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1963

Practical WIRELESS

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OUBLE-SIDED
LUEPRINT

with Full Instructions to build

7-TRANSISTOR PORTABLE

WITH CAR AERIAL SOCKET

BATTERY PORTABLE RECORD REPRODUCER


ADCOLA
ADCOLA
230/250V

LASKY'S RADIO

GREAT 1963 PRICE REDUCTIONS

BUILD YOUR SUMMER PORTABLE AT THESE

VASTLY REDUCED PRICES ★ ★ ★ ★

The SPRITE

Inclusive price of **79/6**

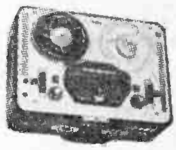
P. & P. 3/6 extra.

★ Six-Transistor Superhet Miniature Personal Pocket Radio. ★ Tunable over Long and Medium wavebands. ★ Uses PP3 battery. Ferrite Rod aerial. ★ I.F. Frequency 470 Kc/s. Transistors: 3 Philco 2067's. 2 Mullard OC81 M OC81 DM and OA90 diode. ★ 3 inch speaker. ★ Printed circuit 2¼ x 2in. ★ Slow Motion Drive. ★ In Plastic Case. size 4 x 2¼ x ⅞in.

In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver and Output stages ready built with all components ready mounted on the printed circuit. To complete assembly you only have to fit the wavechange switch, tuning condenser and drive, volume control, earphone socket and aerial rod, the remaining components all having been prefitted at the factory for you. The SPRITE is offered as above, pre-assembled, plus cabinet, speaker and all components for final construction, at the inclusive price of 79/6. Postage and packing 3/6 extra. Data and Instructions separately. 2/6. Refunded if parcel is purchased. Real calf leather case, wriststrap, personal earphone and case for earphone and battery 12/6 the lot extra. Make no mistake this is a SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit.

TESLA "SONET"

DUO TAPE RECORDER



A continental manufactured 2-speed tape recorder with 1⅞ x 3¾in. i.p.s. Twin track recording to international standards. ★ Takes 5¾in. spools. ★ Fast forward and fast rewind. ★ Record level indicator. ★ Inputs for mic, radio and pick-up. For use on 110 and 200-250 v. 50 c.p.s. mains. ★ Digital position indicator. ★ In attractive wood case with metal top cover fitted with storage compartments and carrying handle. Size 13 x 10 x 7in. High quality record-replay amplifier with internal loudspeaker provides immediate high quality reproduction. ★ Socket for external speaker. ★ Tone control: Supplied with reel of tape, empty spool, microphone and a selection of interconnecting leads, etc., with canvas waterproof cover. Brand New and Unused. Carr. and Ins. 10/6.

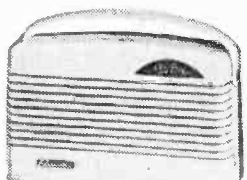
LASKY'S PRICE 24 gns.

Carriage and Insurance 10/6.

The "REALISTIC" Seven

STAR FEATURES ★★★★

- ★ 7 Transistor Superhet. 350 Milliwatt output into 4-inch high flux speaker.
- ★ All components mounted on a single printed circuit board, size 5¼ x 5¼in. in one complete assembly.
- ★ Plastic cabinet, with carrying handle size 7 x 10 x 3¼in. in choice of colours:
- ★ Red/Grey. Blue/Grey, all Grey.
- ★ Easy to read Dial.
- ★ External Socket for car aerial.
- ★ I.F. frequency 470 Kc's.
- ★ Ferrite Rod internal aerial.
- ★ Operates from PP9 or similar battery.
- ★ Full comprehensive data supplied with each Receiver.
- ★ All coils and I.F.'s etc., fully wound ready for immediate assembly.



An Outstanding Receiver. Lasky's Price for the complete parcel including Transistors, Cabinet, Speaker, etc., and Full Construction Data: **£5.19.6** Postage and Packing 4/6

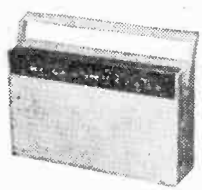
PP9 Battery 3/9. Data and instructions separately 2/6. refunded if you purchase the parcel.

Get ready NOW for the NEW TV frequencies

Lasky's first again with a U.H.F. Tuner. Complete with P.C. 88 and P.C. 86 Valves. Fully variable tuning capacitor, etc. British manufacture. New and unused size 4¼ x 5¼ x 1¾in. Complete with valves. **29/6** P. & P. 2/-

The COROVER '6'

★ A 6-transistor plus 2-diode superhet receiver using the latest circuitry. ★ Three Mullard AF117 alloy diffused transistors are used with OA79 and OA91 diodes, followed by OC81D and two OC81's in push-pull. ★ I.F. frequency 470 Kc/s. ★ Covers the full medium and long wavebands. ★ Sockets provided for personal earpiece or tape recorder, and car radio aerial. ★ Large internal ferrite rod aerial gives high sensitivity. ★ Uses four 1.5 v. pen torch batteries. ★ All components mounted on a single printed circuit. Simple stage by stage instructions. ★ Cabinet size 6¾ x 4 x 1¾in. With carrying handle. ★ All coils and I.F.'s ready wound. ALL COMPONENTS AVAILABLE SEPARATELY. *Data and instructions separately 2/6. Refunded if you purchase the parcel.*



CAN BE BUILT FOR **£5.7.6**

Post and packing 4/- extra. Batteries 1/4.

CRYSTAL PICK-UP CARTRIDGES

Lowest Prices Ever!
Some at Less than Half List Price

All complete with Styli, L.P. and Standard (and Stereo where shown). Fully guaranteed, standard fitting, will fit most P.U. arms and heads.

Postage 1/- each extra.

MONO Type C.T.I.

By well known manufacturer. With two sapphire styli	9/6
Garrard Ceramic GCE 4	15/-
Garrard Magnetic T.O.M.2	15/-
Acos GP.59	14/-
Acos GP.65/3	15/-
Acos GP.65/1	17/-
Acos 67/1	14/-

STEREO

Acostereo 73/1 with two sapphires	25/-
Acostereo 73/2 with Diamond L.P./Stereo and sapphire Std.	29/6
Collaro type C. Turnover, with 2 sapphires	19/11
Collel S.C.1. Turnover with 2 sapphires	19/11
Collel S.C.1. Turnover with Diamond L.P./Stereo and sapphire Std.	25/-
Ronette Stereo O.V. Turnover, with 2 sapphires	25/-
Ronette Stereo type 105 & 106 with 2 sapphires	35/6
Ronette Stereo type 105 & 106 with Diamond L.P./Stereo and sapphire Std.	39/6

TELEFUNKEN STEREO HI-FI AMPLIFIERS MODEL S82

Further Great Purchase Enables us to Offer this Excellent Unit at £5.19.6. Post 7/6.

