead of current. The meter circuit thus has to translate frequency to a direct-current value. Moreover, to be of much use it has to do this in a linear manner without progressive compression or expansion of the scale. That is, any change in applied frequency should give a correspondingly linear change in current reading over a specific frequency range.

The device then graduated to a "tachometer" for checking the speed of car engines, and finally, to a meter for indicating the frequency of any audio signal, whether of square, pulse or sine wave.

Frequency Discriminator

The key to the whole thing is a rather special frequency discriminator* whose circuit is given in Fig. 1. This is how it works. When the input signal goes *negative*, capacitor C1 charges through the signal source resistance, through R1 and through D1. With D1 connected the way round shown on the diagram is, of course, in forward conduction on a negative-going signal, while the emitter junction of the transistor Tr1 is in reverse conduction.

As long as the time constant C1/R1 is short (also assuming a low impedance or resistance source), C1 stores an electric charge equal to CV, where C is the value of the capacitor and V is the amplitude of the input signal.

Now, when the input signal changes to positive (or zero), C1 discharges through the emitter/base junction of the transistor and a pulse of current flows in the collector circuit. This happens on each cycle of signal, and since C1 discharge current is equal to CV/t, where t is a time function of the cycle and is itself equal to 1/f, where f is the repetition frequency, it follows that the average emitter current is CVf. The average collector current is thus CVα, where α is the current gain.

In the common base mode, α is almost equal to unity (actually it is less than unity because the emitter current is equal to the collector current plus the very small base current) so the average collector current can be considered to be CVf. From this, then, it can be seen that the current is proportional both to frequency and the value of C1. The frequency range over which the discriminator will function is thus influenced by the value of C1. Table I relates maximum frequency to value of C1.

In Fig. 1 a milliammeter is included in the collector circuit, and this is scaled to read frequency direct. It is possible to employ a high resistance voltmeter instead of a current meter by putting a resistor in series with the collector and using the voltmeter to indicate the voltage in terms of frequency developed across it. In this case, the voltage as recorded would be equal to CVfR, where R is the value of the collector resistor.

Input Limiter

The basic circuit in Fig. 1 is dependent upon the signal source impedance and amplitude, and is thus somewhat unpredictable. For more consistent operation a "buffer" stage should be interposed between the signal source and the discriminator,

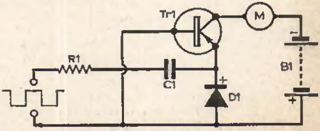


Fig. 1: Circuit of the basic frequency discriminator.

with the buffer acting also as an amplitude limiter.

A practical arrangement in this context is given in the circuit in Fig. 2. Here Tr1 is the buffer/amplitude limiter. It serves virtually as a switching transistor the input signal performing the switching action. This is how it works.

On a negative-going input signal current flows in the emitter/base junction of Tr1 causing a flow of current in the collector resistor R3 and the voltage at the collector to fall. On a positive going input signal, the base is made positive with respect to the emitter and no current flows in the collector resistor and the voltage at the collector rises almost to the supply voltage. During this half-cycle, however, D1 conducts and maintains a constant mark/space ratio. That is, the transistor is switched on and off for equal periods of time.

A square-wave is thus developed at the collector of Tr1. and since the amplitude of this wave is held constant by the transistor bottoming when the input signal swings negative and cutting off when it swings positive, amplitude limiting occurs provided the input signal amplitude is itself sufficient fully to switch the transistor as described. Thus, any increase in signal input amplitude does not influence the amplitude of the square-wave signal at the collector.

The signal, then, is of ideal form to work the frequency discriminator which, in Fig. 2, is Tr2, with C2 as the charging capacitor. A preset resistor is included in series with Tr2 collector and milliammeter to set the current for full-scale deflection at the top frequency it is required to indicate.

Unit Construction

This circuit, in fact, was used by the author both to indicate the pulse repetition frequency of the timebase of an oscilloscope and to determine the turnover speed of a car engine by "counting" the number of pulses produced by the contact breaker of the ignition system, the scale of the milliammeter then translating these direct to revs per minute.

The circuit was built upon a small piece of "Eyelet Board" measuring about 2¼ x 2¼in. The special "eyelets" (see the Component List) are secured in the holes corresponding to the component lead-out wires. The wires, along with the circuit connecting wires themselves, are then soldered to the eyelets.

A word or two about the eyelet board would not be amiss at this juncture. The board itself is made of a resin-bonded laminate and the eyelets are of tinned brass. The laminate is perforated every 0·2in. and the holes (which are about $\frac{1}{16}$in. in diameter) tightly accommodate the eyelets. These are prevented from being pushed right through the holes by a slightly raised flange at one end. This also gives a little clearance for winding round the circuit connecting wire.

The eyelets are fitted to the selected holes by inserting the barrel up to the flange, turning the board over and then gently tapping the protruding barrel end with the tip of a centre punch. One of the automatic press-type punches allows this operation to be handled swiftly and accurately.

Meter Connection

Fig. 3 shows how the board is processed to accommodate all of the components of the circuit. These are wired together underneath the board and connection to the meter terminals is accomplished by the positioning of eyelets close to two holes made in the board to take the terminals of the meter. Each hole thus has one meter connecting eyelet close to it, as shown in Fig. 3. Washers placed on the meter terminals after they have been pushed through the holes in the board thus provide good electrical connection between the adjacent

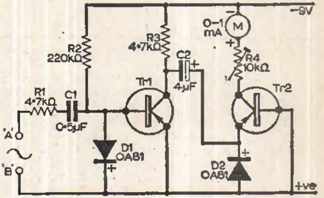
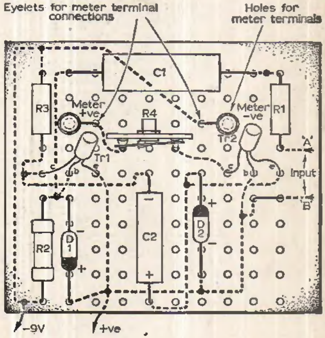


Fig. 2 (above): Circuit of the instrument described in the text.

Fig. 3 (below): Layout of components on the eyelet board.



eyelets and the terminals when the terminal nuts are tightly screwed down. In this way, therefore, the module is secured to the meter movement.

The 1mA meter movement employed by the author had its own mounting case and this easily accommodated the meter-mounted module with room to spare for a small PP3 or PP4 battery if required. The author's prototype is externally powered so no on/off switch was fitted. However, a switch would be needed should internal battery powering be adopted, since the limiter takes a small quiescent current of just under 1mA.

The front view of the instrument, with the scale calibrated in pulses per second, is shown in the heading photograph. The two top terminals accept the input signal and supply positive, to which the input signal is relative while a small terminal on the rear of the case picks up supply negative.

TABLE I

Maximum Frequency	Value for C2
100 c/s	1 μF
1 kc/s	0·1 μF
10 kc/s	0·01 μF
100 kc/s	0·001 μF
1 Mc/s	0·0001 μF

Table I: Showing maximum frequency for variations of C2.

As mentioned earlier the instrument was made originally to indicate timebase repetition frequencies of an oscilloscope up to a maximum of 8kc/s. For this application, a value of 0·01μF was found suitable for C2 (see Table I). After setting the timebase to 8kc/s as determined by a calibrated audio oscillator, the preset R4 should be adjusted to give a deflection of 8 on the meter. A signal of any frequency *below* 8kc/s is then read directly from the scale.

As a Rev-counter

For use as a car engine rev-counter, the pulses as developed between the contact breaker (CB) and switch (SW) terminals of the ignition coil are applied to the instrument. The pulses here have a rate proportional to the engine speed. For a four-stroke engine, the frequency is equal to engine

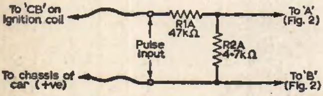
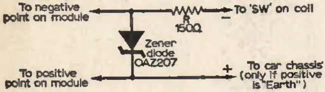


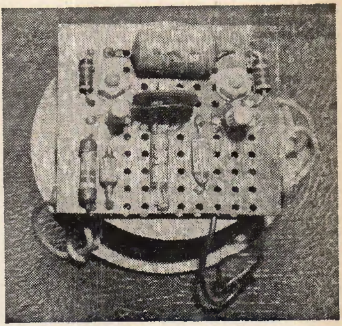
Fig. 4 (above): Circuit of input attenuator required for indicating ignition pulse rate.

Fig. 5 (below): Circuit of zener diode stabilisation.



turnover speed in revs per minute X n/120, where n is the number of cylinders. Thus, such an engine running at, say, 3,000 r.p.m. produces a pulse rate of 100 c/s, while a single cylinder, four-stroke motor-cycle engine will produce a pulse rate of only 25c/s at the same turnover speed.

A top engine speed of 6,000 or 8,000 r.p.m. is generally conventional depending really on the nature of the engine. Thus, the value for C2 is usually in the order of 1μF, but for single cylinder engines a value up to 4μF may have to be used. The value in these cases is best determined by experiment for the least ripple effect on the needle at low revs.



Rear view of finished instrument showing completed circuit board.

It is not safe to apply the contact breaker pulses direct to the circuit since their large amplitude could damage the semiconductors. An attenuator after the style of that shown in Fig. 4 circuit should be used at the input. The rev-counter may be powered either by its own, internal battery (as may be required for some motor cycles without battery powering) in which case the "pulse input" point is connected to "CB" on the ignition coil and the supply positive line of the circuit is connected to the metal of the engine or car body, or powering can be from the car battery.

In the latter case, the car supply voltage must be stabilised, as this has a tendency to rise and fall with engine revs and with varying loads on the electrical system.

The best stabilising element for this application is the zener diode. When this kind of diode is biased for reverse conduction it becomes a relatively low resistance at a specific value of reverse voltage, called the "zener voltage". The current then passed by the diode is called the "zener current". Under this condition, the voltage developed across the zener diode remains substantially constant over a range of input voltages. This means, then that the voltage across the diode is stabilised.

A zener diode stabilising circuit is given in Fig. 5 and "R" in series with the supply and the

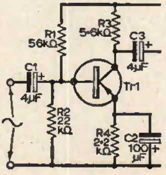


Fig. 6: Circuit of common-emitter amplifier for increasing the sensitivity of the instrument, as described in the text.

COMPONENTS LIST
CIRCUIT FIG. 2

Resistors (all ½-watt carbon insulated)

R1	4·7kΩ
R2	220kΩ
R3	4·7kΩ
R4	10kΩ preset (printed-circuit board type)

Capacitors

C1	0·5μF 12v
C2	(see Table 1)

Semiconductors
Tr1 and Tr2, OC71
D1 and D2, OA81

Meter Movement
Moving-coil 0-1 mA

Sundries
Eyelet Board and eyelets (available from Messrs. R. & E. Lamb, 17 Queens Road, Leytonstone, London E.11. Connecting wire, battery (PP4) and battery clips. Instrument case.

CIRCUIT FIG. 5

Resistor
150Ω 1-watt

Semiconductor
Zener diode, OAZ207

CIRCUIT FIG. 6

Resistors (all ½-watt carbon, insulated)

R1	56kΩ
R2	22kΩ
R3	5·6kΩ
R4	2·2kΩ

Capacitors
C1 and C3 4μF, 12v. Electrolytic
C2 100μF, 6V. Electrolytic

Semiconductor
Tr1, OC71

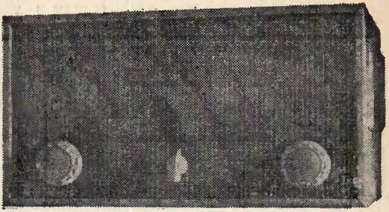
diode sets the zener current. The value is determined by the required load current, the supply voltage and the type of zener diode used. The manner of connecting to the car is revealed in Figs. 4 and 5. This applies only to cars with 12V supplies and positive earths.

The main application of the device, of course, is as a direct reading frequency meter, and the way that it can be used to indicate engine revs may be of academic interest only to some of our readers. Nevertheless, the versatility of the device is revealed.

To provide a frequency indication from low-level signals, an amplifier is required in front of the main circuit of Fig. 2. A suitable amplifier is given in Fig. 6. This is just an ordinary common-emitter circuit, but the lift that it gives to signals is sufficient to allow the device to respond to signals as low as 50-100 mV. When this amplifier is used, R1 and C1 from Fig. 2 circuit should be omitted. ■

* D. E. O'N. Waddington, "A Simple Frequency/Voltage Converter" Marconi Instrumentation, Vol. 10 No. 1.

A SWITCH-TUNED



SUPERHET

PART 2

F. L. THURSTON

STAGE 3—AERIAL AND PRE-SELECTOR SECTIONS

A 10 x ⅜in. ferrite rod is used in the aerial, which is home wound. While this is recommended, it is not essential, and a ready-made type of aerial may be used if preferred. The winding and mounting details for the home-made type are shown in Fig. 5. Note that the aerial is mounted directly on the speaker.

Secure the external aerial/a.g.c. socket in place at the rear of the chassis, checking that there are no shorts to chassis. Secure L3 in place above chassis.

Secure S2 in place.* It will probably be necessary to make this switch up by modifying an alternative type, and the essential dimensions are given in Fig. 6. Such a conversion is not difficult: a multibank switch, at least as long as that shown, is obtained. The switch must have at least 4-ways. The switch is then dismantled, reduced to the correct length, and re-assembled to conform to Fig. 6. If too many "ways" are available, they can be reduced to the correct number (4) by drilling and tapping a 6BA hole in the switch front to take a short 6BA screw which will act as a stop.

When the switch has been secured in place at the front of the chassis, secure the trimmer capacitors in place, as shown in Fig. 6. The method of mounting the beehive trimmers is shown in Fig. 7, where it can be seen that they are soldered to the drilled-out ends of 2 BA screws, which are then bolted directly to the chassis, using a solder tag in place of a normal washer.

Now wire-up the circuit as shown in Fig. 6. Use screened leads where indicated. Check the wiring and switch on. Test voltages are V1, anode 250V, screen 145V, cathode 1.5V.

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*S2 can be made to order by: Specialist Switches Ltd., 79a Duke Road, London, W.4. Price approximately 17/6. Drawings must be supplied with order.

TESTING

Temporarily connect a germanium diode in circuit with one end to the loose end of C10 (audio input) and the other end to the grid of V1. Switch S2 to position 3. The ferrite aerial and diode are now connected as a simple crystal set. If the volume control is turned full up, the Light programme should be heard reasonably well. By adjusting C23 it should be possible to tune the programme in quite sharply, although the Home will probably be heard as well.

Now disconnect the diode from V1 grid and connect it to tag 2 of the 16-way tag strip. The circuit is now connected as a t.r.f. receiver. When S2 is switched to position 3 it will be seen that, by adjusting C23 and C26 together, the Light can be tuned in far more sharply than before, that interference from the Home is greatly reduced, and that the Light now comes in with vastly improved strength. By connecting an external aerial (a few yards of wire into the external aerial socket, the signal strength is increased even more.

The trimmer capacitors should now be aligned, in conjunction with positions of S2, as follows:

Position 1—(Radio Caroline). Tune C21 and Slug of L3.
" 2—(Luxembourg). Tune C24.
" 3—(Light). Tune C23 and C26.
" 4—(Home). Tune C22 and C27. Fixed padder.

Note that the above tuning sequence must be followed. The stations on positions 1 and 2 may be very weak.

This concludes stage 3.

STAGE 4—OSCILLATOR AND MIXER SECTIONS

Secure L4, the oscillator coil in place below the chassis. This coil is sold as a short-wave oscillator coil, to cover the 90 to 250 metre bands. At the particular frequencies used in this receiver, this coil gives a better L/C ratio, and therefore better frequency stability, than would a normal medium-wave oscillator coil.

Secure the small variable capacitor C32, in place at the front of the chassis. On the prototype, this variable has a maximum capacitance of about 15pF.

Secure the three Phillips "beehive" trimmers in place, as shown in Fig. 8. Solder the 100pF postage stamp trimmer, C28, between the insulated stator terminal of C32 and chassis.

Wire-up the circuit as shown in Fig. 8, noting where temporary connections are made. Use screened lead where indicated. The diagram gives the wiring details for the Voltage Regulator, the Oscillator, the Cathode-Follower and the Mixer.

TESTING AND ALIGNMENT

Check the wiring and if satisfactory insert the valves and switch on. Check the voltages as shown in Fig. 1. If all is well, connect one end of a capacitor of about $\cdot 01\mu F$ value and 300 volts working to the pin of i.f.t.1 which goes to pin 5 of V2, the mixer. To the free end of the capacitor connect a germanium diode (GEX 34), and connect the other end of the diode to the free end of C10 (input to a.f. section). Set the upper tuning slug of i.f.t.1 so that it is just below the top of the can.

The receiver as so far constructed, consists of a superhet with a pre-amplifier and a single i.f. stage, followed by a detector and a.f. amplifier.

The set must now be lined up. The r.f. stages have already been approximately aligned to the four required stations in stage 3 of the construction. It remains to finalise their alignment and that of the oscillator.

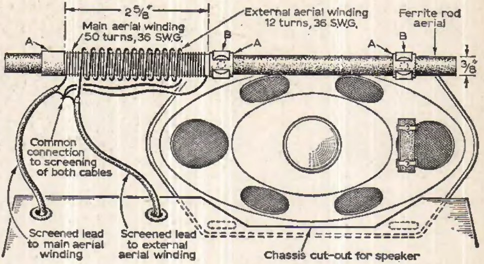
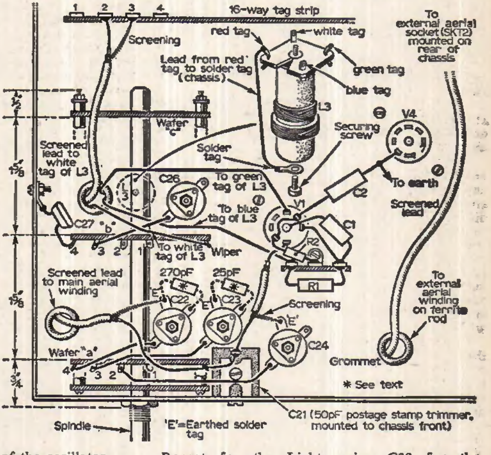


Fig. 5: (above) Aerial winding and mounting details

Fig. 6: (below) Layout and wiring details for stage 3 of construction.



Switch S2 to position 1, and set the front panel trimmer, C32, to mid position. Set tuning slug of L4 half in and lock. Now adjust C28, the 100pF trimmer mounted on C32, until Radio Caroline is heard at maximum strength. There should be no trouble in receiving this station. Now re-tune C21 and L3 slug for maximum signal. Once set, these three trimmers will require no further adjustment. Switch to position 2 of S2, and adjust C29 for Radio Luxembourg, then re-trim C24 for maximum strength.

Repeat for the Light, using C30 for the oscillator, and C23 and C26 for r.f. stages, in switch position 3. Finally, switch to position 4, and adjust C31 on the oscillator and C22 and C27 at r.f. for the Home. Note that, should it not be possible to tune in using the components specified, adjustments can be made by adding or reducing parallel tuning capacitance. This completes the r.f. and oscillator alignment.

Now remove the capacitor connected to the primary winding of the i.f. transformer, and connect it to the secondary winding (pin of i.f.t.1

with no leads soldered to it). Adjust the lower tuning slug of i.f.t.1 for maximum signal (any position of S2 may be used). Now re-trim upper tuning slug, and finally re-train lower slug again. The primary of i.f.t.1 is now fully aligned, while the secondary may be considered to be temporarily aligned (it will require re-trimming after the two additional i.f. stages are added in stage 5 of the construction).

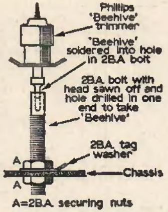


Fig. 7: Method of mounting the beehive trimmers.

EXPERIMENTS WITH THE MIXER/OSCILLATOR SECTION

As constructed, the circuit used for the mixer gives very low noise, while the oscillator is exceptionally drift free and immune from "pulling". By making temporary alterations to the circuits, it is possible to demonstrate quite forcibly the inferiority of some alternative circuits. Space is limited, however, and only two experiments will be given, as follows:

If a small transistor radio with built-in aerial is available, place it near to the oscillator coil (L4) and tune through the medium waveband; a number of whistles will be picked up, demonstrating that the oscillator is working. Tune in to one of these whistles, and then move the transistor set to the r.f. coil, L3; the whistle will still be there, but will be very weak. Finally, move the transistor set to the ferrite aerial; if any whistles are still available they will be very weak indeed.

Now unsolder the 1000pF capacitor, C18, from pin 2 of V2 (mixer cathode) shown as a temporary connection in Fig. 8. Solder a 15pF capacitor between pin 1 of V3 oscillator anode) and pin 1 of V2 (mixer grid). The circuit is now connected as a mixer with the oscillator injected to the grid, quite a common circuit.

If the transistor set is now placed near the r.f. coil, L3, whistles will be heard far more strongly than was formerly the case. Whistles will also be heard at the ferrite aerial. It may be noted that if a superhet is made without a pre-selector stage, using oscillator injection to the mixer grid as is often done the resulting "receiver" will in fact act as a quite effective transmitter!

Another point may be demonstrated with this circuit, by pressing a finger against the mixer grid pin; a quite considerable reduction in volume will be noticed. This loss of volume can be attributed to loading and de-tuning of oscillator and r.f. stages. If the circuit is now rewired to conform to Fig. 8 (the "temporary" connections can now be made "permanent") and the same finger test is made to the point of injection (mixer cathode), it will now be found that no reduction in volume takes place. This is because both the oscillator and r.f. stages are isolated from the point of injection, and also because no loading of the actual injection voltage takes place due to the low impedance used.

The mixer gives very low noise and good gain, and an essential part of the design which makes it possible to obtain these results is the voltage divider and decoupling network, R3-R4-C3, which feeds a constant and predetermined voltage to the mixer screen grid; the screen grid voltage must be within 5V of that shown in Fig. 1. An effective way of demonstrating the importance of this voltage is to replace R3 with a variable resistor of about 100 to 250kΩ value, and adjusting the value while monitoring the screen grid voltage; it will be found that as the voltage departs from that specified, the noise increases and the gain decreases. Many conventional mixers are found to have the high noise and low gain that is associated with this test.

Once the circuit has been re-wired to conform to Fig. 8, stage 4 of the construction is complete.

STAGE 5—I.F. SECTIONS

Wire up the circuit as shown in Fig. 9. Check wiring. Switch on and check voltages as shown in Fig. 1.

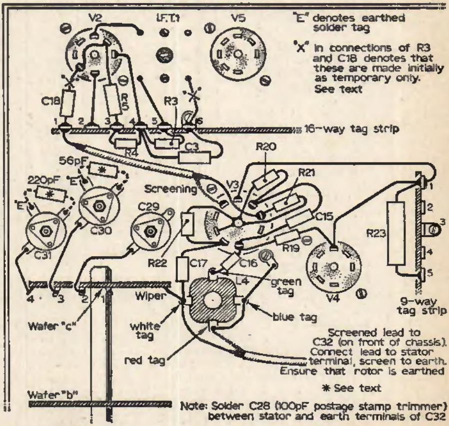


Fig. 8: Wiring and layout for stage 4 of construction.

NOTE. Points marked X in Fig. 9 are temporary connections only.

ALIGNMENT. Disconnect the capacitor used in aligning stage 4 from the secondary of i.f.t.1, and reconnect to the primary of i.f.t.2 (connected to pin 5 of V5). Adjust the primary tuning slug for maximum signal, then re-trim secondary of i.f.t.1 again, and finally re-tune i.f.t.2 primary again. Alignment of i.f.t.1 is now complete.

Move the capacitor to the secondary of i.f.t.2, and repeat the above procedure with the primary and secondary tuning slugs of i.f.t.2. When alignment is satisfactory, move the capacitor to the primary of i.f.t.3, and align the secondary slug of i.f.t.2 and the primary slug of i.f.t.3. To complete the tuning, move the capacitor to the secondary of i.f.t.3 and trim the primary and secondary windings of that i.f.t.

Note that, because of the use of three i.f. stages, the tuning is so sharp that it will probably be necessary to de-tune the i.f.'s slightly if acceptable quality audio is to be received.

Stage 5 of the construction is now complete.

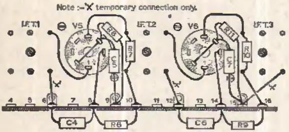


Fig. 9: Wiring and layout for stage 5 of construction

STAGE 6—DETECTOR AND A.G.C.

The permanent detector and filter network can now be connected into the circuit.

Remove the temporary detector circuit used in the two preceding stages (the capacitor and diode). Wire up the circuit as shown in Fig. 10.

The dimensions of the component board shown are approximate only; as an alternative to the board, the components may be soldered to suitable

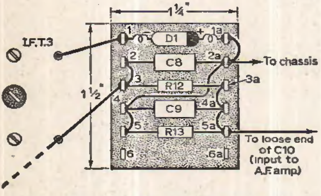


Fig. 10: Wiring and layout of detector/filter.

miniature tag strips. When completed, the circuit is switched on to test that it is working correctly.

If working satisfactorily, wire up the a.g.c. circuit as shown in Fig. 11. Note that the "temporary" connections of Fig. 9 are removed and re-wired as "permanent ones as in Fig 11. After checking over the wiring, switch on and select a station. The a.g.c. circuit may result in some small loss in volume compared to that obtained earlier; the stations should now, however, be virtually free from "fade".

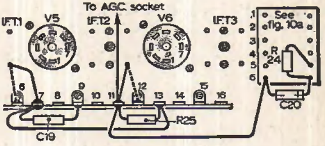


Fig. 11: A.G.C. wiring.

If a voltmeter is available it can be connected to the a.g.c. socket provided at the rear of the chassis. The a.g.c. voltage is negative, and rises in magnitude with the strength of the i.f. signal. Thus, as a signal fades, so the a.g.c. voltage will fall. The voltage will vary between about zero and 5V (measured with a v.t.v.m.), the normal amplitude being about 4V.

The tuning of the r.f. oscillator, and i.f. stages can be perfected if required, by using the a.g.c. point as a tuning monitor.

The construction of the receiver is now complete.

THE CABINET

The prototype receiver was placed in a simple, close fitting cabinet, which was suspended below a cupboard in the kitchen, as shown in the photograph. This cabinet may be a trifle small for really good, cool running of the radio, and the reader may prefer to make a similar cabinet but of larger dimensions. Quarter-inch or heavier ply-wood is used in the construction. The sides and top and base are cut to the required size and nailed and glued together. A fairly rough form of construction can be used, as any mistakes are "camouflaged" when the unit is finally covered with rexine.

Before proceeding further with this "box" section of the cabinet, make up the front panel and check that it fits correctly to the radio. When making the front panel, allow for the thickness of the speaker gauze that will be used to cover it, and the thickness of the Rexine used to cover the "box", when working out the overall dimensions. When the front panel is correctly cut, cover its front and sides with the selected speaker gauze, gluing it in place with "Copydex" adhesive.

Now place the Rexine selected to cover the "box" in position, and after trimming, glue (using Copydex) the Rexine to the front edge and inside only. When the glue has set (about 10 minutes) push the completed front panel in place in the box, peel back the Rexine layed on the box, and secure the front panel in place with a few light nails, hammered in from the outside of the box.

Finally, complete the cabinet by glueing the remaining Rexine in place. ■

on the Short Waves

MONTHLY NEWS FOR DX LISTENERS

All times are in G.M.T. All frequencies are in kc/s.

The Broadcast Bands—by John Guttridge

CONTRIBUTIONS have been lighter than usual this month. Don't forget we want your news. Thanks go to J. McNally, S. Haagensen, S.B.C., A. J. Jenkins, Middlesbrough Boys High School S.W. Club, I. Black and P. A. Church.

Algeria: *Radio Algerie* (21 Boulevard des Martyrs, Algiers) now has English from 2200—2230 on 6,175/890. Same outlets are used for Spanish 2230—2300 and French 0630—0830 and 1700—2200. French is also carried from 1200—1700 (0900—1700 Sundays) or 890/11,835. Report forms are now available from this station which now gives full QSL verification.

Congo: *Radiodiffusion de la Republique Democratique du Congo*, (B.P.3171, Leopoldville) has been heard in French at 1900 on the new frequency of 9,780. Local dialect follows at 1927.

South Africa: *South African Broadcasting Corporation* (P.O. Box 8606, Johannesburg) now carries the Africa service at 0300—0400 on 6,150/7,270, 1000—1600, 15,220/17,805; 1600—1710, 4,975/15,220/17,805, 1710—1845, 4,975/11,900/15,220; 1845—2000, 4,975/9,525/11,900; 2000—2100, 4,975/7,270/9,525; 2100—2115 7,270/9,525. On Sundays transmissions start at 1100 and 17,805 changes to 11,900 at 1650. One of the stations new 250kW outlets is used on 4,975. At 2000 11,900 carries the programme Radio Paradys.

Tunisia: *Radiodiffusion Television Tunisienne* (139 Avenue de Paris, Tunis) is now carrying the home service on the new frequency of 6,305.

Burma: *Burma Broadcasting Service* (Prome Road, Kamayut P.O., Rangoon) can be heard from around 1300 to sign off at 1345 on 4,795.

Japan: *N.H.K.* (Tokyo) can be heard with English around 1300 on 9,525, though there is interference from *Voice of America*, Greenville, in Spanish to Latin America on the same frequency.

Lebanon: *Lebanese Broadcasting Station* (Radio Lebanon, Ministry of Orientation, Information and Tourism, Beirut) has been reported back on 11,770 to Africa from 1830—2030 (English 1830—1900). Reception in England is good.

Papua and New Guinea: *Radio Rabaul* (P.O. Box 71, Rabaul, New Britain) uses 3,385 from 0600—1300. Sends acknowledgement folder. *Radio Kerema* (Gulf District, Papua) on 3,245 from 0720—1100. *Radio Daru* (Western District, Papua) on 3,304 from 0800—1100. *Radio Goroka* (Eastern Highlands, New Guinea) on 2,410 from 0800—1100.

U.S.A. *Voice of America* (US Information Agency, 330 Independence Avenue, S.W. Washington 25, DC). will use the following frequencies to Europe in English from March 6. 3,980 (Munich) 0300—0730, 1400—2345; 5,965 0300—0730, 1630—2200, 5,995 (Greenville) 0300—0730; 6,040 0500—0700; 7,200/7,250 0330—0730; 7,205 1500—1900; 7,210 1900—2245; 9,540/9,740/15,295 0430—0730; 9,565 1830—2245; 9,760 1700—2245; 11,760 1830—2215; 15,205 (Greenville) 1400—2215; 15,290 1400—2000; 17,780 (Greenville) 1400—1800; 1,196 (Munich) 1600—1830.

Netherlands Antilles *Trans World Radio* (Bonaire) has English at 2100 in the 25m.b. Frequency is believed to be 11,840.

Argentina *Radiodifusora Argentina al Exterior* (RAE), (Sarmiento 151, Buenos Aires) now carries English from 2300—2345 and not 2400 on 11,710. The programme has also been occasionally heard on 11,780 and 9,690. After close down of the International service at 0030, 11,710 is reported to carry the National Service.

Brazil: The following stations are available in the early evening: *Radio Mayrink Veiga* (Rua Mayrink Veija 15, Rio de Janeiro) on 11,770; *Radio Sociedad de Bahia* (Rua Carlos Gomes 57, Sa Ivador, Bahia) on 11,875; *Radio Tupi* (Avenie Venezuela 43, Rio de Janeiro) on the new frequencies of 11,705/9,800; *Radio Bandeirantes* (C.P.372, Sao Paulo) on 11,925; *Radio Brasil Central* (C.P.330, Goiania) on 11,815.

Denmark: *Radio Denmark*, (Radio House, Copenhagen V) may reintroduce the programme "Shortwaving to the World" on Saturdays at 1015—1100 on 9,520. On March 6, 15,165 replaces 9,520 for the 1730—1810 transmission.

German Federal Republic, *Deutsche Welle* (Bruedesstrasse 1, Postfach 344, 5 Koln) now uses 9,575/7,175 for the 0300—0340 English transmission.

German Democratic Republic, *Radio Berlin International* (Berlin-Oberschonweide, Nalepastrasse 18-50) uses the additional frequency of 5,300 in its English European transmission at 1730. Other frequencies are 6,080/6,115/7,185/7,300/9,730. There is a new transmission at 1815 on 1,511.

Great Britain, *Manx Radio* (P.O. Box 22, Douglas, Isle of Man) is understood now to have a power of 2kW. After dark uses 1,594.

Hungary: *Radio Budapest* (Brody Sandar—S.U. 5-7 Budapest VIII) has English to Europe on 5,900/7,220/7,305 from 1930—2000 and 2200—2230. The 2200 transmission is also carried on 6,234. English to North America is at 0030—0100, 0130—0230 on 9,833/9,540/7,220/6,234 and 0300—0400, 0430—0500 on 9,833/7,220/6,234/5,900.

Portugal: *Radio Lisbon*, (Rua Sao Marcal, 1-A, Lisbon) reported using 7,285/7,130/6,185/6,025/5,975 for English to Europe at 2015—2100.

Egypt: *Cairo Radio* (UAR Broadcasting and TV, Maspero, Cairo) now carries English to Europe at 2100—2215. Frequencies are 9,475/11,915.

Saudi Arabia: *Saudi Arabia Broadcasting* (Ministry of Information, Airport Road, Jeddah) puts in a strong signal after 2200 on 7,220 but suffers from Budapest on same frequency and a jammer on 7,215.

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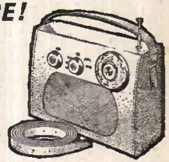

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FULLY TUNABLE ON ALL WAVEBANDS ● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room filling volume from rich toned 7" × 4" speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M & L waves and telescopic aerial for S waves. Real leather look case with gilt trim and shoulder and band straps. Size 9 x 7 x 4in. approx. The perfect portable and the ideal car radio. (Uses PP7 batteries available anywhere).

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"... amazed at volume and performance ... has really come up to my expectations" S.G. Stockton-on-Tees.

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Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¼ x 3¾ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

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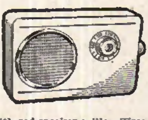

"Home, Light, A.F.N., Lux. all at good volume." G.P. Durham.

● 7 stages—5 transistors and 2 diodes

Fully tunable over Medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic 2½in. speaker etc. Attractive case. Size 6¼ x 4¼ x 1½in. with red speaker grille. (Uses 1289 battery available anywhere.)

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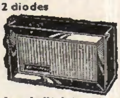
POCKET FIVE

● 7 stages—5 transistors and 2 diodes



Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5¼ x 1¼ x 3½in. (Uses 1289 battery available anywhere).

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● 8 stages—6 transistors and 2 diodes

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6¼ x 4¼ x 1½in. (Uses PP4 battery available anywhere.) Carrying strap 1/- extra.

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Listen to stations half a world away with this 6 waveband portable. Tuneable on Medium and Long waves, Trawler band and two Short Waves. Sensitive ferrite rod aerial and telescopic aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings. Size 7½ x 5½ x 1½in. Carrying strap 1/6 extra.

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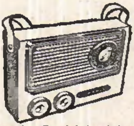

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The Amateur Bands—by David Gibson G3JDG

WANTED! James Bond type agents to sniff out the truth. Out of a large mail bag this month most letters were about 20 DX? No, nor about the VK on topband, or the openings on 20 either. They referred to "that man" NS1A but with a new twist. Apparently we now have a NS1B and NS1C too. No, they do not count as separate zones for a countries worked certificate. Briefly the locations of these stations are assured as follows:—On board Radio London; 10 miles south of Herne Bay; in a motor boat with a No. 19 transceiver; on an Irish river (up the proverbial creek perchance). Will the real NS1s please stand up.

I am taken to task about 80 being deserted by George, ZL3QX, who informs that both ZL4IE and ZL3FZ have been consistently working EUs for some months. Two calls for 80 metre sleuths to be on the watch for. The l.f. bands are producing some very good openings at the time of writing. Both phone and c.w. are well represented —go on, live dangerously, listen now on 160, 80, and 40.

Forty and Down

Some very fine logs for 160 shows what's about. **D. Douglas** (Dundee), HRO, 60ft. 1-wire, sends in what might be confused for twenty, but don't be fooled, it is 160, G, GI, GM, GW, GD, DL1FF, DL4SS, EP2IW, HK4EB, JA6AK, KV4CI, OE6HS, YVØAA, ZB2A, 9M6BM. **R. Iball** (Worksop), SX28, PR30 pre-selector, 160 raised IS1FR, K2DGT, VE2ITU, VE3-AGX, BWY, QU, VO1HN, W1-BB/1, HGT, W2GGL, W8ANO, W9YYG, WØVXO. **Steve Wilson** (Ossett), BC348R, 264ft. 1-wire, 160—DJ2GL, DL7FZ, GI, GM, GW, GD, HB9-CM, TT, IS1FR, OK1-AEF, AKO, OL5-ADO, AFF, OE1FLW/1, OE6HS, PAØDC, PAØPN, VE3BWY, VO1-FB, HN, W1-BB/1, JJU, W8HGW, WØVXO, ZB2AM, 9H1AE. On 40 Steve's best were AP2LK (Pakistan), CN8AW, HK7BCX, VP6BX. On 80 things are lively too, **J. Brown** (Llandaff), 19 Set, dipole, raised the following on phone, CN8AW, CT1-SQ, EE, IT1-AUL, ZGY, MP4BAA (c.w.), many VE's, VP-5GC, 7NP, 9AV, W's including W8-BON, WNL, YN4CU, ZB2AJ, 4X4BO, 7X2AH, 9J2MX. Again, on 40, **Steve Wilson** logged CM2WS, CO1PY, CR7CI (Mozambique), CX2CO (Uraguay), EP2BQ, FG7ND, HK-3AST, 3UZJ, 4ADD, 4ALE, HV1CN (Vatican), JA1OHV, K2-GL, KBT, FCB, K4JC, KØLUZ, KG4AN, KP4BBN, LU6FA, PY-1, 2, 3, 5, 6, 7, 8, VP5AR (Turks and Caicos Is.), VP9FT, VP7NW, W3-MGK, CRQ, W4LVV, WB6JJC/M, YV4CJY, ZC4GB, 4X4FA, 5A3TX, 6Y5XG, 9G1FQ, all c.w. **N. Flatman** (Ipswich) R3629, 68ft. 1-wire, 80 metres bore fruit with CN8AW, HP9ABX, K8YWC, UA-1, 3, OX4BK, VE1UW, W-1KVX, 2CPO, 2ZPO, 3HUM, 4WK, 9CJZ, ZB2-AJ, AM, ZL2BE (0830 hrs), while on 40 the same set up raised DJ, DL, DM, F, GD, LA, LZ, OZ, T4ZUF (?). From further out—JA2BAY, KG4NV, VK1ATU.