A complete stereo amplifier of unsurpassed quality, with inputs for radio, tape recorder, F.M. tuner or any other hi-fi source, either monaural or stereo. Output power 5 watts total (2½ watts each channel). With balance control. New and unused, listed at 16 gns.

LASKY'S PRICE £5.19.6

Distler Miniature Motors

6 volt battery operated 7/11. P. & P. 2/6.

207 EDGWARE ROAD, LONDON, W.2. Near Praed St. PADDINGTON 3271/2 | **33 TOTTENHAM COURT ROAD, W.1.** Nearest Stn., Goodge St. MUSEUM 2605 | **152/3 FLEET STREET, LONDON, E.C.4.** *Telephone:* Fleet Street 2833.

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With the NEW MARK 8

PARISIENNE!!

THE "TEN STAR" TRANSISTOR POCKET RADIO

NOW ONLY £3 . 19 . 6

All components supplied separately if required

- ★ No external aerial or earth required.
- ★ Free 9-volt transistor battery.
- ★ Built-in wave change switch not pre-set. Dial graduated, L. and M. waves.
- ★ Printed circuit for easy assembly including high "Q" ferrite rod aerial.
- ★ High sensitivity ear piece if required, 5/-.
- ★ Cream Polystyrene case with carrying handle.
- ★ Hi-Fi 3-inch moving coil speaker.
- ★ All new components plainly marked, including best Mullard transistors.
- ★ Fully illustrated 30-page booklet with step by step instructions, **2/9.**
- ★ Comprehensive speedy after-sales service.

Money refunded if not satisfied

PLEASE SEND FOLLOWING ITEMS
TICK BOX BELOW AS REQUIRED

☐ FULL SET OF PARISIENNE COMPONENTS £3-19-6
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I ENCLOSE CHEQUE P.O. MONEY ORDER INCLUDING
2/6 P. & P. FOR £. s. d.

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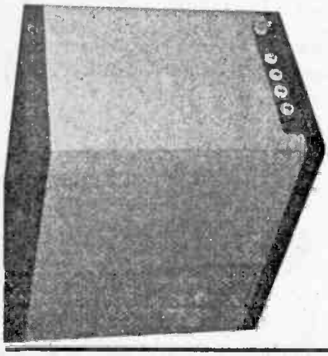
WOLVERHAMPTON
RADIO AND TV SUPPLIES

42, DARLINGTON STREET, WOLVERHAMPTON
Telephone No. 20315 P.W.1.

THE R.S.C. BASS-MAJOR 30 WATT GUITAR AMPLIFIER



A MULTI-PURPOSE HIGH FIDELITY, HIGH OUTPUT UNIT FOR VOCAL AND INSTRUMENTALIST GROUPS

Eminently suitable for bass guitar and all other musical instruments

- ★ Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in. diameter speech coils. Designed for efficiently handling full output of amplifier at frequencies down to 25 c.p.s.
- ★ Dual Cone in second speaker reproduces frequencies up to 17,000 c.p.s.
- ★ Heavily made cabinet of convenient size 24 x 21 x 14in. has an exceptionally attractive covering in two contrasting tones of Vynair.
- ★ For 200-250 v. to 50 c.p.s. A.C. mains operation.
- ★ Four jack socket inputs and two independent vol. controls for simultaneous connection of up to four instrument pick-ups or microphones.
- ★ Separate bass and treble controls providing more than adequate "Boost" or "Cut".
- ★ LEVEL frequency response throughout the audible range.
- ★ SUPERIOR TO UNITS AT TWICE THE COST.

39½ Gns. Send S.A.E. for leaflet. OR DEPOSIT of £4.3.0 and 12 monthly payments of £3.9.11. Carr. 17/6.

R.S.C. JUNIOR GUITAR AMPLIFIER 5-watt high quality output. Separate bass and treble "cut" and "boost" controls. Sensitivity 15 m.v. Two high impedance inputs. 10in. loudspeaker. Handsome strongly made cabinet (size 14 x 14 x 7in. approx.) finished in attractive and durable polychrome. 200-250 A.C. mains operation. **£8.19.6** Or DEPOSIT £1 and 9 monthly payments of £1. Carr. 7/6.

LINEAR TREMOLO/PREAMP. UNIT Designed for introducing the Tremolo effect to any amplifier which is fitted with a reserve power supply point for smoothed H.T. and 6.3 v. A.C. L.T. This applies to practically all amplifiers of our manufacture, and to those of several other manufacturers. The unit plugs into power supply point and any input socket of amplifier. Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume and Switch. Three sockets are for two inputs and Foot Switch. ONLY **4 Gns.**

LEICESTER BRANCH NOW OPEN

TRANSISTOR SALE. Mullard OC71 3/9, OC45 4/11, OC44 4/11, OC72 4/9, OC81 4/11, OC171 8/9, Ediswan XA101 3/9, XB102 3/9, XA112 3/9, XB113 3/9, XB104 3/9, XC101A 3/9. Postage 6d. for up to 3 Transistors.

D.C. SUPPLY KIT. 12 v. 1 a. consisting of a partially drilled metal case, mains trans., F.W. Bridge Rectifier, 2 fuseholders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable for Electric Trains. Limited number available at 29/11

SELENIUM RECTIFIERS

F.W. BRIDGE			
6/12 v. 1 a.	3/11	24 v. 2 amp.	14/9
6/12 v. 2 a.	6/11	24 v. 20 amp.	89/9
6/12 v. 3 a.	9/9	H.T. TYPES H.W.	
6/12 v. 4 a.	12/3	150 v. 40 mA	3/9
6/12 v. 6 a.	15/3	250 v. 50 mA	3/11
6/12 v. 10 a.	26/9	250 v. 60 mA	4/11
6/12 v. 15 a.	35/9	250 v. 80 mA	5/11
		250 v. 250 mA	11/9

CONTACT COOLED. 250 v. 75 mA, F.W. (Bridge), 10/11. 250 v. 50 mA, F.W. (Bridge), 8/11. H.W. 250 v. 60 mA. 5/11.

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched Negative feedback equalisation Positions for Record 1⅞in. 3¾in., 7½in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9 gns. S.A.E. for leaflet.

HUGE PURCHASE OF BRAND NEW 24 v. 20 Amp. F.W. (Bridge) SELENIUM RECTIFIERS. each **49/9**

R.S.C. SENIOR Guitar Amplifier 14 watt high-fidelity push-pull output.

Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-up can be used at the same time. Two loudspeakers are incorporated, a 12in. high flux 14 watt bass unit, and a 6 x 4in. elliptical for treble. Cabinet is well made and finished as Junior Model. Size approx. 18 x 18 x 8in. Only **16 Gns.** Carr. 10/- Send S.A.E. for leaflet. Or DEPOSIT 37/- and nine monthly payments of 37/-.