Twenty and Up

More a daytime band but still a hive of activity both phone and c.w. as the following SWL's report. **I. Black** (Gillingham), HE3O, W6BCX Multee antenna, FR7ZC, HI1JMF, KZ5LC, MP4BCC, OA4KY, OD5-BV, BZ, EN, PZ1BW, UI8AE, VK-2SG, 3LG, 3VJ, 3ALB, 3ATO, 5RT, 6RU, VP2AA (Antigua), VP5RB, VP6KL, XE3MF, ZB2AJ, ZL2-UW, BG, 4X4AS, 5A1TZ, 7Q7PBD, 7X2MD, 9G1TF, 9J2AB, 9M4TX. **C. Claydon** (Fife), 840c, 60ft. 1-wire, KV4CI, KR6MM (Okinawa), CN8MH, CO2CO, CR6JA, CR7IZ, EA9AQ, LU6FA, OX3LP, UA9KDK, UI8ID, UM8KAK, VK3-YS, AXK, VK6WT (Perth), VQ8BJ, W6-EBG, LVF, VS9ARU, ZD7IM, ZD9BE, ZS5UP, ZS6J. From Chepstow one **"Colin"** complete with 888 and 132ft. 1-wire heard CR7-BV, CZ, KP4NN, KV4CX SV1CX, UA6LP, VK6DR, VS9AWL, ZB4BCA, ZC4LK, ZE6JL, ZS6XP, 4X4IK, 9G1FL, **D. Wraige** (Wirral), AR88-LF and 15-20ft. indoor ant. managed to hear VK3VS, W6AM and W6UED on s.s.b., while **Chris Peel** (Stoke-on-Trent), S750, 90ft. 1-wire around the loft, went fishing for DX. Cream of the catch include CN8FH, CP8AU, CR6AJ, CX4AW, ET3USA, FK8PH, HK7KD, JA2NA, KG6APJ, KR6CH, KL7BIC, KZ5AW, LU7FAG, OA4KY, PY1FK, PY5AM, TF2WHI, UA9KFS, VE7MS, VE1AED/SU, VK-2ADA, GW, 3ADR, UK, 4SD, 5SM, VP1CY, VP5RB, VU2CK (India), VQ8BFA, W1, 2, 3, 4, 5, 8, 9, Ø, W6-ILT, ABC, AYM, IPA, W7-SEG, QBA, MKI, XW8AX, YA1AW, YA3LCC, YN4CM, YV4IM, ZC4MO, ZL-2UW, 3NO, 4BY, ZS6ALM, 5A5TA, 9Q1FS. While on 15 metres Chris logged CR4BC, CX1WG, EA7GK, ET3USA, HK4XP, JA6QT, HI8XM, OA4KY, OX3JV, PY2DXI, VS9AWR, W's, XW8NZ, 4X4UG, 5A4TI, 5A5PJ, 5N2FEL, 5Z4AA, 7Q7BN, 9E1VF, 9G1RM, 9H1R, 9K2AD, 9U5IB, 9Q5QR. **F. Simpson** (Hull), RX80, 1-wire, exact length unspecified, reeled in CR7BL, CN8FT, EA8DV, EP3RO, KP4CNC, KW6EJ, KV4CX, MP4TBO, OA8V, VE2AFJ, VK-2NN, 3JA, 4RO, 9PL, VS9AWR, XW8AZ, ZE1AN, ZS1CZ, 4X4SC, 7Q7BN, 9H1S, all on 15 metres. On 20 the same length of wire heard DU1AA, FK8AC, JA1MJ, KA5RC, KR6UL, KW6EJ, KX6DR, PY2BYU, PZ1BW, VK3UQ, VP2AA, VS6AJ, YA1AW, ZL3AB, 9G1LS, 9L1HX. Reports on 28Mc/s are still coming in. **C. Clarke** (Farnham), 12 valve s/het, dipole, G's by the score plus UP2ADZ, ZE2JA, ZS9G, mostly a.m. with a few ssb. **F. Simpson** again heard HB9ED, I1CGV, SV1DZ, ZE1AN, ZE2JA, ZE3JU.

Finally a surprise, a genuine log for 144Mc/s, our very first. The honours for the christening go to **David Douglas** (Dundee), who says the following were "got" with an HRO. (With a converter, I hope), G3-BRA 80, HUI 200, MCR 200, HBØLL, 750, SV1AB 1,200, YU1EXY 750. Numbers refer to distance from the transmitting stations in miles.

—continued on page 1051

BOOKS REVIEWED

BASIC ELECTRICITY/ELECTRONICS LABORATORY WORKBOOK. By Training & Retraining Inc.
Published by W. Foulsham & Co., Ltd., Slough, Bucks.
224 pages. Size 10¾ x 8¼in. Price 35s.

THIS is a book whose introduction was printed in England and the balance in the U.S.A. Doubtless in America this is a useful publication but your reviewer doubts its popularity this side of the Atlantic.

It presents a number of projects involving the use of a VTVM and/or oscilloscope. Each chapter is based on a question and answer technique so that the reader is quizzed on knowledge gained as the book proceeds; the answers are given later in the chapter. Projects range from a simple power supply to a superhet receiver but, as one proceeds, various doubts tend to arise.

Constant irritating references to other volumes (by the same publishers perchance) are one source of doubt. Another is the number of odd things which do not seem to tie up. Page 119 assures that we will need a 1,500Ω resistor, yet the relevant circuit on page 122 depicts 1,500kΩ. The availability of a three-gang 365+365+162pF also might prove difficult. Verdict: Go to America to read this one.—*DLG.*

TAPE RECORDING SERVICING MANUAL
By H. W. Hellyer. Published by George Newnes Ltd.
336 pages. Size 9¾ x 7¼in. Price 3 gns.

ON first flicking through the pages of this monumental tome the reader is likely to register surprised anticipation; on closer investigation he might well exclaim: "At last!" For while there have been, and still are, books on tape recorders this one reaches a degree of completeness never before achieved. The trouble with most books is that excellent though they may be in themselves, they try to cover too wide a field in the space available. Those interested in the servicing aspects often have to make shift with an odd chapter or two. Here at last is a book devoted exclusively to tape recorder servicing.

The author, H. W. Hellyer, will need no introduction to readers of PRACTICAL WIRELESS and *Practical Television*, but it is worth pointing out that in producing his *magnum opus* he was able to draw on his own considerable practical workshop experience of the wayward behaviour of tape equipment.

The introductory chapter covers only 14 of the total 336 pages but condenses in that space a lot of useful information on the basic principles of tape recording. The rest of the book is devoted to an analysis of tape recorders under 62 different trade names! A typical entry details the most important aspects of the machine in question—specification, special features, dismantling, together with notes on special adjustments and servicing with pointers to particular faults peculiar to that model or range of tape recorders. Much of the practical material as mentioned before, is the result of personal experience.

In this way not far short of 300 different tape recorders or decks are dealt with. Circuit diagrams accompany each model or range with mechanical details and component layouts where they serve a useful purpose. In so far as a book of this kind can ever be complete this one is.

Your reviewer has only one criticism and that is the drawings. They are taken from manufacturers' literature and are therefore in almost as many styles as there are circuits, which gives the production a somewhat untidy aspect. However, the meat is there and no doubt the economy involved in not redrawing everything to a standard is reflected in the cost of the book. Still, a pity.

Anyone with any interest at all in tape recording from the servicing angle will miss the buy of the year if he doesn't order this book. For, taking into account the wealth of accumulated data and the potential value of the material, it would be false economy indeed not to add this work to his bookshelf!—*WNS.*

TRANSISTOR RECEIVERS AND AMPLIFIERS.
By F. G. Rayer. Published by Focal Press Ltd.
168 pages. Size 8¾ x 7¼in. Price 30s.

WITH the increasing cheapness and availability of transistors there seems little doubt that the number of enthusiasts using them will also increase. If you are one of these people and you require a not too technical book on the subject of receivers and amplifiers then your problems are solved for 30s. Commencing with an explanation of how these devices work the book continues with chapters on aerials and r.f. amplifiers, mixers, i.f.'s, detectors and a.g.c., Class A, Class B, high-power and hi-fi stages. Bonus chapters include v.h.f. equipment, record players, and test equipment and fault finding. A useful book indeed, steering a practical middle course between high technicalities and boring simplicity.—*DLG.*

MUSICAL INSTRUMENTS AND AUDIO
By G. A. Briggs. Published by Wharfedale Wireless Works Ltd., Idle, Bradford, Yorks.
238 pages. Size 8⅝ x 5½in. Price 32/6d.

THIS book attempts to interest the concert-goer and the audiophile both at the same time. The net result is that it falls between two stools, and at 32s. 6d. it is questionable whether it is worth bending down to pick it up. It discusses instruments of all classes, their manufacture, the sounds they emit, wave forms, the formants, harmonics and just about everything. It is degraded by frequent attempts by the author to be funny, and this is further aggravated by the numerous unfunny cartoons and sketches from old issues of ***Punch***. There are special chapters written by experts in their field, and had the general style of the book followed the examples set by these writers then the improvement would have been such as to justify a firm reccommendation, as it is, however, your reviewer remains unimpressed.—*DLG.*

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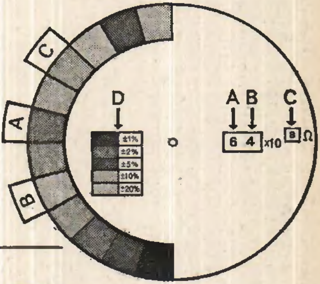

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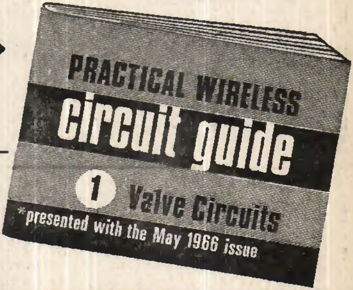

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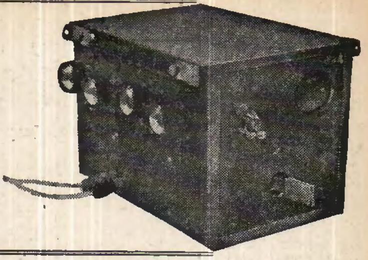
EL KEY

ELECTRONIC MORSE KEY

P. MURPHY



THIS device was built, taking into account the large variety of types of morse one meets with in the communications world. Whether it be slow or fast characteristic or otherwise, e.g. slow dashes—fast dots, or fast dashes—slow dots, short "space" or long "space", and not forgetting of course perfect well balanced morse. The key was thus designed to be as versatile as possible to take into account the above mentioned types of morse, while retaining the advantage of being an automatic device, and works over a range varying from a very very slow pace up to about 40 w.p.m. The key is therefore suitable for both amateur and professional and would be a very useful asset in training establishments. The key is inexpensive to make, suitable for the home constructor to build and has the advantage of being portable. It is economical to run and uses standard transistor batteries.

The newcomer to the electronic key may at first think it is difficult to use, but like everything else a little practice each day for a week or so will soon convince him that it is not as difficult as it first seemed.

Construction

Handle or Paddle:—The construction of the handle can present a small problem, as it must be capable of moving from side to side and returning to its neutral or "central" position automatically when the finger pressure is released from it, also the gap between its central position and the dot or dash stud into which it comes into contact must be very small indeed, approximately between 1/16 and 1/32in., and a general rule which can apply here is that it is better to have too small than too large a gap.

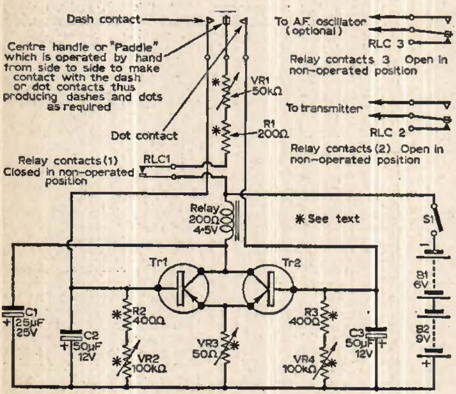


Fig. 1: Circuit diagram of transistorised key.

The paddle described, if constructed properly, can give excellent results and is both simple and easy to construct. However the would-be constructor should pay particular attention to the paddle, a bad handle can spoil the performance considerably, e.g. the letter C is sent thus: —·—· a handle which has, for example, a large gap can give an effect which could sound like —· —· which produces the letter N twice, an experienced electronic key operator can, of course, overcome things like this, but for the beginner a good paddle is most essential. See Fig. 3.

The paddle consists of a nail file (5in. long), a piece of wood 3½in. x 1½in. x ¾in. upon which the nail file is mounted, and an L shaped piece of metal 1 1/5in. long and 3/8in. wide in the horizontal and 1 1/5in. x 3/8in. in the vertical plane (See Fig. 3) which is used to support the nail file on the wooden base. The L shaped piece is secured to the nail file by small nuts and bolts.

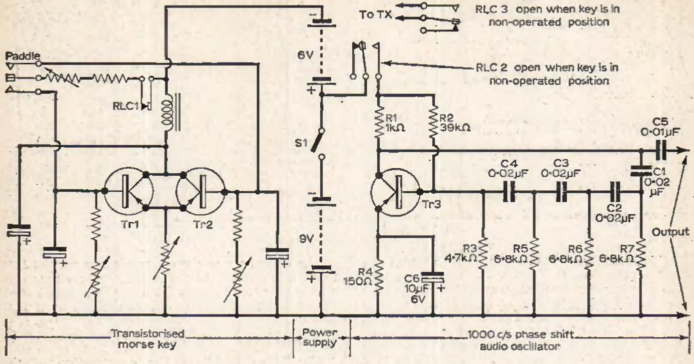


Fig. 2: Diagram of electronic key and phase-shift audio oscillator.

Two flat pieces of formica can be glued to each side of the nail file near its end, which tends to make the paddle easier to operate.

The wooden base can be either glued or screwed to the chassis.

Function of Components in Fig. 1

The components, VR1, R1, C1, make up the time constant (CR) for the space (time interval) between consecutive dots or dashes. Increasing VR1 will therefore increase the space, or vice-versa, the max. space limit chosen was the max. practical limit that would be required although spaces up to unity can be obtained with this type of transistor. They are not required in this case. The min. space depends approximately on the value of C1. In the circuit (Fig. 1) extreme max. and min. values should be obtained, and here as well as the other variables in the circuit, the constructor may, if he so desires, choose closer limits by using the appropriate value of VR1, which he can quickly determine by experiment. The mark length is slightly affected when varying the space control VR1.

R1 Under no circumstances must this 200Ω resistor be omitted or reduced in value as it is a limiting resistor and 200Ω was found to be the min. critical value.

The components, VR2, R2, C2, make up the time constant for the dash side of the circuit. C2 and R2 by themselves provide for the shortest length of dash and by increasing VR2 the length of dash can be increased, here again max. and min. values have been chosen, and it is up to the constructor if he wishes to modify these.

The components, VR4, R3, C3, make up the time constant (CR) for determining the length of dot and as in the case of the dashes extreme max. and min. values were again chosen, R3 and C3 together decide the shortest length of dot and VR4 can be increased to lengthen it.

VR3 varies the overall speed, the ratio of dot to dash and space etc., are fixed by VR1, VR2 and VR4, and VR3 varies the speed of the cycle as a whole, though slight variations do occur in the ratios especially at higher and lower speeds. However this is easily overcome by setting the ratios at approximately the speed one is going to work at and adjusting as necessary. In any case only one control will need adjusting. Increasing VR3 decreases the speed and vice versa.

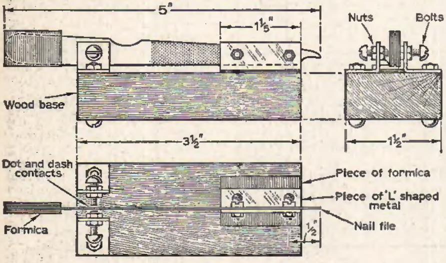


Fig. 3: Complete "paddle" for the key.

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Type 'A' 15 amp for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob quickly adjustable from 30°—80°F. 9/6 plus 1/- post. Suitable box for wall mounting, 5/-, P. & P. 1/-.

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Type 'C' is a small porcelain thermostat as fitted to electric blankets, etc. 1½ amp. setting adjustable by screw through side, 3/6. P. & P. 6d.

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 loft pipes from freezing if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. 7/6. P. & P. 1/1.

Type 'E' This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 7/6 plus 1/- P.

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Transistor set case with carrying handle size 10" x 6" x 3". Strongly made from best plywood and covered Two tone fabric—looks very smart—suitable for receiver—amplifier—extension Speaker etc.—Originally listed at 29/6—but offered this month at only 15/- plus 5/- post and insurance also given free with it is a printed circuit board to suit it and building instructions for fine two wave radios—Don't miss this grand offer.

TAPE RECORDER BARGAINS

Capstan Driven, 5 Transistors

SPECIFICATION:—200/7000 C.P.S.—400 MW output—double track-twin speed (3¾ and 7½) fast rewind time—5m. spool gives one hour playing with standard tape weight 7 lbs. Size 8 x 11 x 5¼. Complete with batteries, microphone—tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop.

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THE 'MINY'

Best of the spool driven machines, remote control on mike, battery operated.

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TRANSISTOR SET CASE

Very modern cream cabinet, size 5½ x 3 x 1⅝in. with chrome handle, tuning knob and scale. Price 4/6 plus 2/- postage.

GANGED POTS

Standard type and size with good length of spindle—made by Morganite. List price is 10/- each but if you act quickly you can have them at 12/- doz. (or 1/6 each if less than doz). Following values in stock all ¼in"—5K + 5K—10K + 10K—100K + 100K —500K + 500 K all new and unused. Post 2/9 on 1st doz then 1/- per doz. 6 doz or more post free.

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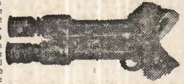
Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9.

See in the Dark

INFRA-RED BINOCULARS



These if 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 lens for TV camera—light cell 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 £2.17.6 plus 10/- carriage and insurance. Handbook 2/6.

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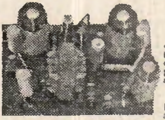

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4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 5 m/v.

Price 19/6

Post and insurance 2/6. 35 ohm Speaker 12/6 extra.

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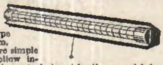
The Princess superhet described below is a very fine little set that has been most carefully designed for high performance. Only recently (under another name of course) this was on offer in many radio shops, for £10.19.6, but we have been fortunate in obtaining the parts at a very low price and now pass this saving on to you. If you act quickly you can purchase this for only 39/6 plus 3/6 post and insurance. Note these features.

- Long and Medium Wave
- Long clear dial with travelling pointer and slow motion drive
- Push pull output approximately 350 m.w.
- A.V.C. and feed back
- Dust cored H.Q. I.F. transformers
- High selectivity ferrite aerial
- Six tested and guaranteed transistors
- Printed circuit board for fool proof assembly
- Economy output circuit gives long life from P.P.3 battery
- Permanent magnet moving coil speaker
- Cabinet size 4¾" x 3" x 1½". Carrying strap

You get over 80 parts (list value over £10). In fact everything you need and easy to follow wiring and aligning instructions. Don't miss this wonderful offer. Make up several while you have the chance. Use them as presents and you'll be loved for ever. Battery 1/9 extra. Data separately 2/6.

INFRA-RED HEATER



Make up one of these latest type heaters, ideal for bathroom, kitchen, bedroom, etc. They are simple to make from our easy to follow instructions—use silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal-casing as illustrated, 21/6 plus 3/6 post and insurance. Pull switch 3/- extra.