HEAVY DUTY LOUDSPEAKERS IN SUBSTANTIAL REXINE COVERED CABINETS. Type BG1. Suitable for Bass Guitar Speaker Unit. 15in. High Flux. 15 ohms. 25 watts. Cabinet size approx. 24 x 21 x 13in. Only 19½ gns. Or Deposit 42/- and 12 monthly payments of 34/9. Type BG2. Suitable for Bass Guitar. Super Sensitive, 15in. 15 ohms high flux speaker. Cabinet size approx. 30 x 21 x 14in. Attractive covering of two contrasting tones of Rexine and Vynair. Rating 50 watts. Only 29 gns. Or Deposit £3.7.6 and 12 monthly payments 50/-. Type BG3/2. Suitable Bass and Lead Guitar. Two 12in. high flux 15 ohm 25 watt speakers, one with aluminium speech coil and dual code to provide smooth frequency response from 25 to 17,000 c.p.s. Cabinet size approx. 30 x 21 x 14in. Covered in two contrasting tones of grey Vynair and Rexine. Rating 50 watts. Only 29 gns. Or Deposit £3.7.6 and 12 monthly payments of 50/-.

LARGE REXINE COVERED SPEAKER CABINETS. Heavy blockboard construction. Very attractive two tone covering of Rexine and Vynair. Size 30 x 21 x 16in. cut for 15in. or 18in. speaker or for two 12in. 11 gns. or Deposit 25/9 and nine monthly payments 25/9. Size 30 x 30 x 16in. cut for 15in. or 18in. speaker 13 gns. or Deposit 30/4 and nine monthly payments 30/4. Suitable speakers available.

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

HI-FI 10 WATT AMPLIFIERS Brand new. Manufacturer's discontinued line. Fitted latest Mullard valves. Dual inputs for "mike" and gram., etc. Bass and Treble Controls. High sensitivity and quality. Output for 3 ohm or 15 ohm speaker. For 230-250 v. A.C. Carriage 4/6. Only **£7.19.9**

ANNOUNCING THE R.S.C. B20 BASS GUITAR AMPLIFIER A highly efficient unit incorporating a massive 15 in. high flux loudspeaker specially constructed to withstand heaviest load conditions. Rating 25 watts. Individual bass and treble controls give ample "boost" and "cut". Two high impedance jack socket inputs are separately controlled. All controls are conveniently positioned in a recess on top of the cabinet. Cabinet is of substantial construction and attractively finished in two contrasting tones of Rexine and Vynair. Size approx. 24 x 21 x 13in. Operation from 200-250 v. 50 c.p.s. A.C. mains.

Send S.A.E. for leaflet.

29½ Gns. Carr. 17/6. Or Deposit £3.2.0 and 12 monthly payments of 56/10.

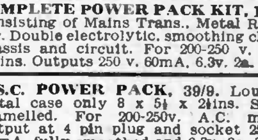
Ex. GOVERNMENT ACCUMULATORS. Size 7½ x 4 x 2in., 2 v. 16 A.H. brand new, 6/9 each, 3 for 15/6.

Ex. GOVT. SMOOTHING CHOKES. 200 mA, 3-5 H, 50 ohms, Parmeko 8/9; 100 mA, 5 H, 100 ohms 3/11; 150 mA, 10 H, 50 ohms 9/9; 80 mA, 20 H, 900 ohms 5/9; 120 mA, 12 H, 100 ohms 8/9; 50 mA, 50 H, 1,000 ohms 6/9; 100 mA, 10 H, 100 ohms 6/9; 60 mA. 5-10 H, 250 ohms 2/11.

COMPLETE POWER PACK KIT, 19/11 Consisting of Mains Trans., Metal Rectifier. Double electrolytic, smoothing choke chassis and circuit. For 200-250 v. A.C. mains. Outputs 250 v. 60mA, 6.3v. 2a.

R.S.C. POWER PACK, 39/9. Louvred metal case only 8 x 5¼ x 2½ins. Stove enamelled. For 200-250v. A.C. mains Output at 4 pin plug and socket 250 v. 60 mA. fully smoothed and 6.3v. 2a. Suitable for power requirements of almost any Pre-amp or Radio Tuner.

R.S.C. BABY ALARM or INTERCOMM. KIT. Complete set of parts with diagrams, etc. Housed in two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250 v. A.C. mains. Fully isolated. Controllable at both units. An Intercomm. of this class would normally cost £20-£30. Only 79/6, carr. 5/- or assembled ready for use £5.15.0.



R.S.C. (Manchester) Ltd. *MAIL ORDERS to 5 County Arcade, Leeds 1. Terms: C.W.O. or C.O.D. No C.O.D. under £1. Postage 2/9 extra under £2. 4/6 extra under £5. Trade Supplied. S.A.E. with all enquiries please.*

LEICESTER:	BIRMINGHAM:	SHEFFIELD:	HULL:	LIVERPOOL:	BRADFORD:	MANCHESTER:	LEEDS:
32 High St. Half-day Thursday	6 Gt. Western Arcade Birmingham No half-day	13 Exchange St. Castle Market Bldgs. Sheffield Half-day Thursday	51 Savile St., Hull	73 Dale St. Liverpool 2 Half-day Wednesday	56 Morley St. (above Alhambra Theatre) Bradford	8-10 Brown St. (Market St.) Manchester 2 No half-day	5-7 County (Mecca) Arcade Briggate, Leeds Half-day Wed.

AUDIOTRON HI-FI TAPE RECORDER KIT 25½ GNS. Carr. 17/6

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

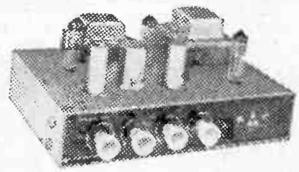
Incorporating the latest Collaro Studio Tape Transcriptor. The audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 14¼ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately **£40.** Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS. Deposit £2.13.9** and 12 monthly payments of **44/-**. Cash price if settled in 3 months.

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

SPECIAL NOTE. The Tape Decks we supply are latest models. Where customers already have a Deck or wish to use one of those being offered cheaply we can supply Kit less Deck at **13 gns.** carr. 10/-. Or deposit **2 gns.** and 12 monthly payments 23/9. Also if required we can supply in lieu of portable cabinet and 7 x 4in. speaker, the Equipment Cabinet illustrated at foot of opp. page and a high flux 8¼ x 5¼in. speaker for **8¼ gns.** extra.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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

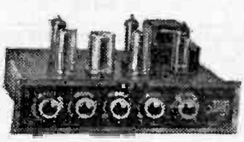


Two input sockets with associated controls allow mixing of "mike" and gram., as in A.10. High sensitivity. Includes 5 valves. ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING-BASS, GUITARS,** etc.
OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-
(Or factory built 51/- extra.)
If required louvred metal cover with 2 carrying handles can be supplied for **18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9** and 9 monthly payments of **24/9.** Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets. Speaker. Microphones, etc., with cash and credit terms.