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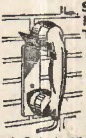

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Transistors

These are GEC S3 type transistors. Type GEC S1 will perform equally well and although others have not been tried in Fig. 1, it is presumed that any p-n-p type transistor which is suitable for a class B output stage e.g. Mullard OC72 would be suitable, GEC types were chosen because they were less expensive at the time. It may be necessary to adjust some of the component values, if other types of transistors are used, because differences in performance was noticed, even with individual transistors of the same type, but these variations were slight.

Layout and General Information

For the right-handed operator it is necessary that all the adjustable controls can be easily turned with the left hand, so that adjustments can be made whilst actually operating, and saves the necessity of having to stop to alter the ratios or speed etc. A left hand operator should have access to the variable controls with his right hand.

The two pairs of wires from the relay contacts RLC2, RLC3 should each preferably be terminated in a plug and socket at the back of the box or chassis to prevent wires going to the tx and osc. (only for separate osc. not built in the key as in Fig. 1) from getting in the way near the paddle. The on/off switch would naturally be convenient in the front, (when Fig. 2 is built only one pair of contacts need be terminated in plug and socket for tx). The max. height of the handle above the bottom of the box or chassis should not exceed 2in., this height also includes the width of the nail file.

When operating the key the correct position of the arm and hand is absolutely essential and it is as follows:— The arm from the elbow down should lie relaxed on the table, with the thumb side of the hand upwards, the handle of the key is then operated with thumb and first finger in a gentle side to side movement. The whole of the hand up to the wrist should follow the movement of the fingers and in this way, an operator can send for hour after hour without getting tired. The writer knows of no other method which can equal that just described for operating the key and getting the best results from it with the minimum of effort.

When assembling the device, especially when experimenting with it, it was found on several occasions that minute pieces of solder, dust, etc., got between the relay armature and pole face preventing the key from functioning, and it was only after testing everything else that the relay was examined and the fault discovered, however, a thorough clean-up after the unit is placed in the box would avoid this fault altogether, together with careful soldering.

When Fig. 2 is built (i.e. key and oscillator together) a loudspeaker may be built-in or a "split phones" arrangement with a 3-way switch, i.e., e.g.

Switch Position

1. One earpiece to Radio Reciever, other earpiece to audio oscillator.
2. Both earpieces to Radio Receiver.
3. Both earpieces to oscillator.

While on the subject of Fig. 2, the current consumption with oscillator and key drawing from the batteries, varies between some 20 to 30mA, negligible current is drawn when not keying; however the on/off switch from the supply should be switched off when the key is not in use.

The photograph shows the key when built; it can however be enclosed in a much smaller space, and must not be too light in weight although the batteries do help to make up weight, also the width should not be less than say 3 to 4in. This helps to stabilise the unit and prevent it from moving when keying. Component tag boards were screwed to the side of the box and the opposite side was used for the variable pots. A suitable lid fits on top and the workings are then completely enclosed.

Although there are many different combinations of capacity and resistance which would give the same results as the key in Fig. 1 the circuit design is a standard, and providing the constructor can comply with the transistor limitations, and provide enough current to operate the relay, a wide range of combinations are open to him. Dots are normally to the right operated by the thumb, dashes are normally to the left operated by the first finger. In Fig. 1 both dots and dashes can be obtained from either side, should an operator require the opposite. ■

ON THE SHORT WAVES

—continued from page 1043

There are VK's on topband and at least one of our reporters has heard a JA. Anyone else hear these remote parts at this frequency? For those wanting to know when to listen on 20 and 15 the answer is that they are open from 0600-1800 G.M.T. Someone will doubtless hear a piece of fabulous DX at 1081 now that I've said that! Listen on phone only for VQ8AZ and VQ8BZ in Mauritius. ZD8's are planning some DX-peditions in the Caribbean area soon, ZD5M is loose on 21 c.w. (Swaziland), while on 20 c.w. TL8SW is quite a rare bird. ZS2MI reported active from Marion Island, and spies report that an expedition is promised for Rio de Oro soon. Contests for March include 12-13th, ARRL DX Contest (phone); 19-20th, BERU; 26-27th, ARRL DX Contest (c.w.); April 3rd, Low Power (QRP) Contest. All logs welcome, deadline for May issue is March 27th.

A COMMENTARY BY HENRY

PRACTICALLY WIRELESS

No. 20

M.T.B.F.

THE perennial subject of breakdown has haunted the electronics industry from the "shed-in-the-back-garden" days to this era of chrome and plastic fabricatories, despite the analysis and study of a whole new group of pseudo-scientists, whose main function seems to be to evaluate and correlate and argue at length with each other in the learned journals.

It does not haunt those of us who were raised on the breadboard and makeshift component. Breakdowns were the order of the day. We righteously asserted that one could only learn by one's mistakes. But to a later generation of experimenters and constructors, brought up on ready-made receivers, and elegantly annotated kits, failure is taboo.

It may seem strange that a manufacturer should even admit the possibility of failure when launching a product. Let alone publish his estimate of Mean Time Between Failures, which is what the electronics industry understands by those initials.

The aforesaid pseudo-scientists have great fun working out the MTBF and juggling the figures as dextrously as a radio retailer trying to explain battery working hours to the rather dim purchaser of a portable tape recorder.

It is becoming a modern trend to admit not only that the equipment can go wrong, but that it will predictably continue in its back-sliding ways. Our postbag shows that many readers are not yet educated into this way of thinking. Any practising service engineer could soon offer a host of demonstrations.

Trying to explain to a rather dim purchaser.

We do not have to look much farther than the cheaper imported transistor radios. Except that a request for repair will show that the MTBF is either zero or infinity depending on whether the harassed salesman is sucker enough to accept the job, or shuns any responsibility.

In the words of the poet: "Radios out of Old Hong Kong, All too frequently go wrong".

And the optimists who imagine that things will improve are due to be disillusioned. Already, rising labour rates, are worrying the Japanese, and have brought the electronics section of Hong Kong's labour force into the "elite" class. With Taiwan emerging as a healthy radio manufacturing centre and the great labour markets of Korea and India as yet untouched it seems likely we shall get more and more of the cheap and nasty cut-price models in the near future.

To digress: a Japanese industrialist told us the interesting story of an argument with a taxi-driver whose radio blared annoyingly in the cab. He took a lot of convincing that Hong Kong was part of the wrong Empire. The sun will never set on shoddy goods—that's for sure! Of course, it is unfair to lay the whole blame abroad. There are too many examples nearer home.

Henry has been taken to task, and is unrepentant, for dwelling on the maker's obsession with profit, to the apparent exclusion of reliability. Apart from the top-quality goods, where competition is for specifications and facilities and where high price seems an added attraction, most development seems to consist of finding

An argument with a taxi driver.

ways of cutting costs.

A nodding acquaintance with the term "serviceability" comes only from the copy-writing lads, who see a hinged chassis or plug in parts and go delirious in print. Original reason for the hinge was probably that it fitted a factory jig or facilitated swifter inspection. The plug and socket connectors are now mass-produced by astute experts who have a formidable range of such products, and can thus supply more cheaply than the set-maker can get his joints laid in and soldered.

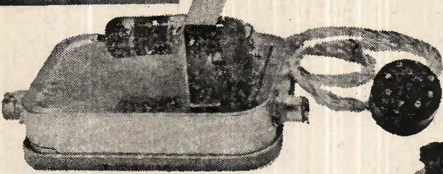
There is a notorious television receiver with both these "advantages". Only trouble is that to take full advantage of the hinge it is necessary to partially dismantle the tuner unit and 405/625 system switch, and the first time the serviceman tries it he generally manages to break the edge of the printed board. On later marks, the plug sections have wiring added to the back pins, compounding the felony. The l.o.t. is almost impossible to remove unless the printed board is flexed and the system switch rod bent.

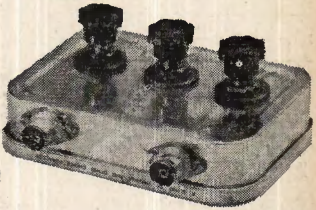
MTBF, in this case, is in inverse proportion to the amount of extra time taken by the service engineer in clearing what may have been originally a simple fault.

Probably one of those plug connectors not making properly. Hong Kong fashion.

FOR THE BEGINNER

A VERSATILE PREAMPLIFIER and TONE CONTROL





by A. S. Ellis

IN the field of audio, need is often felt for an unspecialised preamplifier capable of being used with a wide variety of equipment for various purposes not necessarily forming a permanent part of any of these pieces of equipment. The particular preamplifier to be described was originally built to give greater sensitivity to a somewhat insensitive "gram" amplifier incorporated in a radio receiver. The preamplifier unit has, however, since then been used with enormous success in a number of other applications.

In the particular "gram" amplifier modified no variable tone controls were present and reproduction of gramophone records tended to be somewhat disappointing at times. Most annoying of all was an almost complete absence of bass. Accordingly the tone control box was constructed for insertion between the pick-up and the preamplifier. The results, when all modifications had been completed, were astounding. Since then the tone control box, too, has been put to numerous uses, not the least of which has been that of a tone correction device whilst making tape recordings.

No originality whatsoever is claimed for the circuits used; the preamplifier is of fully conven-

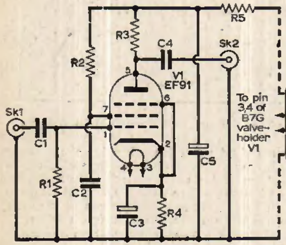


Fig. 1: The circuit diagram of the preamplifier.

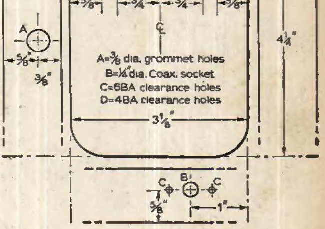


Fig. 2: Preamplifier chassis drilling details (top view).

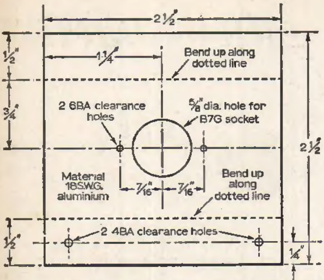


Fig. 2a: Drilling and bending details of valveholder bracket.

tional design, the control circuit is that used in the very popular Mullard two and three valve preamplifiers. However, the form of unit construction is somewhat novel and adds considerably to the versatility of both units.

Externally Powered Preamplifier

The preamplifier circuit is built around the well-known pentode type EF91, which is easily obtainable. In this circuit (Fig. 1) the valve consumes no more than about 1mA h.t. It also requires a heater supply of 6·3V at 0·3A, but both these requirements should easily be met without any overloading of the power-pack of the equipment to which it is attached.

Construction of this unit was carried out in and around a 2oz. tobacco tin of the variety measuring

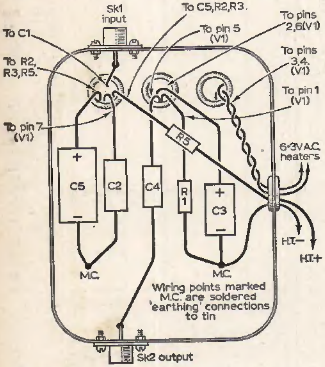


Fig. 3: Preamplifier component layout and wiring.

PRE-AMPLIFIER COMPONENTS LIST (Fig. 1)

Resistors:

R1	1M Ω	R4	2·7k Ω
R2	1M Ω	R5	15k Ω
R3	220k Ω		

All 10% ½W carbon.

Capacitors:

C1	0·1µF	paper	150V.
C2	0·1µF	paper	350V.
C3	50µF	electrolytic	12V.
C4	0·1µF	paper	350V.
C5	16µF	electrolytic	350V.

Miscellaneous:

V1, EF91, SK1, SK2 coaxial sockets. PL1 power supply plug to fit socket mounted on receiver or other equipment, type optional. 2oz. tobacco-tin, size approx. 4 x 3 x 1 in.

Small piece aluminium 2½ x 2½ in. One B7G valveholder. Nuts and bolts.

TONE NETWORK COMPONENTS LIST (Fig. 4)

Resistors:

R1	47k Ω	R3	68k Ω
R2	39k Ω	R4	6·8k Ω

All 10%, ½ w.

Capacitors:

C1	560pF	silvered mica
C2	8200pF	silvered mica
C3	2200pF	silvered mica
C4	0·02µF	paper 150V.

Potentiometers:

VR1	250k Ω	log.	treble
VR2	250k Ω	log.	bass
VR3	250k Ω	log.	volume

Miscellaneous:

2oz. tobacco tin, approx. 4 x 3 x 1 in., 3 miniature instrument knobs, SK1, SK2 coaxial sockets.

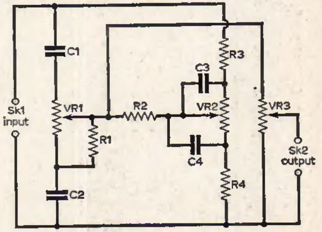


Fig. 4: Circuit diagram of tone control network.

approximately 4 x 3 x 1in. The lid of the tin was removed, later to become the baseplate of the preamplifier. The tin itself was then turned upside down and used as a chassis. Drilling details are shown in Fig. 2. It was decided not to mount the valve vertically on the tin as it was thought that wiring beneath would become unnecessarily crowded and inconveniently placed. Accordingly a piece of aluminium 2½ x 2½in. x 18 s.w.g. was

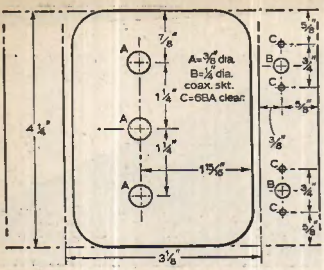


Fig. 5: Tone control chassis drilling details.

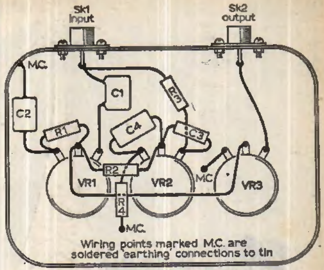


Fig. 6: Tone control wiring and component layout.

cut, drilled and bent as shown in Fig. 2a so that the valve could be mounted horizontally. This support was secured to the main chassis by means of 4BA nuts, bolts and shakeproof washers. Wires to the valveholder were taken from inside the tin via holes A, B and C (see Fig. 2). (Heater wiring was kept well away from the rest of the circuit.) Small components such as R1, R2 and R3 were wired directly to the valveholder but the remainder of the components were mounted inside the tin out of sight (see Fig. 3 underchassis point-to-point wiring diagram). Earthing connections were easily made by soldering directly to the tin chassis. Power supply leads were taken through hole D1, which was fitted with a rubber grommet. The replaced lid forming a baseplate, completed the preamplifier. *Note:* If desired a volume control may be incorporated in the unit by substituting a miniature 1MΩ log. potentiometer for R1. This can be mounted vertically in the tin after drilling a suitable hole and can be fitted with a miniature instrument knob.

Preamplifier Power Supplies

The unit appears to be fairly tolerant of power supplies applied to it, though an h.t. supply voltage of between 200 and 300V d.c. is preferable. In the prototype the power supply leads were terminated in an old Mazda octal valve base which took on the role of a supply plug. A similarly wired matching valveholder was mounted on the main equipment.

Tone Control Box

A very wide range of tone control is available with this circuit (Fig. 4): VR1 provides treble cut and boost; VR2 provides bass cut and boost; VR3 is a volume control. It must, of course, be borne in mind that as with all passive tone control networks there is a considerable insertion loss. However, if the unit is used with the preamplifier already described a fair excess of signal is still available.

As before, a 2oz. tobacco tin was used as a chassis, the lid being temporarily removed to be used as a baseplate later. The drilling details of the tin are given in Fig. 5; holes A, B and C are for the bushes of the vertically mounted potentiometers. (It is recommended that miniature potentiometers be used, otherwise some difficulty may be encountered in fitting all three components into the tin.) There is ample room in the tin for all wiring and components may be supported on the potentiometer and socket connections (see Fig. 6). When complete and with lid replaced the circuit is completely screened; there will therefore be no hum problems.

No difficulty should be experienced in building either of these units even by the newcomer to audio circuitry. ■

THE PW REFLE…

G.J.KING

THE exercise was to create a pocket-sized two-transistor local-programme m.w. radio with an internal ferrite rod aerial, suitable for working a crystal earpiece, and that could be built easily from readily obtainable parts.

While the set could have been made somewhat smaller than the final version, measuring about $2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{3}{4}$in., including the battery, this represents about the smallest size that can be achieved by the use of easily obtainable components.

A smaller overall size could probably have been obtained by the use of a PP5 battery instead of the PP3 used, but the latter was eventually decided on because this is obtainable anywhere.

Moreover, for fair performance the ferrite rod aerial should not be too short, and the dimensions referred to above allow the use of a $2\frac{1}{2}$in. length of $\frac{5}{16}$in. dia. ferrite rod upon which the m.w. aerial coil is wound. The pick-up efficiency and the "Q" (goodness factor) of a ferrite rod aerial deteriorate as the length and the diameter of the rod are reduced.

Most pocket-sized sets use a single-gang tuning capacitor, sometimes with a stage of "untuned" r.f. amplification. The set to be described uses two-ganged tuning, one section for the ferrite rod aerial and the other for the r.f. stage. This improves the efficiency a little above that possible by the use of an untuned stage.

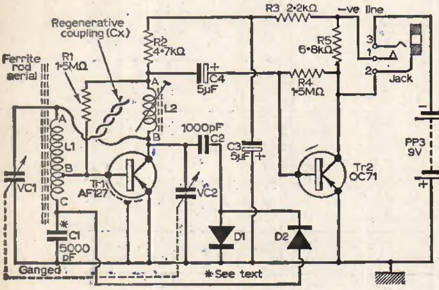


Fig. 1: Circuit of the Reflex 2.

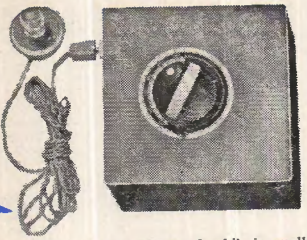
The Circuit

Before the construction of the set is described, let us have a look at the circuit, which is given in Fig. 1. It will be seen that two transistors and two diodes are used, marked (Tr1, Tr2, D1 and D2 respectively).

Now, the first transistor Tr1 is arranged in a "reflex" circuit so that it performs two functions. Firstly, it acts as an r.f. amplifier. That is, it has coupled to its base signals from the ferrite rod aerial L1, tuned by VC1 section of the tuning gang. These signals are developed in amplified form across the collector coil L2, tuned by VC2 section of the gang. From the collector of TR1 they are coupled to the detector circuit through C2. The detector comprises the two diodes D1 and D2 in conjunction with the input impedance of Tr1.

Thus, audio signal acts in the base-emitter junction of Tr1, and this is how the transistor does its section job. That is, it acts as an audio amplifier. This time, however, the amplified audio signals are developed across the collector resistor R2. From the audio aspect, L2 and its associated components have virtually no effect while from the r.f. aspect R2 is isolated by the low impedance presented to these signals by C4 and the base circuit of Tr2. We thus get audio at the junction of R2 and L2 yet very little r.f. signal.

At the collector proper of Tr1 we get both audio and r.f. signal. The audio is somewhat attenuated by the r.f. coupling to the detector diodes, but there occurs a certain degree of negative feedback which tends to reduce the efficiency of a single transistor circuit so reflexed below that possible by the use of separate transistors and properly isolated circuits. Nevertheless, the extra gain possible



by the reflexed action is well worth while in small receivers.

Now, the audio signal at the junction of R2 L2 is applied to the base of Tr2 through the electrolytic coupling capacitor C4. Tr2 is arranged as a low-level second audio amplifier for working the crystal earpiece. The audio signal is developed across the collector load R5 and is directly coupled to the earpiece via the jack socket, at terminals 1 and 2. Terminal 3 on the jack socket serves as a switch, so that a switch contact in the jack makes when the jack plug is inserted, thereby connecting the battery supply circuit from battery negative to the negative line of the circuit, via jack socket terminals 3 and 1.

Switched Jack

Miniature "switched" jacks are available, but those investigated by the author are arranged so that the switch *opens* when the earpiece jack is inserted. This action can be reversed, so that the switch *closes* when the jack plug is inserted, by easing the spring switch contact so that it is above the jack contact (contact 3) which is activated by the plug. Fig. 2 shows at (a) the jack socket in its ordinary state and at (b) the socket with the contact rearranged in the manner described above.

Both transistors run with very small emitter current, and this current is determined by the values of R1 (for Tr1) and R4 (for Tr2). R3 and C3 serve to decouple the two stages and improve the stability margin.

Tr1 is a Mullard AF127, which is a smaller version of the AF117. The latter can be used but its larger size takes up most of the room between the tuning gang and the ferrite rod aerial. Tr2 is a medium gain OC71. The diodes D1 and D2 are miniature Mullard OA91's or equivalents. It is important to make sure that they are connected round the right way in the circuit otherwise the sensitivity will be impaired.

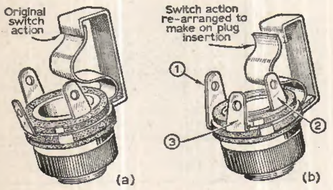


Fig. 2: Modifications for the phone socket.

The receiver is built on a laminate or bakelite panel of approximately 2½ x 2¼in. Most of the components are secured to the panel and connected in circuit by the use of small eyelets fitted in holes drilled in the panel. In addition to the eyelet holes, the panel carries a ⅜in. diameter hole for mounting the tuning gang, two holes for L2 coil former, two holes for the rubber band that fixes around the ferrite rod aerial mounting grommets, two holes for the battery securing rubber band.

Drilling details for the panel are given in Fig. 3, and the holes marked with "Y" are those to accommodate the eyelets, of which there are twenty-four. These holes should be of a size that provides the eyelets with a fairly tight fit, the actual size, however, being determined by the type of eyelet employed. A *ready drilled* chassis board is available plus twenty-four push-fit eyelets (see components list). A No. 48 drill is used for the former fixing holes of L2, while a ⅛in. drill is used for the rubber band holes that are used for securing the ferrite rod grommets and battery.

Fig. 4 shows how the holes in the panel are employed, and this also incorporates a point-to-point wiring diagram. The eyelets, it will be seen, carry the capacitors and resistors on the left-hand side of the panel, also the lead-out wires of Tr1 and Tr2 (the latter in the top left-hand corner) in addition to the two diodes and capacitor C1 (near the ferrite rod aerial). The broken lines on this diagram correspond to point-to-point connections made beneath the panel, while the full-line connections are those made on the top of the panel.

When the holes are drilled in the panel and the eyelets fitted, the next move should be to solder the components to the eyelets, after which the larger components can be more easily fitted. As each component is soldered to the appropriate eyelet the above- or below-panel interconnecting wire or wires should also be soldered. These wire interconnections can either consist of thin, flexible p.v.c. covered stranded wire or about 26 s.w.g. tinned copper wire covered with insulated sleeving. Stranded miniature p.v.c. wire was found to be the best for the job by the author.

The eyelet-connected components on the left-hand side of the panel are mounted vertically, and it is this kind of mounting that enables all the components (of "standard" size) to be accommodated on the board. The idea is to dress one of the lead-out wires from resistor or capacitor back along its length, so that the two ends can then be pushed into the adjacent eyelets. It is a good plan to put a short length of insulated sleeving over the wire running by the side of the component to prevent any possibility of short-circuiting.

A miniature soldering iron will greatly facilitate the various joins and prevent burning the insulated sleeving and components. It is important, though,

continued overleaf

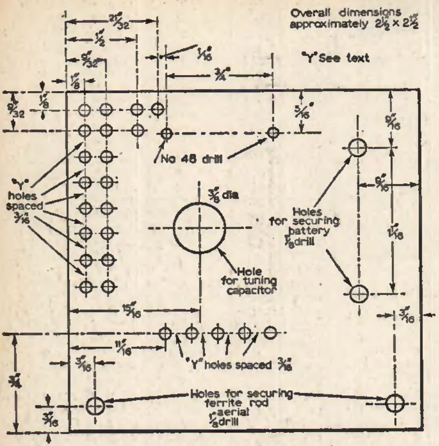


Fig. 3: Drilling details for the panel.

that the tip of the iron be clean and nicely tinned and—of course—as hot as possible. When soldering to the eyelets, the author found it best first to fill the eyelet holes with solder, to cut the component lead-out wires to the correct length, tin the ends and then plug them as it were, into the eyelets after making the solder molten with the tip of the soldering iron. This technique also makes it simple to change components and to experiment with components of different values.

After the eyelet components have been soldered in position and the interconnecting wiring completed as far as possible, the two-gang tuning capacitor should be fitted. The large centre thread of the gang spindle bearing fits in the ⅜in. diameter hole on the panel, and the gang is secured to the panel by the large brass nut. At this stage, make sure that the protruding 6BA thread on one of the gang bolts appears at the top left-hand side of the chassis board.

The next item to position is the former for L2. This is an ordinary bakelite or polythene type of component. It is secured in position by two "self-tapping" or "binder" screws from the top of the panel. The coil winding is put on later.

It then finally remains for the ferrite rod aerial to be wound and mounted, for L2 to be wound and put on to the former and for the wiring to be completed.

Aerial and Coil Windings

The ferrite rod winding is made on top of a piece of thin brown paper or card itself wound round the rod. The card should be cut to 1½ x 1½in., allowing for two turns round the rod, giving a winding length of 1¼in.

The winding is made of a total of 72 turns of 28 s.w.g. enamelled-covered copper wire, tapped at ten turns from one end. Close spaced, the turns occupy almost the whole length of the card leaving a little margin at each end, as shown in Fig. 5. The turns are finally secured in position by means of Sellotape. The card former allows the winding easily to be slid along the ferrite rod to provide a small adjustment of inductance, maximum inductance being with the winding midway along the rod.

The coil (L2) is also made on a paper or thin card former but this time it is cut to measure 7/16 x 1¼in. with two turns round the former. It is best to hold the former in position with Sellotape before commencing the winding, and this technique can also be used for the aerial winding.

L2 consists of a total of 136 turns of 39 s.w.g. enamelled-covered copper wire in four layers of 34 turns, each layer being separated from its partner by two thicknesses of Sellotape.

COMPONENTS LIST

Resistors:

R1 1·5MΩ R4 1·5MΩ
R2 4·7kΩ R5 6·8kΩ
R3 2·2kΩ
All 20% miniature.

Capacitors:

C1 0·005μF (5000pF)
C2 0·001μF (1000pF)
C3 5μF 12V. electrolytic
C4 5μF 12V. electrolytic
All miniature types.

Semiconductors:

Tr1 AF127 Mullard (or AF117, larger size)
Tr2 OC71 Mullard
D1 OA91 D2 OA91 (Mullard)

Miscellaneous:

Miniature 300pF twin gang, PW/01. Drilled chassis board with 24 push-fit eyelets, rubber band for battery, PW/02, 2½ x 5/16in. dia. ferrite rod—paper former—quantity of 28 s.w.g. enam. wire—mounting grommets—rubber fixing band, PW/03.

0·3in. coil former—dust core—paper former—two binding screws (self-tapping)—quantity of 39 s.w.g. enam. wire, PW/04.

Miniature battery clips, PW/05.

Ready drilled case and back—dial—knob, PW/06.

Crystal earpiece with lead, 3·5mm. jack plug and socket.

PP3 battery or equivalent

Small quantity of wiring wire.

Items: PW/01—PW/06 may in cases of difficulty be ordered directly from R.C.S. Products Ltd., 11 Oliver Road, Walthamstow, London, E.17.

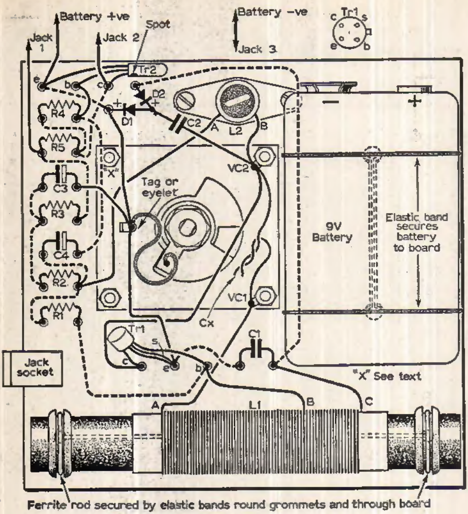


Fig. 4: Component layout and wiring details.

It is best to produce this winding either on a separate former or on the former to be used *before* it is finally fitted to the panel. The card former can then easily be slid over the former once the latter is in position and screwed down.

The ferrite rod is held clear of the panel by two ¼in. rubber grommets, one at each end. These are also used for securing the rod a thin rubber band passing round them and through the holes at each side of the panel. A similar rubber band is used to hold the PP3 battery to the panel (see Fig. 3).

Finally, a thin flexible two-conductor lead should be made up for the battery connections, the ends of the conductors terminated in suitable connectors for the PP3 battery and a three-conductor flexible lead should be processed for connecting from the panel at the various points indicated in Figs. 3 and 4 to the jack socket. Extreme caution should be taken over this latter exercise to ensure that the conductors are terminated to the correct tags or terminals on the jack socket (see Fig. 2). It is also very important, of course, to avoid reversing the battery polarity, for while this may not completely ruin the transistors it could reduce their efficiency and alter their characteristics.

There is sufficient room to accommodate the jack socket between the ferrite rod aerial and R1 (see Fig. 4, for instance), but since the jack socket terminals carry the full negative voltage of the battery, inadvertent contact between one of these terminals and the base end of R1 could immediately destroy Tr1. For this reason, *an insulating sleeve* should be dressed over the terminal end of the jack socket.

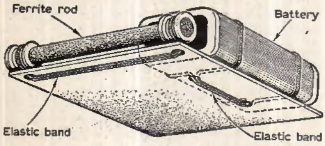


Fig. 5: Method of connecting battery and ferrite rod.

Tuning Up

L2 former should be fitted with a dust-iron core and initially this should be adjusted so that it embraces the whole of the winding width. With L2 so adjusted and with the aerial winding in the centre of the ferrite rod, there should be no difficulty in receiving the local m.w. station. To peak reception on this programme, L2 core should be re-adjusted while slowly turning the tuning gang a little either side of the station for optimum gain.

While it is impossible for a receiver of this kind to track accurately over the whole dial, reasonable tracking is achieved owing mainly to the flat tuning of L2. However, if the set is required to be peaked to a more distant station the station should be tuned as near as possible on the gang and then L2 should be re-adjusted at this new setting for optimum gain

A degree of feedback occurs in the r.f. stage, especially towards the higher frequency end of the band automatically due to stray capacitance. However increased feedback can be applied simply by flexing a pair of thin, insulated conductors between the two " live " terminals of the tuning gang. This is shown as the " regen coupling " on the circuit (Fig. 1) and the coupling in physical form is clearly shown in Fig. 9. On no account should a d.c. connection exist between the two flexed conductors, for their purpose is simply to provide a small variable capacitance. In the prototype, the five

—continued on page 1081

Modulated Light Telephone

We have experimented with the Modulated Light Telephone Link (February issue) at school and have found results reasonably good although there was a fair amount of background noise and distortion when used outside in daylight.

We discovered that a large lens was better for focusing the light beam onto the photocell than a parabolic reflector. The frequency response at 20ft. went up to nearly 4 kc/s.

I would be interested to know if anybody else tried this and what their results were like.

R. H. Boston.
The Chalet,
Pett Road, Pett,
Hastings,
Sussex.

Copies for Sale

I have the complete copies of Practical Wireless for the years 1959—60—61—62—63—64—65, and if any of your readers are interested I would be willing to dispose of these for a reasonable sum.

All enquiries should be accompanied by a stamped addressed envelope.

W. R. Hebditch.
90 Clarendon Road,
Hove 3,
Sussex.

Who Wants?

Owing to lack of space, I am forced to dispose of an amount of old and new radio chassis and components. Also I have available P.W.'s from January 1961 to March 1965, and a number of various other magazines.

I am willing to give to anyone who cares to call, any of the above items. Sorry, but no letters will be answered.

Nicholas Hansen.
413 Church Road,
Upper Norwood,
London,
S.E.19.

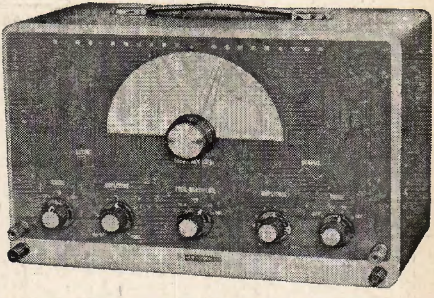
Tapespondent Wanted

I would like to tapespond with anyone of my own age (16) interested in Hi-Fi radio and popular music.

M. K. Beeny.
28 Wheatfields,
St. Ives,
Huntingdon.

NEWS AND...

SINE-SQUARE WAVE GENERATOR



From Heathkit comes the IG-82U sine-square wave generator which has a frequency range of 20c/s to 1Mc/s in 5 bands. Sine and square wave outputs are available separately or simultaneously and there is less than 0·15μSec. rise time on square wave and less than 0·5% distortion on sine wave. Separate output terminals and attenuators permit individual control. In kit form, the price is £24 10s. and assembled and tested £36 10s.

MULLARD MINIBOOKS

"Principles of Electrostatics" is the title of the first in a new series of "minibooks" announced by the Mullard Educational Service.

Based on the successful series of filmstrips and slides produced by the Service, the new books are expected to become popular with both student and teacher.

"Principles of Electrostatics" is a 32-page book measuring 15cm. x 21cm. Its 13 sections each cover a particular aspect of electrostatics. Typical headings are: insulators and conductors; the electrification theory; the gold leaf electroscope; capacitance and capacitors.

Minibooks are available from The Mullard Educational Service, Mullard Ltd., Mullard House, Torrington Place, London, W.C.1, price 2s. 6d. (including postage), cash with order.

GRUNDIG MANDELLO RESTYLED

Grundig (Great Britain) Ltd. announce that their popular Mandello Stereogram has been restyled to bring it up to date.

For those who treasure their discs, the four speed de-luxe record changer incorporates a micro-lift facility. The smart push button radio receives v.h.f., m.w., l.w. and s.w. (bandspread) and can be fitted with a decoder when stereo broadcasts become available.

Two Grundig Superphon ceramic magnet loudspeakers provide 6W of stereo power—3W per channel—and sockets are provided for the connection of extension loudspeakers, stereo decoder, tape recorder and external aerials. The Mandello incorporates a dipole and ferrite aerial, 6 valves, metal rectifier and 2 diodes. Price is 99 guineas including P.T.

..COMMENT

SILVER MEDAL AWARD FOR MULLARD FILM

The Mullard film, "Thin-film Microcircuits", was awarded a silver medal (1st prize) in its category at the 10th International Festival of Scientific-Teaching Films, organised by the University of Padua in conjunction with the 1965 Venice Film Festival. Over 150 films from 18 countries were entered and of these 52 were selected for showing to the international jury.

Britain did particularly well this year. Seven of the ten films entered were chosen for screening and three gained awards.

"Thin-film Microcircuits" is a 16mm sound and colour film which deals with the manufacture of this new type of electronic component from design stage to the finished product. The film also describes typical applications including space vehicles, miniature computers and industrial electronic equipment.

Another Mullard film, "Electromagnetic Waves—Part 2", won a bronze medal (2nd prize) at Padua last year.

Both of these films were featured at the P.W. and P.TV. Filmshow on Feb. 4th (see page 1030).

ELECTRONICS GROUP

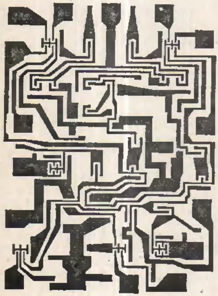
The St. Cyres Electronics Group are holding a series of meetings in Penarth (Glam.) the first of which was on 14th January, 1966.

By kind permission of Mullard Ltd., this group will be showing a very wide range of technical films which they have issued. As Penarth is only about 5 miles from Cardiff, many readers may be interested in joining the Group and seeing these films.

Further details may be obtained from the organiser, Mr. C. Bogod, "Dickens", 26 Forrest Road, Penarth, Glamorgan.

HAM COMPETITION

An international competition for radio hams is being held in Tenerife. The competition is based on the total number of contacts made during a given period, between operators all over the world and those in Tenerife. Allowance is made for the distances involved. Prizes include a 20-day trip to Tenerife for two people including accommodation in a first-class hotel. Diplomas and Silver Cups will also be awarded.



ELECTRIC MODERN ART

Resembling an artistic design of modernistic proportions, this pattern is actually an industrial creation made by electronic engineers at the molecular electronics division of the Westinghouse Corporation in the USA. The pattern is to be reduced thousands of times until it is finally engraved on a piece of silicon of almost microscopic size.

The microminiature will then become an integrated circuit for use in a computer.

Any Ideas Please?

CAN any of your readers suggest a practical design for a simple transistorised audio generator tuning over a range of about 20—200 c.p.s.?

This would be of use in tuning loudspeaker enclosures and would not require a critical waveform output.

F/Lt. G. Halbert.

Officers' Mess,
R.A.F. Lyneham,
Wiltshire.

Frequency Synthesisers

I WAS interested to see in the March issue a description by "Henry" of a piece of apparatus known as a Frequency Synthesiser. He appears, however, to have grasped the wrong end of the wrong stick. As I understand it, and I have used frequency synthesisers, the equipment has nothing to do with diversity reception or multi-channel transmission as Henry would appear to believe.

The frequency synthesiser is a device which combines the stability of a crystal oscillator with the flexibility of a v.f.o. It can give any frequency from 1kc/s to 30Mc/s in 1kc/s steps with an accuracy of ± 2 parts in 10^8 and is normally used by s.w. broadcast stations as the r.f. drive input to a transmitter.

The basis of the synthesiser is a 1kc/s crystal whose harmonics up to 30Mc/s are selected by a triple mixing system to give the required output frequency. It uses about 90 valves and would cost a wealthy ham about £1,500.

J. N. Douglas.

Glasgow, N.W.,
Scotland.

Sell or Loan

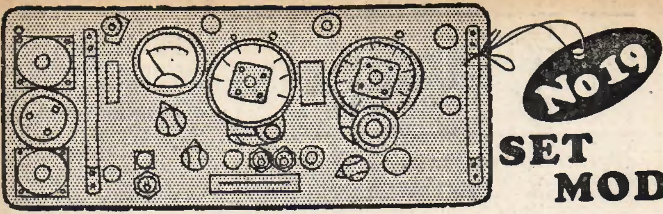
Sir, I would be grateful if any reader could sell or loan me . . .

. . . ferrite rod aerial for Cossor 524 a.m./f.m. receiver.—T. F. Jones, Flat 2, Block 3, Wychbury Court, Highfields Estate, Halesowen, Birmingham.

. . . a circuit diagram, and any information (i.e. modern equivalents of valves) etc. of the R1155A and R107 ex Government receivers.—Brian Carling, A4941, 27 Ellis Close, Cottenham, Cambs.

. . . the circuit diagram of the Sound A20/03858 tape recorder.—N. McFerran, 58 High Street, Newtownards, Co. Down, N. Ireland.