B.S.R. MONARDECK TAPEDECKS. Speed 3¾in. per sec. With high quality recording heads. **£6.19.6.** Carr. 5/-. Cabinets to take Deck and amplifier **39/6.**

R.S.C. TRANSISTORISED GRAM. AMPLIFIER. Output 1 watt, for 3 ohm speaker. Transistors Mullard OC71, OC81D, OC81, OC81. Fitted Vol. Control with switch. Assembled and tested. Suitable for any normal crystal pick-up. Only **59/9.**

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



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts, suitable for all crystal 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.**
Full constructional details and price list 2/6. Carr. 10/-.
Kit can be supplied assembled ready to use for **59/6** extra.

HI-FI CRYSTAL PICK-UP HEADS. (Cartrides.) Acos Standard replacement for Garrard, B.S.R. and Collaro, **16/9.** Acos Stereo-Monaural 39/9. Ronette Stereo-Monaural 59/6. B.SR. Stereo 39/9.
BRADMATIC RECORDING HEADS. High Impedance Record/Playback 22/-. Low Impedance Erase, 12/6.
PICK-UP ARMS. Complete and with latest Acos/hi-fi Turnover Cartridge **29/11.**
CRYSTAL MICROPHONES. Hand type NP110 **14/9,** R.T.C. **19/9,** Acos Mic 40 **25/9,** Acos Mic 45 **29/9,** Stick type Acos 39-1 **39/9,** BM3 with neck band and heavy table stand **59/9.** Lapel type 35/9.
COLLARO JUNIOR 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only **£3.19.6.**
B.S.R. UA14 4-sp'd AUTO-CHANGERS with hi-fi turnover head, **£6.19.6.** Carr. 4/6.
GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER with high fidelity pick-up. Latest model For 200-250 v. A.C. mains. **£7.19.6.** Carr. 4/6.
GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTO-CHANGERS. Turnover GC8 head, for 200-250 v. A.C. mains. **11 gns.**
GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2-3 ohm speaker. For 200-250 v. A.C. mains. Size 11¼ x 2¼ x 2¼in. Controls: Vol. and Tone with switch. Only **59/6.**

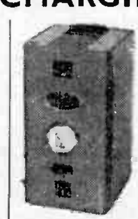
R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250v., 50 c/s. Guaranteed 12 months.

HEAVY DUTY CHARGER KIT 6/12 v. 6 amps. variable output. Consisting of Mains Transformer 0-200-230-250 v.; F.W. (Bridge) Selenium Rectifier; Ammeter. Variable Charge Rate Selector Panels. Plugs, Fuses. Fuseholder and circuit. **59/9.** Carr. 4/6.

CHARGER KIT, 12v. 14 AMP or 24v. 7 amp. Consisting of mains trans. 200-230-250 v. F.W. (Bridge) selenium Rectifier, F Ammeter, Fuses, Variable Resistor and Circuit. Only **6 gns.** Carr. 15/-. Please state if 12v. or 24v. kit required.

SOLDERING IRONS. 230-250 v. 30 watts. First quality. For Radio work. **18/9.** Spare elements and bits available.



Assembled 4-5 amps. 6/12 v.
Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finished. Fused and ready for use with mains and output leads. **69/9** Carr. 5/-. Terms: Deposit 13/3 and 5 monthly payments 13/3.
6/12 v. 3a., all facilities as above. Only 59/9. carr. 3/9.

ASSEMBLED 6/12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Fused, ready for use with mains and output leads **49/9** Carr. 3/9
6/12 v. 1 amp. 27/9 Less meter.

ASSEMBLED 12V. 10 Amp with variable charge rate adjustment, ammeter and strong louvred, stove enamelled case. Ready for use. Only **7 gns.** Carr. 10/- or in Kit Form 5 gns.

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 extra

6v. or 12v. 1 amp.	22/9
As above, with Ammeter	28/9
6 v. 2 amps	19/9
6v. or 12v. 2 amps	25/9
6 v. or 12 v. 2 amps, inclusive of Ammeter	35/9
6 v. or 12 v. 4 amps	45/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector	52/9

CHARGER AMMETERS
0-1.5 a., 0-3 a., 0-4 a., 0-7 a., 0-60 a., 8/9 ea.

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

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

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. 5v. 2a	18/9
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	25/9
300-0-300v. 130mA. 6.3v. 4a. 6.3v. 1a. for Mullard 510 Amplifier	29/9
300-0-300v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 150mA. 6.3v. 4a. 0-5-6.3v. 3a	29/9
425-0-425v. 200mA. 6.3v. 4a. 5v. 3a	49/9

FULLY SHROUDED UPRIGHT

250-0-250v. 60mA. 6.3v. 2a. 0-5-6.3v. 2a. Midget type 2½-3-3in.	17/11
250-0-250v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	27/9
300-0-300v. 100mA. 6.3v. 4 a. 5v. 3a	27/11
300-0-300v. 130mA. 6.3v. 4a. C.T. 6.3v. 1a. for Mullard Amplifier	33/9
350-0-350v. 100mA. 6.3v. 4a. 5v. 3a	27/11
350-0-350v. 150mA. 6.3v. 4a. 5v. 3a	35/9

FULLY SHROUDED (continued)—

425-0-425v. 200mA. 6.3v. 4a. C.T. 5v. 3a	55/-
425-0-425v. 200mA. 6.3v. 4a. C.T., 6.3v. 4a. C.T., 5v. 3a.	59/9
450-0-450v. 250mA. 6.3v. 4a. C.T. 5v. 3a	69/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66 : 1 for 3S4. etc.	4/6
Small Pentode, 5000 Ω to 3 Ω	4/6
Small Pentode 7/8,000 Ω to 3 Ω	4/6
Standard Pentode 5,000 Ω to 3 Ω	5/9
Standard Pentode 7,000 Ω to 3 Ω	5/9
10,000 Ω to 3 Ω	5/9
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 ot 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, 6L6, KT66, EL34, etc.	49/9

MIDGET MAINS Primaries 200-250 v. 50 c/s.

250 v. 60 mA, 6.3 v. 2a.	11/9
250-0-250 v. 60 mA, 6.3 v. 2a	12/11

Both above size 2¼ x 2¼ x 2¼ins.

FILAMENT TRANSFORMERS
All with 200-250 v. 50 c/s. primaries 6.3 v. 1.5a. **5/9**; 6.3 v. 2a. **7/6**; 0-4-6.3 v. 2a. **7/9**; 12 v. 1 a. **7/11**; 6.3 v. 3 a. **8/11**; 6.3 v. 6 a. **17/6**; 12 v. 1.5 a. twice. **17/6.**

SMOOTHING CHOKES

150 mA. 7-10 H H 250 ohms	11/9
100 mA. 10 H 200 ohms	8/9
80 mA. 10 H 350 ohms	5/9
60 mA. 10 H 400 ohms	4/11

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries; 0-9-15 v. 1½ a. **12/9**; 0-9-15 v. 2a. **14/9**; 0-9-15v. 3 a., **16/9**; 0-9-15 v. 5a., **19/9**; 0-9-15 v. 6 a. **23/9**; 0-9-15 v. 8a. **28/9.**

AUTO (Step up/Step down) TRANS. 0-110/120-230/250 v. 50-80 watts, **13/9**; 250 watts, **39/9**; 150 watts, **27/9.**

MICROPHONE TRANSFORMERS
120 : 1 high grade, clamped, **6/9**; 120 : 1 Plotted. Mu-metal screened, **9/9.**

UNIVERSAL AVOMETERS

Guaranteed perfect working order. Supplied complete with leads, batteries and instructions.
Model "D" 34 range £8.19.6
Model "7" 50 range £11.0.0
Registered Post 5/- extra.