. . . the circuit diagram or service manual for the Air Ministry Oscilloscope type 11 Ref. No. 105/562.—R. E. Fields, 4° Torkington Road, Gatley, Cheshire.



SET MODS

by S. Simpson — *Part 2*

Inclusion of output stage

The reader should now have a highly sensitive receiver which, using about 10ft. of aerial, will provide signals all over the 4·5 to 8Mc/s dial. The 2 to 4·5Mc/s band will be relatively quiet at the 2Mc/s end until dusk. One does not always use a headset, however, so the next modification is the provision of loudspeaker output.

(1) Strip all components and wiring from above and below the v.h.f. end of the chassis, other than the valve sockets and the input plugs. (If desired, the input plugs can eventually be removed and the holes blanked off but, at present, the h.t. and l.t. live leads must be retained for two more checks before the mains power supply is introduced. Take care not to damage the two-gang v.h.f. variable capacitors, to be used later.

(2) Remove B GAIN and in its place, fit an s.p.s.t. toggle switch (hereafter "LS switch"). Mount the switch horizontally and ensure that ON entails moving the dolly towards the centre of the panel so that it "brings on" the output stage when wanted.

(3) Check that V8A, pin 8 is earthed. Connect a heater lead from V8A, pin 7 to the ON contact of the LS switch. Connect the OFF contact of the LS switch to V3A pin 2.

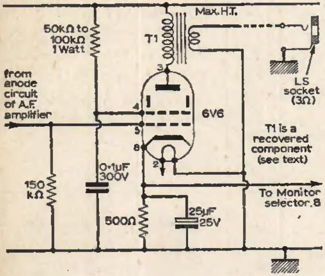


Fig. 4: Output stage, showing monitor point.

(4) Make up the circuit for V8A as shown in Fig. 4. The screened, grid-input lead is connected to TS1 tag 4A (already carrying a phone output lead; the lead remains there). The screen is earthed at TS1, tag 3.

(5) An output transformer was set aside earlier. This should now be fitted adjacent to V8A (Fig. 2). The blue terminal is connected to V8A, pin 3, green to TS1, tag 9, red to one lead of a 10in. length of twin cable, and white to the other lead; white is also earthed.

(6) Remove the KEY socket; note the required contacts to adapt the KEY socket to serve as a non-self-shorting loudspeaker plug. Connect the twin output lead to these contacts, then refit the socket.

(7) Fit one of the two 6V6 valves (supplied with W.S.19) to V8A socket. Connect the loudspeaker to the LS plug and insert the plug into the LS (formerly KEY) socket.

(8) Set up the receiver for phone operation, and when assured signals are being received, set the LS switch to ON. The loudspeaker should operate after the usual warm-up time for V8A. Switch off LS and check the loudspeaker output fades out.

Inclusion of band-spread

The tuning drive on the four-gang capacitor is quite slow, but although satisfactory between 2·5 to about 3·5Mc/s, signals whip through the dial rather swiftly at higher frequencies. A very satisfactory band-spread can be incorporated using existing material, but entails a fair amount of dismantling of the P.A. tuning arrangement.

(1) Dismantle the P.A. tuning drive as under:—

(a) Remove the central screw on the FLICK/SET control; remove the knob.

(b) Remove the four flick pre-set screws from the centre-piece on the P.A. TUNING dial.

(c) Remove two 4BA screws securing the complete drive and capacitor assembly to the chass's. The assembly should now be loose, but not yet removable.

(d) Remove one 4BA dome-head screw securing the slow-motion drive assembly to the panel.

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The latest craze! Push-button operation; crystal control. Fully transistorised (3-transistor circuit) for perfect reception. Tremendous commercial scope. Complete with strap, battery and 6-section antenna. Uses 9v. PP3 battery and operates up to half mile in open country. Measures 5½in. x 2¾in. x 1½in. Frequency 27.125 Mc/s.

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(*Post and insurance.* 4/6).

More powerful models available.

These sets cannot be operated in U.K.

MINY PORTABLE TAPE RECORDER Mk. II

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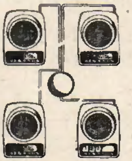
OUR PRICE £6.15.0.
(*Post and insurance* 4/6)

BATTERY/MAINS model, 220-250v. £7.15.0.
(*Post and insurance* 4/6).



Bargain of the Month
Save £7 ! !
Benkson 4-way Intercom

Bulk purchase has cut retail price by half! A top quality, fully transistorised system designed for hard office and professional use. Consists of one master unit and three sub-stations with built-in call system. Absolute privacy to each extension. Push-button control. Crystal clear reproduction through 3in. speakers. Suitable desk or wall mounting (size 6 x 4in.). Supplied complete with 50 yards cable, junction box, instructions, etc.

£7.10.0 (*Post and insurance* 5/-).

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SOLDERING IRONS

230/250v. copper bit and rapid heat element. Ideal printed circuit work 11/6 (*Post and insurance* 2/-).

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Two Valve Amplifier for portable gram units. Specification includes volume and tone control with 2-watt undistorted output.
£3.19.6 (*Post and insurance* 3/6).

Linear L 45A, 3-valve amplifier with treble/bass control. Quality reproduction at a realistic price.
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Stereo 2-valve amplifier using 2 UCL82 valves. Mono/stereo control switch with tone control etc. Absolute snip.
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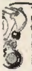
WESTRON TELEPHONE AMPLIFIER



You've waited years for this! Just insert PP3 battery, plug sensitivity cone to side of 'phone, and an incoming call is amplified. No need to stop work waiting for numbers to answer! Used with tape recorder (e.g. MINY, see above), perfect recording of conversation can be made. Ideal field sales reports.

ONLY 59/6 (*Post and insurance* 4/-).

TRANSONIC 6 RADIO

The very latest 1966 Transonic 6; single waveband with latest PNP circuit. Guaranteed tremendous performance.

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GARRARD AUTO-SLIM £5.19.6.
GARRARD AT5. £5.15.0.
GARRARD 3,000. £8.8.0.
B.S.R. UA16, £4.15.0
(5/- *post and insurance on each of above*)

STEREO CABINETS £3.10.0
(*Post and insurance* 5/-)

Vest Pocket MULTIMETER

Measures A.C./D.C. 0-1000 v., A.C./D.C. 1,000 ohms/V. D.C. current 150 mA. Resistance 100 k ohms. 39/6 (*post and insurance* 2/6)

BATTERY ELIMINATOR

Easy-to-fit eliminator takes the place of most 9v. batteries. Boosts expended batteries for re-use. PP3 Model 17/6 PP9 Model 26/-
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SPEAKER BARGAINS

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12in., specification as above but with built-in Tweeter. 3 or 15 ohms 39/6 (*Post and insurance* 4/6).

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Please send, without obligation, details of the Full-time Course in Radio and Television.

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Address ____________________

____

CMP3

(Note that there is a stout leaf spring holding the slow motion spindle against the edge of the engraved dial.) Remove the drive assembly.

(e) Loosen the grub-screw in the side of the dial centrepiece; it should now be possible to separate the dial from the flick-stop assembly; this will expose a small tapered pin which passes through the collar of the flick-stop stub-flange and the capacitor shaft. This collar (not the pin) is required for the modification and the pin must therefore be removed. (Note that the pin is fairly soft and easily burred. One way of removing it is to cut away the tapered end with a hacksaw and punch out the remainder.)

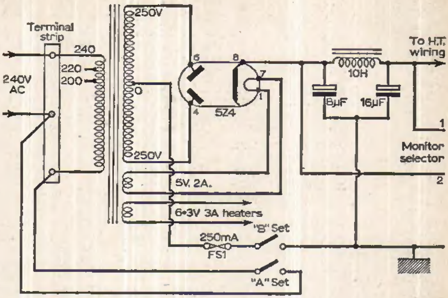


Fig. 5: Power supply circuit, showing monitor points and h.t. control.

(f) Summing up the results: One should have available the slow motion drive and attaching 4BA dome-head screw, the engraved dial riveted to a metal disc to which the centrepiece is attached by one 4BA dome-head screw, the collar and stub-flange removed from the capacitor shaft. At this stage it is advisable to prepare a new dial to replace the existing engraved plate, which can be removed by withdrawing the 4BA screw from the centrepiece and drilling out the four small rivets securing the plate to the metal disc. In the author's version a circular disc of thin card and of the same diameter as the engraved plate was marked with 30 equidistant divisions around one semicircle and Letraset numerals 1, 5, 10, 15, 20, 25 and 30 attached at the relevant divisions. The centre of the card was removed to almost the diameter of the underside of the centrepiece, then the card disc was secured to the metal disc, using Cowgum. The centrepiece was then refitted to the metal disc to complete the dial assembly.

(2) Earlier the reader removed the v.h.f. two-gang capacitor mounting plate. This assembly is now used as the bandspreader. Fit the collar to the capacitor shaft and insert the collar through the panel aperture formerly occupied by P.A. TUNING; leave the mounting plate as it stands for the moment.

(3) Fit the dial to the collar (note the flat on the collar which mates with the dial). Fit the slow-motion drive to loosely mate with the dial.

(4) By trial assess what shimming is necessary between the bandspreader mounting plate and the receiver chassis to obtain adequate slow-motion drive on the dial. Also check for positioning of the capacitor for all-round smooth drive. Mark the chassis, remove the capacitor assembly, drill and *tap* the chassis (there is no access for nuts under the chassis), then fit the complete assembly.

(5) Set the dial to 30 opposite the right-hand index mark. Fully enmesh the capacitor vanes, then lock the capacitor shaft, using the grubscrew accessible in the stub-flange.

(6) Strap both sets of fixed vanes and leave approximately 10in. tail on the lead.

(7) At the four-gang capacitor unsolder and remove the compression trimmer at OSC (marked on top of the capacitor plate). Pass the band-spreader tail through the trimmer hole, assess and cut the length to reach the rear connection, i.e. to the fixed vanes. Withdraw the lead, prepare and heavily tin about ½in. of the tail, reinsert the lead and solder it to the rear tag.

(8) Set up and check the receiver to try out the bandspreader. Note that it has little effect around 2-3Mc/s but is extremely useful at higher frequencies, drawing "attention" to dozens of c.w. signals usually unnoticed without band-spreading.

Inclusion of Power Supply

The reader, running through this article as "something to read", may wonder why a mains power supply has been left so late; the reason lies in the weight of the W.S.19, even as found, and the lifting and turning necessary during the preceding changes. If a power supply were added as an early step the work of the succeeding steps would be quite laborious. To add the power supply proceed as follows:

(1) Obtain a top-of-chassis mains transformer to supply about 250V at 50mA, 6·3V at 3·0A, 5V at 2A, also a smoothing choke giving about 10H at 50mA. A smoothing capacitor assembly providing 8μF and 16μF at 300V working, a 5Z4 rectifier and a three-way tag-board complete the components list.

(2) The circuit diagram is standard and given in Fig. 5. The locations of the components are shown in Figs. 1 and 2.

(3) The mains input lead terminates on the three-way tagboard (if possible attached to the choke) which will carry a flat-twin mains lead to the A SET switch.

(4) Dismantle the two-way switch assembly to gain access to A SET and B SET switches.

(5) Cut the existing lead on A SET passing into the W.S.19 power input plug cableform. Parallel-connect the freed contact on A SET and its neighbour at that end. Add one wire of the flat-twin mains lead (sub-paragraph 3) to the parallel connection.

(6) Remove the l.t. connection at the other end of the switch, parallel the two tags at that end and add the remaining wire of the mains lead.

(7) Ensure that all l.t. leads (less that passing into the W.S.19 power supply cableform) which were associated with the A SET l.t. connection are still in good contact. Fit a short length of sleeving over the common connection and tuck safely away.

(8) At the B SET switch remove the lead passing into the W.S.19 power supply cableform, cut the lead short at the power input plug. On the B SET remove the lead supplying h.t. to the circuitry and connect it to the tail from the smoothing choke (see Fig. 5). Connect the contact on B SET, just cleared, to chassis. Connect the contact which carried the W.S.19 h.t. lead to the centre tap of the h.t. winding on the mains transformer. The B SET switch now provides means of disconnecting h.t. while the heaters remain active.

(9) At the remote end of the mains supply cable check for continuity between leads with A SET "on" and open-circuit with A SET "off". Check for open-circuit to chassis with A SET in both positions.

(10) Connect a voltmeter (to read 300V) between the smoothing choke output and chassis.

(11) Ensure A SET is switched off and l.s. is also off. Connect the mains supply cable to a power outlet. Switch on A SET and B SET and note that the valve heaters are alight. Watch for the developing h.t. in the voltmeter. Switch off A SET.

(12) Plug in the headset, turn up A GAIN and R.F. GAIN. Connect the aerial and switch on A SET. Check the receiver functions normally, then turn down A GAIN to minimum and check for hum on the h.t. supply. If all is well switch off; if hum is present make the usual checks of capacitors, leaking cathode insulation and so on.

(13) Fuses. If it is desired to fit fuses a panel fuse to carry h.t. can be installed in the QUENCH aperture and another may be fitted in the rear wall of the chassis to carry mains input. The h.t. fuse should be connected in the earth return from the h.t. winding of the mains transformer (Fig. 5). Suitable fuses would be 250mA (h.t.) and 2A (mains).

Monitoring system

The inclusion of a monitoring system is a fairly simple task but, in a complex receiver, an addition well worth having. The system involves a nine-way single-pole wafer switch instead of the existing five-way double-pole component and uses the existing meter. The monitor system is shown in Fig. 6.

(1) Remove the panel meter and clamp assembly held by one 4BA screw passing through an eyelet on the clamp.

(2) Remove the clamp from the meter by loosening an 8BA screw at the top of the clamp.

(3) Using a 10,000Ω series resistor check the meter on a 1·5V supply for continuity. If satisfactory proceed to step 4 and then to step 7. If the meter is faulty continue as follows (these instructions are based on the author's findings on a faulty meter and the fault may be common in these meters, now several years old).

(4) Withdraw three small screws from the side of the meter case, withdraw the meter from the case and ensure the needle is free to move.

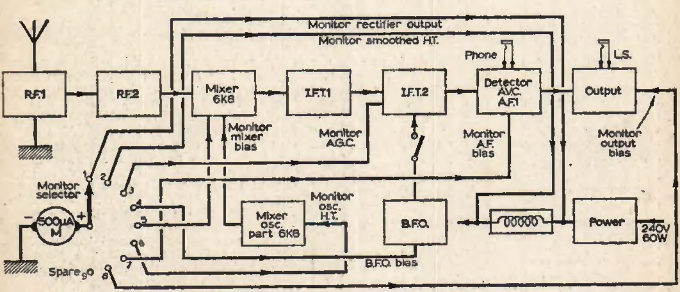


Fig. 6: Monitoring system in modified W.S.19 receiver.

(5) Again check for continuity but this time across the movement lead-in connections, i.e. close to the hairspring. If no reading is obtained check, using a lens, for broken connections. If there are no breaks the coil is damaged beyond amateur repair.

(6) If a reading is obtained when the movement is checked at the lead-in connections look for a minute break at the termination of a small coil on top of a resistor attached to one input terminal. (The break is probably caused by wire, hardened by age and subjected to fairly severe vibration during service life.) Resolder the connection and check the meter from the external terminals.

(7) Remove the existing dial. Prepare a new dial numbered one to ten and attach it to the existing dial (as was done with the bandspreader dial). Refit the modified dial to the meter.

(8) Reassemble the meter and put it aside meantime.

(9) Cut all wiring to the monitor switch. Remove the switch.

(10) Fit a nine-way single-pole switch in place of the removed monitor switch. (Space is limited, therefore the diameter of the new switch must not exceed 1¼in..)

(11) Obtain about 15in. (at least) of nine-way multicore cable, preferably having leads of different colours. Strip the outer sleeve (and screen if any), then prepare ¼in. tinned connections at one end of the cable. Pass the untreated tail of the cable through one of the two eyeletted holes adjacent to the bandspread capacitor.

(12) Turn the monitor switch knob fully counterclockwise and locate contact 1, also the wiper contact. To contact 1 solder one tinned lead of the cable. Follow on with the remainder of the cableform, noting on a monitor schedule the colour of each lead and its relevant contact on the monitor switch.

(13) When all leads have been attached to the switch contacts solder a 3in. lead to the switch wiper.

(14) Refit the meter. Earth the negative terminal. To the positive terminal connect the switch wiper lead.

The selection of monitored points is, perhaps, something for the reader to decide since views on this subject are many. The author suggests the following as being very useful (reasons are given against the less obvious points):

(1) Main h.t. at rectifier cathode.

(2) Main h.t. at choke output. If a fault changes the h.t. current demand noticeably this is shown by a change in the known difference between the cathode voltage and the correct value of choke output voltage.

(3) Automatic volume control (measured by its effect on cathode bias of V1C. This setting provides visual tuning control and indication of signal amplitude but only on R.T.).

(4) Beat-frequency oscillator cathode bias. (If no b.f.o. note can be obtained this setting provides a quick check on (a) the presence of h.t. at the valve, (b) whether or not the valve is oscillating. In case (a) there is no bias reading, in case (b) the reading is above normal.)

(5) Frequency-changer bias. (If the oscillator section of the 6K8 fails the bias reading is slightly, but noticeably, greater than when the oscillator is normal. Two conditions are noted in the monitor schedule: (a) Normal operation at 4·5Mc/s, (b) bias with the oscillator dead.)

(6) Frequency-changer oscillator h.t.

(7) First a.f. amplifier cathode bias.

(8) Output stage cathode bias.

(9) In the author's receiver this position is used to monitor the +28V supply to a teleprinter used in conjunction with the receiver.

All of the above are shown in Fig. 6. Whichever circuits are chosen the value of resistor to be connected between the monitor point and the cableform lead can be found from the Ohm's Law formula:

$R=E/I$ where R is in megohms, E in volts, and I is a fixed value, 250 (this is the half-scale reading of the monitor meter).

For example, supposing one wants to monitor a 10V cathode bias point,

$$R=10/250=0{\cdot}04M\Omega=40k\Omega.$$

Since the readings need not necessarily be *exactly* half-scale any value between (say) 37kΩ and 44kΩ should be satisfactory.

Two points which should have the same resistor value, however, are the rectifier cathode h.t. and the choke output h.t., the reason being that one requires a comparison of meter readings to show the voltage drop across the resistor in the h.t. supply.

When all wiring has been completed in the monitoring system the cableform should be laced with button thread to tidy off. The receiver should then be run up and allowed ten minutes or so for temperature stabilisation, then the various readings taken down on the monitor schedule, which should be attached to the receiver, or filed for reference.

The inclusion of a monitoring system completes the series of modifications carried out by the author. If no snags have been encountered and the original receiver was in reasonable condition to begin with the reader should now possess a receiver whose performance in the 2 to 8Mc/s band is the equal of many very much more expensive receivers. If he has had experience in alignment of receivers he may be able to improve this high performance still further by slight co-ordinated adjustment of the four compression trimmers situated in the area to the rear of the waveband switch. (The fifth trimmer, near the panel, alters beat frequency and should be left alone.) If he has no realignment experience leave these four trimmers to someone with the necessary knowledge to adjust them.

Ensure all superfluous wiring and wire clippings are cleared out of the chassis and that new wiring, components, etc., will be clear of the inner base when fitted. Drill the outer case to pass the mains cable (and provide access to the mains fuse if fitted), then fit the receiver into its outer case to complete the job. ■

A MIC PREAMP

A high-gain unit using a single transistor

by A. E. J. Simons

PREAMPLIFIER PERFORMANCE	250V H.T.
Voltage gain	320
Current consumption	0·7mA
Output impedance	5kΩ
Input impedance	200Ω

THIS high-gain preamplifier is suitable for use with a succeeding valve amplifier. The normal 250V h.t. line will supply the requirements of the OC70 Mullard transistor via resistors R4 and R5. Having no hum or microphony and a voltage gain of over 300 the preamplifier is suitable for a low-impedance microphone or pick-up.

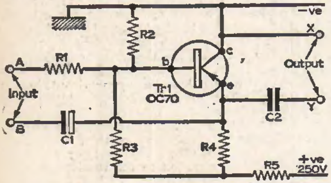


Fig. 1: The single-transistor circuit of the unit.

The writer has used the preamplifier as a second microphone input to an existing valve amplifier with excellent results. The output of the preamplifier was connected to the gramophone pick-up sockets; the gramophone volume control thus became the second microphone gain control. Being only 3in. x 1½in. x ½in. in size, the unit fits easily into a tape recorder, care being taken to keep the transistor away from components which run hot, i.e. valves and smoothing resistors.

COMPONENTS LIST

R1	100Ω	C1	100μF	12V
R2	100kΩ	C2	0·1μF	150V
R3	470kΩ	Tr1	Mullard OC70	
R4	5·6kΩ			
R5	330kΩ			

All resistors ½W 5% high-stability.

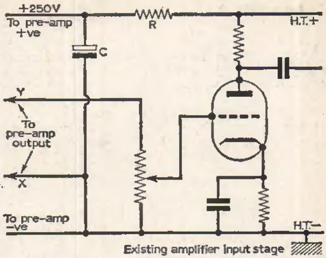


Fig. 2: The arrangement of a valve amplifier input stage for connection of the preamp. R has a value to regulate the amplifier h.t. to 250V for the preamp. C=8μF 350V.

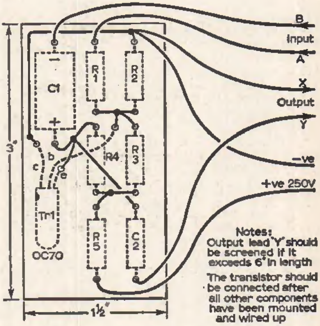


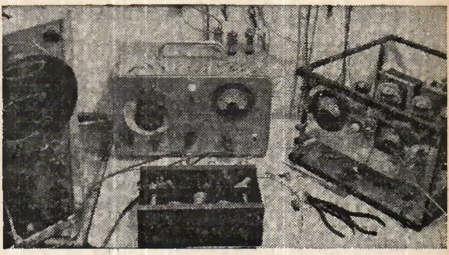
Fig. 3: Construction of the unit is on a piece of paxolin and the above layout was used successfully by the author.

Construction

The preamplifier can be built on a paxolin strip 3in. x 1½in. The strip should be drilled to take the wire ends of the components, which are twisted together behind the strip and soldered—shown by heavy dots in Fig. 3. Input, h.t. and output connections are made with flying leads.

Before connecting to the h.t. supply check the polarity of the preamplifier. Successful operation has been obtained with an h.t. supply of between 150-260V. Should the valve amplifier h.t. be in excess of 260V it can be reduced to a safe level as shown in Fig. 2. This also shows the method of coupling the preamplifier to the valve amplifier. ■

An ELECTRONIC GATE or TRACE DOUBLER



FOR SINGLE BEAM OSCILLOSCOPES

H. T. Kitchen

THE majority of oscilloscopes used by the majority of amateurs have one characteristic in common, the inability of displaying two separate signals as two separate and distinct waveforms on their cathode ray tubes at the same time. They are, in other words, single beam oscilloscopes.

Now it is quite probable that many amateurs will never need, or want to, view two different signals simultaneously, whilst others, like myself, will only need to do so from time to time. Undoubtedly the easiest way of doing so is by using a double beam oscilloscope, though this type of instrument, due to its high cost, can almost certainly be regarded as an unjustifiable luxury in all but a few exceptional cases. We must not, however, overlook the amateur who has either bought or constructed a first-class single beam oscilloscope for, having spent a goodly portion of his hard-earned income upon it, he will not exactly be overjoyed at having to start again.

Fortunately it is not unduly difficult to obtain double beam operation from a single beam oscilloscope, though not, unhappily, with the same facility as would be obtained from a genuine double beam instrument. This is brought about by the use of a special electronic gate into which the two signals are fed simultaneously. The gate then allows each signal to be passed turnabout to the oscilloscope, suppressing in the meantime the signal that is not being passed, the net result being two separate waveforms corresponding to the two separate signals.

Gate Principles

The principle of the electronic gate is quite simple and is illustrated in Fig. 1. It comprises two amplifiers for the Y1 and Y2 signals and a gate generator which provides two gating signals, these being square waves of identical frequency but out of phase by 180°. These are also fed into the Y1 and Y2 amplifiers and alternately allow them to conduct and then drive them into cut-off.

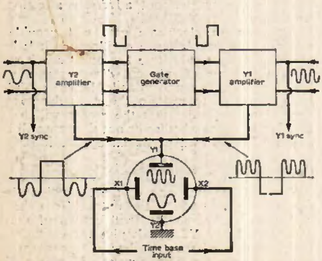


Fig. 1: Diagram showing operation of the electronic gate.

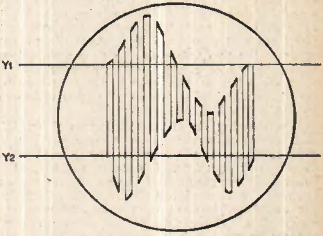


Fig. 2: The effect of a slow gating speed. The Y1-Y2 waveforms are composed of positive and negative peaks of the gating waveform.

Being in anti-phase it follows that when the Y1 amplifier is conducting, the Y2 will be cut off and vice versa, so that the c.r.t. is presented with a sequence of "samples" which, if the gating waveform is of the correct frequency, gives the impression of two separate traces. If the oscilloscope timebase is adjusted to display the gating waveform the Y1 and Y2 signals will be seen to occupy the horizontal portions of the square waves' positive and negative peaks. This effect, which is shown in Fig. 1 and also in Fig. 2, is only shown to explain how the gating waveform provides two separate traces. In actual use the timebase will be used to display the input signals only and the gating waveform will not be visible except under certain circumstances. These will occur when a fairly slow gating speed is used and the input signals will be seen to consist of a series of dots or dashes, depending on actual frequency, which are really the positive and negative peaks of the gating waveform. At high gating speeds it is possible for the intervening spaces to be rendered luminous by the gating waveform and occasionally for the waveform to be faintly discernible. With practice it is possible to ignore both effects and concentrate only on the waveforms to be examined.

With a double beam oscilloscope each trace has its own vertical shift control and so can be positioned just where it is wanted. The two traces can be superimposed, transposed or one removed right off the screen. With an electronic gate, however, the two traces will move as one every time the oscilloscope's vertical shift control is operated. The superimposition and transposition facilities can, however, be retained, though neither trace can be removed off the screen without going to some, and usually unnecessary, trouble anyway. The gating waveform, as already explained, is a square wave which is fed into the two amplifiers out of phase by 180°. If the gains of the two amplifiers are exactly equal the two anti-phase signals will cancel out and in the absence of any Y1 or Y2 signals will show on the oscilloscope as a straight line. Where Y1 and Y2 signals are present they will be superimposed, occupying, as they do, a common baseline. Although this may suffice for some applications it is an unsatisfactory way of doing things, for there is every possibility of the superimposed traces causing misunderstandings and mistakes. It is desirable to either separate the two traces so that they are no longer superimposed or else to make one much brighter than the other or even to make the best of both worlds by combining them and neither objective is particularly difficult to achieve.

It was earlier stated that if the two Y amplifiers had equal gains the gating square wave would cancel out and the oscilloscope would simply display a straight line. It must be understood that since both the gating and the external signals are fed into the Y amplifiers this remark will apply to the gating waveform's gain only and not to the signal gain. If the gain of the two amplifiers to the gating waveform is made unequal the output will be a square wave and it will be possible to separate the two external signals. This is done most easily and conveniently by varying the bias on the gating stages, so causing unequal anode currents to flow in the common anode load resistor, thereby providing the required unequal outputs. It is customary to label the top trace the Y1 and the lower the Y2 trace and to label the input sockets accordingly, thereby making it possible to identify the two signals.

It is also possible to make one trace more or less brilliant than the other by varying the mark space ratio of the gating square wave. The two traces will be equally brilliant when the gating waveform has a mark space ratio of one to one. If the mark space ratio is altered the two traces will differ in brilliance since one waveform, the more brilliant of the two, will be allowed to remain longer on the cathode ray tube than the dimmer trace which will have been allowed the least time. In practice the mark space ratio can be altered by providing the multivibrator with unequal grid leak resistors or by making the cross-coupling capacitors unequel in value. It is not usually possible to alter the mark space ratio to any great extent without adversely affecting the waveform.

Although an electronic gate will provide the services of a double beam oscilloscope it is by no means a perfect substitute for one since it suffers from a number of inherent disadvantages which limit its scope (no pun intended!) and usefulness. It is proposed to explain these disadvantages in some detail in order that the reader will be in a position to judge whether or not the gate will be of any use for his own particular applications.

SPECIFICATION

Power Supply Required:
250V at 20mA
6·3V C.T. at 1·2A

Y Amplifiers:
Freq. Response: 15c/s—50kc/s ±1dB
10c/s—200kc/s ±3dB
Input Impedance: 1MΩ
Gain: x5

Gate Generator:
Fixed frequencies of 50c/s, 175c/s, 500c/s, 1750c/s, 5000c/s approx.

Gate Output: 85V P-P (anodes of V1)
Gating Transients: 11V P-P (cathodes of V2 V2)

Note 1
All static voltages except multi: V1 measured with VR1 at mid position and with S1 at "off" position using 250V and 10V ranges of 20kΩ/V meter.

Note 2
Gain and frequency response of Y1 Y2 amps measured separately with VR1 at mid position and gate at "off".

Limitations

Strangely enough one of the limitations is the oscilloscope into which the output from the gate will be fed. This output will consist of the two external Y1 and Y2 signals plus the gating square wave which has been described, with perhaps some justification, as the carrier wave. Now one of the properties of a square wave is its ability (unwanted

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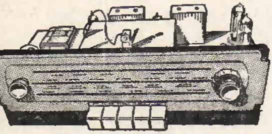

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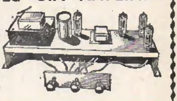

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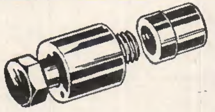

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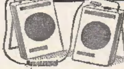

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in this particular application) to reveal the characteristics of the equipment through which it has been passed. Sagging or sloping tops will denote a phase advance due to a poor low-frequency response, whereas rounded corners will denote a phase lag caused by a poor high-frequency response. In really bad cases the emergent waveform will bear very little resemblance to the ingoing one. It will therefore be evident that for successful operation of the gate the oscilloscope's Y amplifier must pass the gating square wave without distorting it, at least to any excessive extent. If it is unable to do so the output from the gate will have to be fed directly to the cathode ray tube's Y1 plate, in which case some alteration to the deflection circuitry will probably be necessary. Where the oscilloscope's vertical amplifier uses symmetrical or push-pull deflection it will be necessary to earth the Y2 plate (capacitively if there is any z.f. voltage on it) and to feed the gate to the Y1 plate only. Due to the variety of deflection circuits in common use more explicit directions cannot be given, though it can be said that additional amplification before and after the gate will probably be necessary and will be due to the very small gain afforded by the Y1 and Y2 amplifiers plus their inability to deliver the very high peak-to-peak voltages necessary to fill the working area of the c.r.t.. It must be emphasised that these modifications will only be necessary with very simple oscilloscopes with restricted vertical bandwidths and it is quite possible for the gate to work, at least reasonably well, with the majority of amateur oscilloscopes. It is safe to say that if the oscilloscope can reproduce the gating square wave with reasonably vertical sides, square shoulders and reasonably horizontal positive and negative peaks that it will work well with the gate.

Yet another limitation is the gating speed. In theory it should be half the timebase speed so that each waveform can be traced out in turn. In practice surprisingly good results can be obtained with very widely varying gating/timebase speeds. Some authorities recommend a low gating speed, others a high speed. My own experience is that very slow gating speeds cause the waveform to sparkle in a rather fascinating way which causes eyestrain rather more rapidly, whilst very high gating speeds cause the space between the Y1 and Y2 waveforms to be rendered luminous. Of the two the latter effect is preferable to the slow speed sparkling, but since individual preferences vary and since it *is* desirable to work at half the timebase speed whenever possible the gating waveform is made variable in frequency.

Bandwidth

The last disadvantage to be covered is that of bandwidth. By the very nature of its operation the bandwidth that can be covered is restricted to the audio and low radio frequencies and is due to the inability of the simple gating circuit used to generate the ideal square wave necessary to bring about satisfactory gating at high frequencies. It will nevertheless satisfactorily handle 200kc/s since waves as shown in the waveform diagrams for which purpose the two inputs were temporarily connected in parallel. The distortion evident was present in the input signal which was derived from a transistorised "Nombrex" signal generator. This shows that in spite of the remarks concerning the recommended gating to timebase speed ratio of 2-1 (or 1-2) acceptable results can be obtained

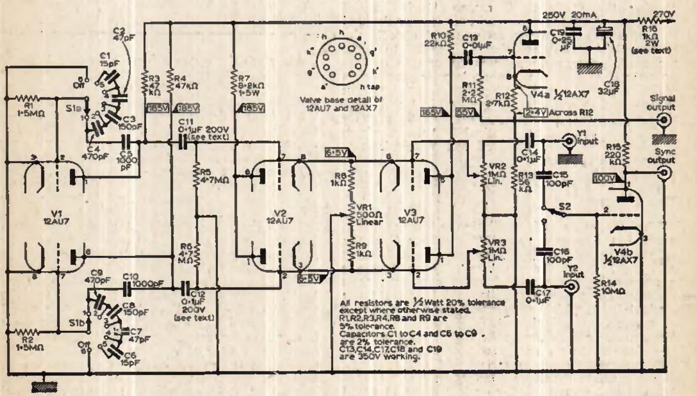

Fig. 3: Complete circuit of the trace doubler.

with widely differing ratios, for the gating speed used in this case was 1,750c/s. Although my own tests ceased at 200kc/s it is not unreasonable to suppose that even higher frequencies could be handled, though the signal gain would be well down when compared to the reference frequency of 1k/c. These remarks apply to sinewaves, the square wave response deteriorating after about 25kc/s, after which considerable rounding off occurs. The waveform diagram shows a square wave with a frequency of 25kc/s as generated Y1 trace and as reproduced at 1W output by a 10W amplifier on the Y2 trace. The rise time of the square wave was 2·0μS (the oscilloscope shows this as absolutely square, no rounding off, overshoot or sag) and as the Y1 trace is still reasonably square the performance of the gate as a whole can be considered to be eminently satisfactory—for all but the most exacting requirements anyway.

The complete circuit of Fig. 3 will be seen to be quite simple when split into its individual stages, which will be considered in turn commencing with the gate generator V1. This is connected as a cross-coupled multivibrator, the traditional form of square wave generator. Although the cathode coupled multi is somewhat simpler and cheaper to build the necessity of providing two anti-phase outputs precluded its use in favour of the cross-coupled variety. The variation in the gating speeds is brought about by S1a and S1b, which selects two sets of five close-tolerance (2%) frequency determining capacitors, C1 to C5 and C6 to C10. Two methods of discriminating between the two Y1 and Y2 traces have already been considered. It will be remembered that one method was offsetting the two traces so that they lay one above the other and the other method was making one trace brighter than the other by altering the mark space ratio. During initial development of the gating circuit it was decided that offsetting the two traces was undoubtedly the best method and it was thereby decided to make the mark space ratio as near to one to one as possible. Hence the close-tolerance capacitors which also confer another benefit upon the circuit. In conjunction with close tolerance (5%) grid leaks they ensure that no two positions of S1 provide oscillations at or near identical frequency, which could possibly have occurred had wide-tolerance components been used.

Time Constants

The frequency of oscillation of a multi is approximately equal to 0·77/CR where C is the value of one of the coupling capacitors and R the grid leak. Since large values of capacitors are correspondingly larger and more expensive than smaller ones the two grid leaks R1 and R2 are made 1·5MΩ, which means that the largest value of capacitor required is 1,000pF, for fo=50c/s. For convenience in wiring the capacitors are wired in series so that the next capacitor value is 300pF (1,000pF and 470pF in series) and fo=1,700c/s. The frequency therefore changes in five steps of 3-1 and makes it possible to select a gating speed most appropriate to the timebase speed within quite wide limits.

COMPONENTS LIST

Resistors:

All 20% ¼W except where stated.

R1	1·5MΩ 5%	R9	1kΩ 5%
R2	1·5MΩ 5%	R10	22kΩ
R3	47kΩ 5%	R11	2·2MΩ
R4	47kΩ 5%	R12	2·7kΩ
R5	4·7MΩ	R13	55kΩ
R6	4·7MΩ	R14	10MΩ
R7	8·2kΩ 1·5W	R15	220kΩ
R8	1kΩ 5%	R16	1kΩ 2W see text

Potentiometers:

VR1	500Ω lin.	VR2	1MΩ lin.
VR3	1MΩ lin.		

Capacitors:

2% silver mica except where stated.

C1	15pF 2%	C6	15pF 2%
C2	47pF 2%	C7	47pF 2%
C3	150pF 2%	C8	150pF 2%
C4	470pF 2%	C9	470pF 2%
C5	1000pF ceramic	C10	1000pF ceramic
C11	0·1μF 200V paper. See text.		
C12	0·1μF 200v paper. See text		
C13	0·01μF 350V paper		
C14	0·1μF 350V paper		
C15	100pF ceramic		
C16	100pF ceramic		
C17	0·1μF 350V paper		
C18	32μF 350V electrolytic		
C19	0·25μF 350V paper		

Valves:

V1, V2, V3 12AU7 V4 12AX7

Valveholders:

4 B9A

Switches:

S1 2 pole, 6 way, rotary

S2 1 pole, 2 way, miniature slide

Sockets:

4 co-ax.

Although the outputs from V1 could have been applied directly to the Y1 and Y2 amplifiers' V3, it was considered desirable to incorporate a cathode follower buffer stage V2 between V1 and V3. The gating waveforms are therefore developed across R7, VR1, R8, the cathode loads, which are also common to V3, and V3 is therefore allowed to conduct and driven into cut-off, the two halves working in anti-phase. VR1 varies the bias voltages, increasing one as the other is decreased, so bringing about trace separation in the manner already described. The outputs from the two halves of V3 are developed across the common load resistor R9 and are fed via C13 to the cathode follower output stage V4a. It had originally been intended to use direct coupling until the voltage on the anodes of V3 was measured and found to be 165V. This would have necessitated a cathode voltage on V4a of about 170V, which it was felt was liable to put somewhat of a strain on the heater-to-cathode insulation of V4a. The output from the cathode of V4a was connected directly to the output socket without the customary coupling capacitor simply because the oscilloscope contains its own z.f. isolating capacitor and it was felt that two such capacitors in series were quite unnecessary.