MICROAMMETERS

0-500 microamps. 2½in. circular flush panel mounting. Dials engraved, 0-15, 0-600 volts. BRAND NEW. BOXED. 15/-. P.P. 1/6.

7.5 K.V.A. AUTO TRANSFORMERS

0-115-230 volts. Brand new boxed. £15. Carriage 10/-.

230/250 VOLT A.C. MOTORS

4½ x 3in. dia., 90 watts, 5,000 r.p.m. ¼in. spindle. 22/6. P.P. 1/6.

1 K.V.A. ISOLATION TRANSFORMERS

230 v. Pri.: 230 v. Sec. Boxed. £5 each. Carriage 10/-.

VARIAC TRANSFORMERS

24 amp., 230 volt primary, 185 to 250 volt output. £12.10.0. Carriage 10/-.

TELEPHONES TYPE "H"

Sound powered, generator bell ringing, 2 line connection. Fully tested. £4.19.6 pair. Carr. 5/-.

HELIPOTS

Available in the following sizes, 10kΩ. 50kΩ. 10k + 2kΩ. All new, boxed, 22/6 each. P.P. 1/3.

3000 WATT AUTO TRANSFORMERS

0-115-230 volts, step-up or step-down. Brand new, boxed ex-U.S.A. £7.10.0 each. Carr. 10/-.

PANEL METERS

100µA	2½"	F.M.	D.C.	42/6
100µA	3½"	F.M.	D.C.	62/6
1 mA	2½"	F.M.	D.C.	25/-
30/0/30 mA	2½"	F.M.	D.C.	9/6
350 mA	2½"	F.M.	D.C.	10/6
300 v.	2½"	Proj.	A.C.	19/6
300 v.	2½"	F.M.	A.C.	25/-
500 v.	2½"	F.M.	A.C.	25/-
120 v.	3½"	F.M.	D.C.	32/6
1500 v.	2½"	Electrostatic		25/-

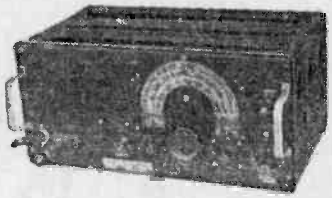
FIELD TELEPHONES TYPE "F"

Suitable for many applications. Generator bell ringing, 2 line connection. With batteries and wooden carrying case, fully tested. £4.19.6 per pair. Carr. 5/-.

SUB-STANDARD D.C. AMMETERS

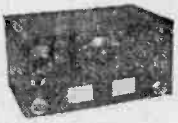
9 ranges, 150mA, 1.5A, 3A, 7.5A, 15A, 30A, 60A, 300A, and 450A. Housed in teak portable case, 8in. mirror scale. Supplied brand new with all shunts and leather carrying case. £15 each. P.P. 10/-.

P.C.R.2 RECEIVERS



800-2,000 metres, 190-550 metres 6-22 Mc/s. output for phones or 3Ω speaker. As new £5.19.6. Carr. 10/6. **PCR3** as PCR2 but covers 190/550 metres, 2-7 Mc/s, 7-22 Mc/s, including top band. As new £8.8.0. Carr. 10/6. All above models can be supplied with internal power unit to operate on 200/250 v. A.C. at 39/6 extra or alternatively plug-in external power units are 35/-.

NATIONAL H.R.O. RECEIVERS



SENIOR MODEL. Supplied complete with full set of 9 coils covering 50 kc/s. to 30 Mc/s. Each receiver thoroughly checked and available as follows:
TABLE MODEL. As new condition £25.
TABLE MODEL. Extremely good used condition £19.19.0.
RACK MODEL. Extremely good used condition £18.18.0.
Carriage £1 extra.
200/250 volt A.C. power packs for above receiver, also sold separately. 59/6. Carr. 5/-.

PRECISION COMBINATION VOLTMETER/AMMETER FOR A.C. AND D.C.

Two separate instruments housed in polished wood case. 6in. scales with knife edge pointers.
Ranges:
Volts A.C. and D.C. 160-300-600 v.
Amps. A.C. and D.C. 25-50-150-200 A.
Supplied complete with all current shunts, leads and leather carrying case. Manufactured by Elliott Bros. Supplied brand new. £9.19.6 each. Carriage 7/6.

HALLICRAFTER S-36A V.H.F. RECEIVERS

F.M./A.M. 27-143 Mc/s. 110/230 volt A.C. operation. Improved version of S-27. Tested before despatch.
Brand new, boxed, with instruction manual. **£40** each. Carr. £2.

MINE DETECTOR No. 4A

Will detect all types of metal. Fully portable. Complete equipment supplied tested with instructions. 39/6. Carriage, 10/6. Battery 8/6 extra.

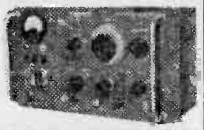
COLLARO STUDIO TAPE TRANSCRIPTOR

Brand new 1962 model, 3 speeds, 3 motors, digital counter, etc. With latest Bradmatic heads and interlock button. Supplied with spare spool, instructions, fixings, 10 gns. each. Carr. paid.

FABULOUS TAPE OFFER

Famous American Brand Tapes. Brand new, fully guaranteed. 5in.—600ft., 10/6, 5in.—900ft., 13/6, 5in.—1200ft., 17/-, 7in.—1200ft., 13/6, 7in.—1800ft., 18/6, 7in.—2400ft., 27/6, P. & P. extra. S.A.E. for full tape list.

CT-53 SIGNAL GENERATORS



Precision instruments covering 8.9 to 15.5 Mc/s. and 20 to 300 Mc/s. on 6 bands. Variable attenuator from 1 microvolt to 100 millivolts. Operation 110/200/250 volts A.C. Supplied in perfect working order. Complete with calibration charts. 19 gns. each. Carriage 10/6.

MARCONI CR100/8 RECEIVERS BRAND NEW

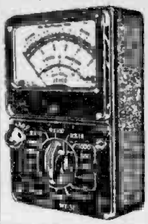
Packed in original transit cases and complete with handbook/manual.
60 kc/s to 30 Mc/s.
200/250 volt A.C. operation.
Tested before despatch.

£35

Carriage £2.

JEMCO 4,000 OHM/VOLT TESTMETER

1% Precision Resistors throughout. Single control system for all ranges. Highly accurate. Sensitivity 4,000 Ω/volt A.C. and D.C.



Ranges:
D.C. volts: 0-10-50-250-500-1,000v.
A.C. volts: 0-10-50-250-500-1,000v.
D.C. current 0-250 µA 0-25-500mA
Resistance: 0-30kΩ 0-300kΩ 0-3MΩ
Decibels: —20 to +36 dB (2 ranges)
Meter sensitivity: 100 microamp. 59/6 each P.P. 2/6.

JEMCO 20,000 OHM/VOLT TESTMETER

As above but with increased sensitivity and extended resistance range (0-5MΩ). 97/6 P.P. 2/6. Either type brand new. Guaranteed with leads, prods, batteries, instructions.

L.T. METAL RECTIFIERS

All full wave, bridge connected. Brand new, guaranteed.

12/18v.	1.5A.	3/9	24/36v.	4A.	22/6
12/18v.	2.5A.	6/3	24/36v.	15A.	45/-
12/18v.	4A.	8/3	36/48v.	2A.	19/6
12/18v.	6A.	12/3	36/48v.	4A.	29/6
12/18v.	10A.	22/6	36/48v.	6A.	32/6
12/18v.	15A.	37/6	48/60v.	2A.	21/-
24/36v.	1A.	7/3	48/60v.	10A.	82/6

Please add postage.

L.T. TRANSFORMERS

All primaries tapped 200/250 volts. **1 Battery Charging.** 3.5, 9 or 17 volt, 1 amp., 9/9. Ditto 2 amp., 14/3. Ditto 4 amp., 16/6. 9 or 17 volt, 6 amp., 26/-.
2 Model Type 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24 or 30 volt, 2 amp., 18/6. Ditto 4 amp., 27/6. Ditto 5 amp., 37/6. Add Postage.

MINIATURE MODEL ACCUMULATORS

Lead Acid. BRAND NEW. 2v. 1.5 A.H., 4 x 1¼ x 1in., ⅟₂lb., 5/6. P.P. 1/3. 12v. 0.75 A.H., 4 x 3 x 1½in. 2lb., 15/6. P.P. 1/6.

R.C.A. PLATE TRANSFORMERS

Pri. 200/250 v. sec., 2,000-0-2,000 v. 500 mA. tapped 1,500 v. New. Boxed, £6.10.0. Carriage 15/-.

DUMONT K1051P1 DOUBLE BEAM C.R.T.

Twin Gun. Brand new, boxed. 59/6. P.P. 3/6.

1.2 Ohm 12 Amp RHEOSTAT

Geared slider type, new, boxed, 15/6 each. P.P. 3/6.

MARCONI TF-885 VIDEO OSCILLATORS

25c/s-5Mc/s. Supplied in guaranteed as new condition. £90 each.

H.R.O. DIALS

Brand new, 27/6. P.P. 2/6.

MINIATURE PANEL METERS

For 1½in. dia. panel hole.

0-50 µA	39/6	0-300 v. D.C.	27/6
0-500µA	32/6	"S" meter	35/-
0-1 mA	27/6	"VU" meter	42/6
0-5 mA	27/6		

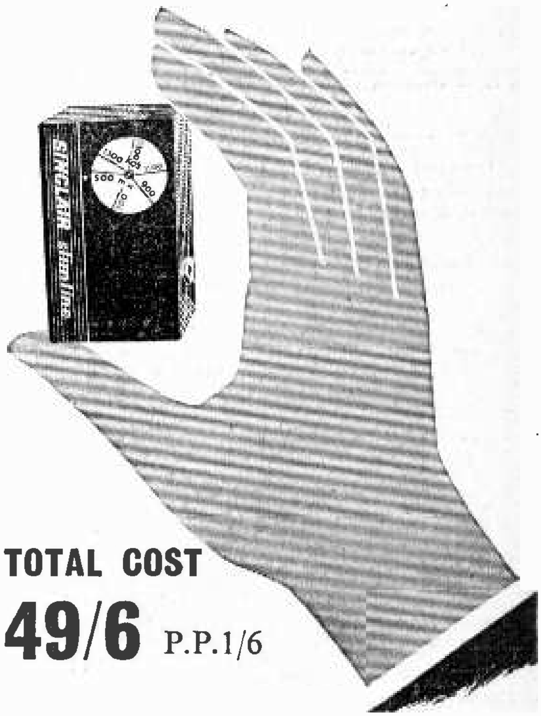
Hours of Business: **3 LISLE STREET, 9 a.m.—6 p.m. Half Day Saturday**
34 LISLE STREET, 9 a.m.—6 p.m. Half Day Thursday

Send S.A.E. For Bargain Lists

C.W. SMITH & CO (RADIO) LIMITED

Phone GERRARD 8204/9155
Cables SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

SUCCESS



The SINCLAIR SLIMLINE has proved itself. Over a thousand constructors have already built this wonderful little receiver and dozens have written to let us know how pleased they are. The reasons for this enormous success are simple:

1. The **Sinclair Slimline** is the smallest receiver of them all, only **$2\frac{3}{4}$ x $1\frac{5}{8}$ x $\frac{5}{8}$in.** Yet in performance and design it far surpasses sets many times as large.

2. Using only its internal ferrite rod aerial it will receive all stations on the medium wave band including **Home, Light, Third, Luxembourg and dozens of continental transmissions.**

3. Elegant deep royal blue case with gold lettering and calibrated dial in gold on white. Both designed by a professional artist.

4. The earpiece provided gives superb reproduction free from noise or distortion and sufficient volume even for use in a car.

5. All the components are brand new and MICRO-ALLOY TRANSISTORS are employed throughout.

6. The completely new reflex circuit developed by Sinclair Radionics engineers results in a radio with the sensitivity and selectivity of a good superhet but with no alignment problems.

7. Well illustrated, superbly clear instructions are provided.

8. A carefully designed printed circuit board, on which all the components are mounted, is supplied.

9. Assembly is perfectly straightforward and simple even for a complete beginner yet the brilliant performance will more than satisfy the expert.

TOTAL COST

49/6 P.P.1/6

Just two of the many letters we have received. The originals may be seen at our Cambridge office.

Dear Sirs,
I have just built your Transistor Micro-Radio the "Slimline" and I'm amazed at the results. So far I've got about 10 stations including AFN, Stuttgart and Munich. I've built many sets but this one leaves them all standing

Thanking you,
H.S., Watford.

Dear Sirs,
I have received delivery of the "Sinclair Slimline" and have completed assembly. The quality of reproduction for both voice and music obtained with your circuit is so delightful that I do not overstate when I say that I have lost interest in the other more conventional transistor sets that I have built. I have one good quality sound reproducer, which I described some years ago in the technical press, but have found that I can obtain an equal effect for personal listening with the "Sinclair Slimline".
I should be favoured to receive a further kit when more are available (I assume the demand will be high and shall be glad to take my turn). I enclose a cheque in payment for this further order.