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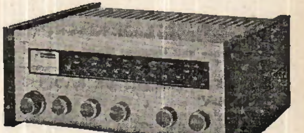

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TRACE DOUBLER

—continued from page 1078

V4b is arranged as the sync amplifying and limiting stage, more as a matter of wiring convenience than electrical necessity. The provision of a suitable sync signal is rather more involved than would be apparent at first. During the gate's early stages trouble was experienced with synchronising the trace using the internal sync position of the oscilloscope. A certain amount of jitter plus a reluctance of the trace to stay synchronised was finally put down to the gating waveform, the frequency stability of which is not particularly good. The sharp leading edge of its square wave, however, synchronised the oscilloscope's timebase much better than a sinewave input having a much higher frequency stability, with the result that the sync tended to "wander" with the gating waveform. Once this was realised the sync signal was extracted before being gated and was fed into the oscilloscope, switched for external sync, with the result that jitter was absent and the timebase stayed synchronised to the input signal. S2 allows either the Y1 or the Y2 signal to synchronise the timebase.

CONTINUED NEXT MONTH

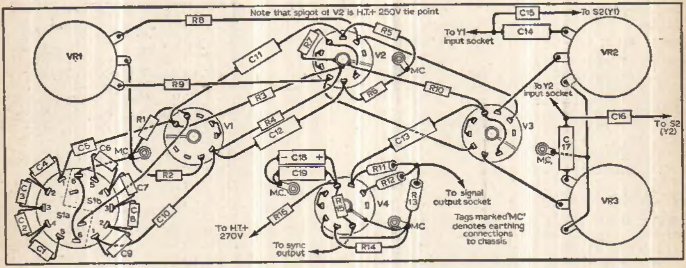

Fig. 4: Chassis wiring. The centre spigot of V2 is used as an h.t.+ point.

Reflex 2

—continued from page 1059

twists on this coupling were sufficient to put the r.f. amplifier in oscillation over the entire band. It was found that just a single twist is sufficient for most purposes, depending upon the nature of Tr1.

Capacitor C1 in the tuned circuit of L1 constitutes a form of padding capacitor, as well as serving as an r.f. bypass. Thus, the tracking can be influenced by varying the value of this component. Unfortunately, there is not available a miniature preset capacitor of sufficiently high value to permit easy adjustment here. The author found that an 0·005μF fixed capacitor satisfied the tracking for his reception area, but values above or below this could be tried since C1 is not difficult to change.

It is as well to remember that a simple set of this kind employing a sub-miniature ferrite rod aerial and only two transistors cannot be claimed to have super-sensitivity! Nevertheless, the prototype gave good volume on local stations, while after dark the more powerful European stations were received.

Housing the Receiver

The complete receiver is fitted in a small ready drilled plastic case as shown in the photograph which comes with back, tuning knob and paper dial. The gang retaining nut being used to lock the assembly to the front panel and a hole in the side of the box to cater for the jack socket which, again, is held secure by its locking nut. The long 6BA bolt on the rear of the tuning gang is used to hold the back of the case in position.

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2—DESIGN OF TRANSISTOR OSCILLATORS

When average transistors are used at low voltages two transistors will probably be necessary as a minimum in a resistance-capacitance oscillator. An advantage of the two amplifying stages as compared with a single transistor is that positive feedback can be obtained directly without resorting to the 180° phase shift of a ladder network. Simpler forms of network can therefore be used which have zero phase shift at the frequency of oscillation.

Wien Network

The most widely used of these is the Wien network (Fig. 3a), which has several less familiar variations, including current duals. The output from these networks reaches a peak equal to one-third of the input at the frequency where the phase shift becomes zero. With the surplus of amplification usually available the oscillator can be stabilised by an appreciable amount of negative feedback applied to reduce the loop gain to unity.

On subtracting the output of a Wien or similar network from its input to give the inverse response, i.e. by taking the new output from the other part of the network, a valley type response is obtained with a minimum equal to two-thirds of the input at the frequency of zero phase shift. In a true null network the minimum output would, of course, fall to zero.

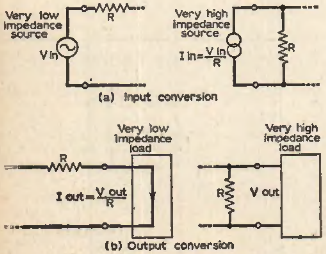

Fig. 1: Alternative arrangements at end of network where there is a resistance.

This form of network, e.g. a bridged-T (Fig. 4a), can be utilised in a negative feedback path, but a large amount of positive feedback is required in an auxiliary positive feedback loop to bring about oscillation, so it is quite a difficult type of network to use successfully in the simpler types of oscillator. Since the net feedback will be positive, conditions approximate to those in a Wien bridge oscillator because when the input is a blend of positive and negative feedback it can be influenced by a phase shift in either.

Parallel-T

The true null network is a parallel-T. Although it has a rather different form of phase-shifting characteristic it can be substituted for the bridged-T network and, since the negative feedback now disappears altogether at the frequency of oscillation, considerably less positive feedback is required in the auxiliary loop.

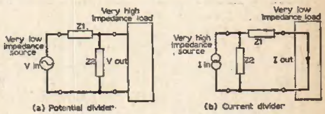

Fig. 2: Single stage networks.

The Parallel-T can likewise be rearranged to give an inverse response, which is a peak at zero phase shift, equal to the input and therefore three times that of the Wien network. Decreasing the impedance of the low-impedance branches will increase the output slightly above the input and it can then be used in an emitter follower type of oscillator where the actual voltage gain of the amplifier is less than unity (Fig. 7).

The disadvantage of the Parallel-T network is that it requires three capacitors and three resistors. The values of these are not all alike and require, for the null circuit, to be in a certain ratio, usually 2:1:1 as in Fig. 4b.

Tuning

In variable frequency oscillators tuning is easily accomplished by means of resistance capacitance networks. With their wide tuning range it is possible to cover from a few cycles per second to

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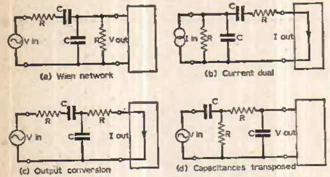

Fig. 3: Variations on the Wien network.

the lower radio frequencies in four ranges of switched capacitances, usually with a 10:1 ratio between adjacent ranges, and ganged potentiometers employed for fine tuning provide scales of about 300°. The potentiometers are normally wire wound to an inverse semi-log characteristic and of adequate resolution to enable a large-scale and sufficient accuracy of setting to be obtained.

Networks of the Wien type require only two capacitors to be switched per range and a dual-ganged potentiometer, by varying both of the network resistances simultaneously, avoids changes in the attenuation of the network, although altering the impedance it presents to the amplifying section. The amplifier normally requires to have a very low output impedance (and high input impedance), assuming a voltage transfer network, to avoid variation of the amplitude with tuning. A thermistor will probably be included to compensate for amplitude variations but it is advisable not to delegate too much of the task to the thermistor.

Amplifier Phase Shift

As far as possible all the frequency dependent phase shift should be concentrated in the R-C network, where it is determined entirely by passive components. The amplifier should be constant in performance and independent of frequency.

At high frequencies internal phase shift in the transistors can be minimised by employing r.f. transistors. At low frequencies amplifier phase shift can be overcome by means of direct coupling. A positive feedback loop nevertheless must normally contain a blocking capacitor to prevent it from exerting an unstabilising effect on the quiescent points of the transistors, but this may be one of the capacitors of the phase-shifting network. A negative feedback loop, on the other hand, has a stabilising effect on the d.c. levels and so may with advantage be direct coupled throughout.

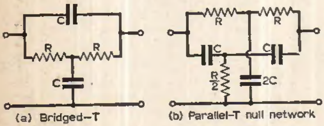

Fig. 4: Networks with valley-type responses.

Impedance Levels

Considering the frequency response as concentrated in the network assumes that the amplifier and network act independently. At both ends of the network, however, variable loading effects, if present, can interfere with the frequency response, making it less predictable and constant. Ideally the network must neither load or be loaded by the amplifier and instead of an impedance match for maximum power transfer the impedance levels of the amplifier and network should be widely different. This is necessary also to avoid distortion due to the non-linear input impedance of a transistor.

There are two ways of minimising the effect of a load variation. One is to make the source impedance much lower than that of the load, in which case the voltage remains nearly constant. The other method is to make the source impedance much higher than the load, in which case the current is nearly constant. When the source impedance is zero it is called a voltage generator and when the source impedance is infinite it is called a current generator. Each is represented by a special symbol in diagrams as in Fig. 1. In practice it is a question of the ratio between source and load impedances and we can speak of a "voltage input" when negligible voltage is developed across the load.

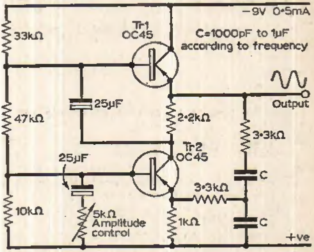

Fig. 5: Oscillator with modified Wien network.

A voltage transfer network, which subjects a voltage to its frequency response, can only be used when an amplifier has a low output impedance and a high input impedance relative to the impedance level of the network. For a current transfer network the reverse conditions apply.

High input impedances and low output impedances in the amplifier can be secured by the use of emitter-follower stages. A special arrangement may be necessary for the bias supply to the base of the input emitter-follower, since a d.c. path must be maintained via a resistance to every electrode of a transistor. The high amplifier output impedance that is required for a current transfer network can only be provided easily when one of the resistors of the phase-shifting network serves also as a collector load resistor.

Network Duals

Voltage transfer networks can be regarded as composed of various potential dividers containing resistances and capacitances. Since two impedances in parallel constitute a current divider (Fig. 2b) it is possible to build current transfer networks on close analogy with the voltage transfer networks. To every voltage transfer network there corresponds a current transfer network called its current dual and it can be derived, for all the three-terminal networks we are considering, simply by turning the network round so that the input and output change places. The amplifier impedance levels must also be interchanged.

It is shown in Fig. 1 that a voltage generator in parallel with the resistance is equivalent to a current generator in parallel with the resistance. This is less obvious than the corresponding output conversion based on the current through a resistance being proportional to and in phase with the voltage across it.

It is convenient to be able to alter the feed arrangements of a network in this way but if the change is made only at one end the network maintains its frequency response but now derives an output voltage from an input current, or vice versa, so that the amplifier impedances can be both higher or both lower, as the case may be, than the network impedance.

A similar conversion can be made with capacitances at the ends of the Wien network if the change is made at each end so that the phase shifts cancel. By applying all of the preceding transformations to the Wien network quite a number of other networks with a similar frequency response can be derived. Some of these are shown in Fig. 3.

Networks appear to consist of simple sections but the loading of later sections upon earlier ones makes analysis more complicated. Separation of the sections of some networks is possible by inserting isolating stages between them, but this would be unusual in a transistor oscillator since it would increase the number of transistors.

Oscillator Circuits

It is possible to overrate current duals as oscillator networks and the typical a.f. oscillator uses a Wien network, which is of the voltage transfer type. This requires a high input impedance in the amplifying section and with transistors this can be obtained from a compound emitter-follower arrangement involving two transistors. A third transistor will be necessary to secure a low output impedance and the amplifier must provide voltage amplification without phase reversal. The best direct-coupled arrangement combines p-n-p transistors with n-p-n. Increasing the number of transistors in an oscillator allows greater scope in design, enables the performance to be improved and permits variable tuning.

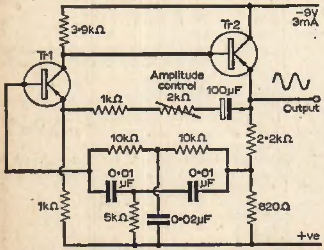

Fig. 6: Parallel-T —ve feedback oscillator.

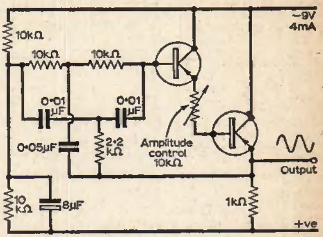

Fig. 7: Parallel-T +ve feedback oscillator.

In a two transistor oscillator the possibilities are more limited, especially with direct coupling, and with less orthodox circuits snags are encountered such as the provision of satisfactory forms of amplitude control to prevent limiting.

The oscillator shown in Fig. 5, however, has a good performance and only consumes 0·5mA of current. It contains a Wien network supplied from the low-output impedance of the upper transistor, an emitter-follower, and from the Wien network an output current enters the emitter of the lower transistor, a ground-base stage, whose collector load resistance is increased in value artificially by the bootstrap action of the upper transistor. The current gain of the emitter-follower depends upon a sufficiently low impedance in its output circuit, hence the low resistance values in the network, but the equal capacitors C can be given a range of values to yield various spot frequencies. Amplitude control, gradual in action, is by varying the impedance in the base circuit.

The oscillator of Fig. 6 employs a Parallel-T null network in a negative feedback path. A Bridged-T would not give such a large undistorted output. Positive feedback between the emitters is varied for amplitude control.

An even better oscillator using a Parallel-T is shown in Fig. 7. In this optimum amplifier conditions can be secured with very high input impedance and a low output impedance. The low-impedance arms of the network are made lower in impedance than for a null network in order to step up the output voltage to the base of the first transistor. Amplitude control is by a resistance between the transistors but the low-resistance branch of the network could be varied instead. ■

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ONE of the international Y.M.C.A.'s most senior organisations, City of Belfast Y.M.C.A. Radio Club (GI6YM), is among the oldest radio clubs in the British Isles. The Club was founded in 1922 and received its transmitting licence and callsign in 1927, but there is some evidence of previous activity dating back to shortly after the close of World War I. It may be interesting to note that the Club licence holder, Mr. Robert Barr (GI5UR), a "call" well known to the world's c.w. DX fraternity, has been continuously in membership since those early days and is still one of 6YM's most active members.

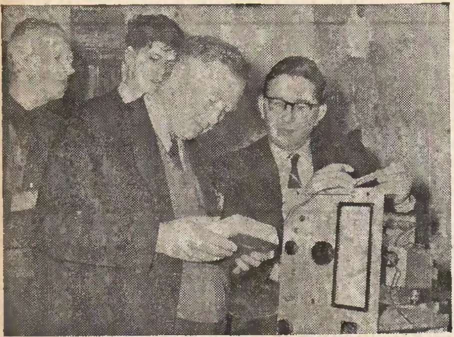
The lifetime of GI6YM spans the history of radio experimentation in the north-east corner of Ireland and thus the City of Belfast Y.M.C.A. Radio Club can rightly be considered as the "cradle" of amateur radio in the most populous region of the six Irish counties comprising Northern Ireland. Certainly the majority of radio men and enthusiasts in the Belfast area, many of whom have made their mark on the "ham" hobby or in the wider radio world outside as Government scientific officers, Post Office, BBC and service technicians and operators, have all been connected with GI6YM at one time or another.

In the Y.M.C.A. tradition of "Service, Not Self" the City Club membership takes modest pride in its record during World War II days and was one of the few clubs which "carried on" in spite of cessation of transmitting activity and the loss of many of its most active members—of all ages—to the Royal and Merchant navies, Army and R.A.F. or engaged in security duties at home. Through its connection with the parent Y.M.C.A. —"Mecca" for thousands of Service men passing through Belfast—the City Club kept "open house" for Service "hams" from all over Ireland, Great Britain, the Commonwealth and the U.S.A. Many of these men held club office while stationed in Northern Ireland and needless to say, the wartime visitors' book is one of the most treasured items in the club archives.

Club accommodation is second to none and comprises a general clubroom on the third floor of the main city Y.M.C.A. building with a transmitting room on the floor above. The clubroom, recently refurbished in contemporary "decor", contains comfortable seating (including settee and easy chairs!) library with technical and current British and U.S. radio publications, listeners' corner complete with junior HRO, Morse practice equipment transcription record player and hi-fi amplifier for the club's audio section.

The well-appointed transmitting room on the floor above contains most of the equipment

As a YMCA organisation GI6YM's emphasis has always been on youth. Pictured are some of the Club's SWL members and "junior ops." On the extreme left is GI3UKS, Dave Vizard, the area's youngest licensee.



Left: Making checks on the Club's new S.S.B. transmitter are (from left) R. Barr (GI5UR), SWL Evans, F. Robb (GI6TK) and Major Ian Kyle, club member and local T.A. "boffin".

Below: Tuning-up the standby T1154 transmitter are (from left) T. J. Moss (GI3UFH) Club treasurer, J. Beattie (GI3NQH) Club chairman, C. Rourke (GI3IVJ) Club secretary, licence-holder R. Barr (GI5UR) and SWL member.

necessary for efficient operation under present-day conditions (the club recently made DXCC in spite of restricted hours of operation), the gear comprising a KW77 receiver, medium-power c.w. transmitter for 80 40 and 20m, 4m transmitter/receiver and all ancillary equipment. S.S.B. operation is also engaged in using a Sphinx transmitter, until the construction of the Club's own all-band S.S.B. rig is completed.

Main aerial requirements are taken care of by the recent construction and erection of a fine tri-band quad and supporting tower which has been mounted on one of the Y.M.C.A. building's highest points overlooking busy Wellington Place and already a city landmark. This erection also carries the v.h.f. aerial and will eventually be remotely controlled from the transmitting position. The emergency aerial is an all-band trap dipole.

The City of Belfast Club takes a full part in all local, national and international "ham" radio activity, chief among these being National Field Day and the popular Jamboree-on-the-Air, both events being held in conjunction with City Y.M.C.A.'s own Scout troop, which has a splendid QTH on the south side of the city.

Regular meeting nights are held each Wednesday and Saturday evenings from 8 o'clock but activities such as Morse practise and construction take place on other evenings as required and access to the club is available at all times. Any enthusiast—transmitting or SWL—whether "local" or just passing through can be assured of a real Irish Cead Mile Failte in the best "YM" tradition. Club secretary is Mr. Cedric Rourke, GI3IVJ, 32 Kirkliston Park, North Road, Belfast 5. ■

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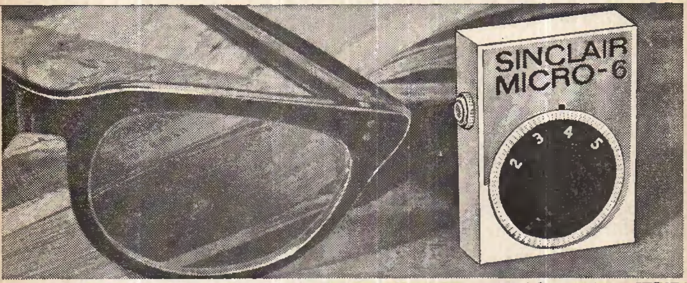

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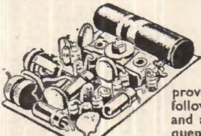

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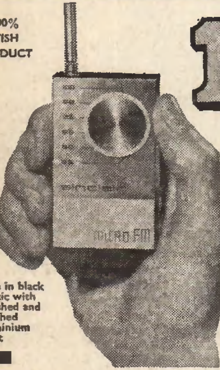

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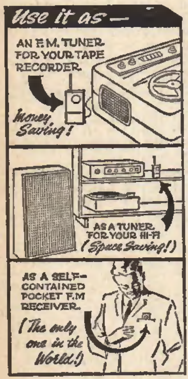

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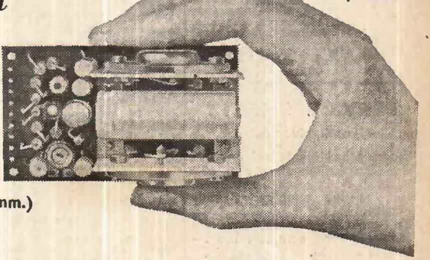

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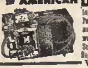

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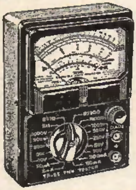

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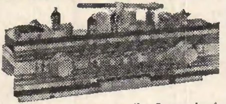

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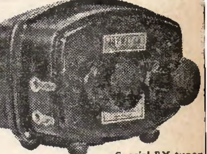

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