Yours faithfully,
J.F., Glasgow.

We would like to thank all those constructors who have written us such pleasant letters and to apologise for slight delays in delivery which have occurred owing to the overwhelming demand. However we have now increased our staff to cope with this and can give a very prompt service.

A complete book on MAT'S entitled "22 TESTED CIRCUITS USING MICRO-ALLOY TRANSISTORS" is available from us at 5/9 including postage.

Prices of MAT's remain

MAT 100 and MAT 120 .. 7/9
MAT 120 and MAT 121 .. 8/6
POST FREE

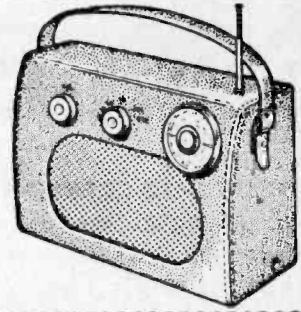
SEND FOR YOUR 'SLIMLINE' TODAY TO:—

SINCLAIR radionics LTD

69 HISTON ROAD, CAMBRIDGE

"ROAMER" 7 (5 Wavebands)

PERFORMANCE WILL AMAZE YOU!



★ (7 Transistor plus 2 Diode design)

★ Med/Long Waves, Trawler Band and 2 S.W. to approx. 17 metres.

★ Rich-toned heavy duty 5in. Speaker

Total cost parts **£7.9.6** P.P 5/6.

★ Fine for car radio use.

★ Telescopic aerial for S. Waves.

★ FERRITE ROD AERIAL FOR M/L.

★ Full After Sales Service.

★ Air spaced ganged Tuning Condenser.

★ Push-Pull output for room filling volume.

★ Simulated hide case with gilt trim fitted with shoulder & hand straps.

★ Case size 9 x 7 x 4in. approx.

★ Parts price list and data 3/-.

THE SUPER SEVEN

★★★ (7 Transistors plus 2 Diodes)

★ 2 R.F. STAGES.

★ Coverage of Medium, Long Waves, Trawler Band.

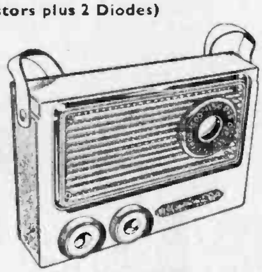
★ Telescopic aerial for Trawler Band.

★ Use as domestic radio, car radio or fit with strap for carry-about.

★ No aerial required.

★ 3-inch speaker but will drive a larger speaker.

★ Push-Pull Output.



SIZE: 7½ x 5½ x 1¼in.

May be built for **£6.5.0** plus 3/6 post, etc.

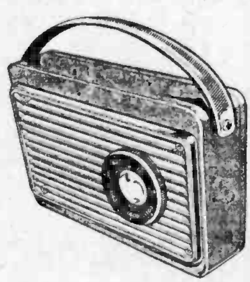
PARTS PRICE LIST AND EASY BUILD PLANS 2/-

NEW TRANSONA-6

★ (6 Transistors, plus 2 Diodes, 8-Stage)

★ MW/LW

Powerful magnet 3in. high grade speaker. Push-pull transformers. This is a top performing receiver. Many stations listed in one evening including Luxembourg loud and clear. A pleasure to listen to. **FERRITE ROD AERIAL.** All parts sold separately, grille in red. Uses 9 volt battery.



Total building cost **£3.19.6** P.P. 3/-. Size 6½ x 4½ x 1¼in.

"Luxembourg as loud as local. Your easy build diagram helped a lot . . . my first attempt."—H. S., Penzance, Cornwall (poor reception area).

PARTS PRICE LIST AND EASY BUILD PLANS 1/6

All components used in our receivers may be purchased separately if desired.

AFTER SALES SERVICE

Radio Exchange Co.

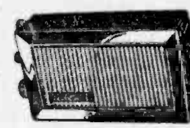
27 HARPUR STREET, BEDFORD

Phone: 2367

10 a.m.—1 p.m. Sat. Opp. Co-op.

"POCKET-5"

(MW/LW and TRAWLER BAND) (7 Stages)
(5 Transistors, plus 2 Diodes)



Designed round supersensitive **FERRITE ROD AERIAL** and fine tone moving coil speaker. Attractive case in black with speaker grille in red. On test, Home, Light, Radio Luxembourg and many Continental stations were received.

Total cost of all parts required **£2.19.6** P.P. 3/-.

EASY BUILD PLANS AND PARTS PRICE LIST 1/6

PUSH-PULL FIVE

(5 Transistors, plus 2 Diodes 7 Stage)

★ **2¾in. Super-tone Loudspeaker.**

★ **Ferrite rod aerial.**

★ Tuning condenser.

★ Volume control

★ Case with speaker grille in red.

★ Fully tunable over med/long waves.

★ Simple assembly diagrams.

★ 250 Milliwatts Push-pull output.

Can be built for **59/6** P.P. 3/-.

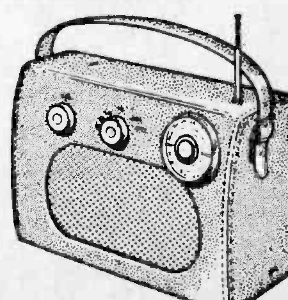
★ PARTS PRICE LIST, etc. 2/-.

"Home, Light, AFN, Lux., all at good volume."—G. P., Durham.

"ROAMER-6"

5 Wavebands (M/L, T.B. and 2 S.W.)

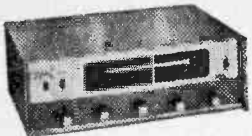
Uses 6 top grade transistors plus 2 diodes. 5in. Speaker. Ferrite rod aerial for sensitivity. Telescopic aerial for short waves. Handsome case with gilt fittings size 9 x 7 x 4in. approx. Listen to stations half a world away.



Total cost of parts **£6.19.6** Post & Packing 5/6.

Plans, parts price list 3/-.

POST FREE MAIL ORDER SERVICE



"EAGLE-PIONEER" AUDIO MASTER FM.B100

Will delight the most critical enthusiast. Has many features—tuners for MW, SW and FM, an output of 10 watts, microphone input and complete facilities for Hi-Fi reproduction and simultaneous recording on to tape. Supplied complete. Price £57.10.0. S.A.E. for leaflet.

All goods sent by return

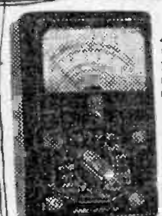
PORTABLE MAINS SOLDERING IRON SP.1

30 watts. Features removable handle that covers tip and barrel. Complete for 18/9.

SIGNAL INJECTION PROBE IT1.1.

Push button operation. Ideal for making rapid checks on radios, TV, Amps, tuners, etc. Price 42/6.

Full range of Eagle Products always in stock



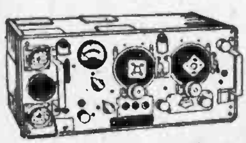
MULTI-METERS

All complete with test prods, batteries and instructions.

Model EP.100K. 100,000 O.P.V. A handy size high sensitivity multi tester, with shockproof 9.5μA meter. Ranges D.C. volts, A.C. volts, D.C. amps, Ohms, etc. Size 5g x 3g x 2½in. Originally £14.14.0.
RELDA EXCLUSIVE OFFER UNOBTAINABLE ELSEWHERE **£6.19.6**
EP.50K. 50,000 O.P.V. complete £9.19.6
EP.30K. 30,000 O.P.V. complete £6.19.6
EP.10K. 10,000 O.P.V. in Kit form £3.9.6
TK.20A. 1,000 O.P.V. Complete £2.9.6
S.A.E. for leaflets

All goods available as previously advertised

No. 19. 2-8 Mc/s TRANSMITTER RECEIVER

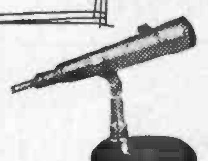


This most famous Army Trans/Receiver covers 2-8 Mc/s. (150-37 metres in two bands). Has an intercom, amplifier. Designed for 12 and 24 volt operation but supplied with "P.W." Mains conversion details. Uses a 6 valve superhet receiver, I.F. being 465 Kc/s, and a 6 valve transmitter designed for voice and C.W. operation. Incorporates test and tuning meter for voltages, aerial loading and current tests. Panel Controls: Frequency tuning, P.A. tuning, Gain control, MCW. CW, R/T switch. Het-tone netting. Off-on Quench aerial, AVC LT-HT—Drive tests. Supplied complete with valves and instruction book. Only 75/-.

PANEL METERS

"S" Meter Model, 35/-;
DC Microammeters, 5 m/a, 27/6; 300 v., 27/6; 0-50μA, 39/6; 0-500μA, 32/6; DC Milliammeter, 0-1mA, 27/6. Clear Plastic or Black Bakelite. Will fit 1½in. dia. cut out. Also new Edgewise Panel Meters. Size 3½" w. x 1" h. x 3½" d. EW.16. 0-200μA, 69/6; 0-1mA, 59/6. All boxed and fully guaranteed.

3-WAY SLIM CRYSTAL MICROPHONE



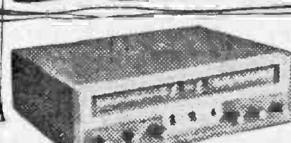
MODEL 100C. May be hand-held, floor stand or desk stand mounted or suspended by lavalier cord. Response 60-10,000 cps. Built in on/off Switch. Output level —52dB. Omni-directional head. Clips on or off standard stand adaptor permitting tilting for multi-angle use. Satin chrome finish. *Supplied complete with table stand, cable and lavalier cord.* Price 48/-.

VISIT OUR HI-FI SHOWROOM AT 87, TOTTENHAM CT. RD., W.1

TAPE SPLICER & CUTTER. Model T.635. Cuts 2 rounded indentations in the tape splice leaving the edges of the tape which contact parts of the recorder entirely free of adhesive. As little as ¼in. tape need be removed. Complete with instructions, 18/9.

A MINIATURE TAPE RECORDER IN KIT FORM NOW ONLY £4.19.6.

Exclusively offered complete with all accessories. No extras to buy. Consisting of three transistor amplifier, recordplay, Volume control, miniature speaker, forward-stop-rewind switch, reel of tape and spare reel, motor, attractive coloured case, Mic. and earphone sockets, pick-up coil, mike, earphone and carrying handle supplied. Standard battery operated. Simple to put together in less than one hour. Brand new and guaranteed.



"EAGLE-PIONEER" STEREO-MASTER SM.Q141. A masterpiece of brilliant engineering, providing for every possible modern listening feature. Comprises Hi-Fi amplifier, AM, FM, SW tuners, dual pre-amp for every known input plus multiplex system. The ultimate in Hi-Fi. Price £78.15.0. S.A.E. for leaflet.

Relda Radio Ltd.

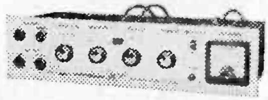
MAIL ORDERS TO: DEPT. 'P' 32A. COPTIC STREET, LONDON, W.C.1 Tel: MUSeum 9606

See our other advertisement on page 175 for more attractive items

Stern's

SPECIALISTS IN SOUND EQUIPMENT FOR OVER 25 YEARS

STEREO TAPE PRE-AMPLIFIER



MODEL STP-1. For use with current TRUVOX, BRENELL, or COLLARO "STUDIO" ½ and ¼ track Stereo Decks. Incorporates Ferroxcube Oscillator, 4 speed Equalisation Signal Level Meter and separate Gain Controls. Includes separate Power Unit.

KIT OF PARTS **£22.0.0** ASSEMBLED **£28.0.0**

TAPE PRE-AMPLIFIER MULLARD'S Type "C"

Suitable for most ½ track, Mono Tape Decks. Incorporates Ferroxcube Push Pull Oscillator and 3 Speed Treble Inductor. Includes Separate Power Unit.

KIT OF PARTS **£14.0.0** ASSEMBLED **£19.10.0**

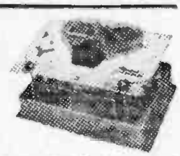
MULLARD'S TAPE AMPLIFIER

MODEL HF/TR 3

Based on Mullard's Type "A" design and suitable for most ½ track Mono Tape Decks. Incorporates Ferroxcube 3 speed Treble Inductor and Gilson Output Transformer. Includes separate Power Unit.

KIT OF PARTS **£13.13.0** ASSEMBLED **£19.0.0**

STERN'S "ADD-A-DECK"



A self contained Unit consisting of Garrard Deck and matched Preamplifier on one chassis. Provides full tape recording facilities and replays through Pick Up Sockets or standard Radio receiver or Amplifier.

PRICE includes Spool of Tape **£18.18.0**

and NOW!!! STERN'S OFFER

THE "EMPRESS" STEREOSCOPE UNIT

A SPECIAL BULK PURCHASE ENABLES US TO OFFER THIS HIGH GRADE STEREO PRE-AMPLIFIER AT APPROX THE MANUFACTURER'S PRODUCTION COST. IT IS ENGINEERED TO THE VERY HIGHEST TECHNICAL STANDARDS AND REPRESENTS THE ULTIMATE IN PRECISION HIGH FIDELITY EQUIPMENT FOR

EXCEPTIONAL VALUE
10 + 10 WATTS

Unquestionably the most advanced STEREOPHONIC Pre-amplifier available today. It provides the greatest range of facilities ever offered in a single unit. It incorporates full input facilities for Crystal or Magnetic Pick-Ups and Microphones, Radio Transmissions, Tape Recorders and Replay direct from high impedance Tape Heads. A miniature Cathode Ray Tube provides for VISUAL balancing of the input signals, and also for measuring the frequency response of PICK UPS and the power output in watts. The controls include Scratch and Rumble Filters. Loudspeaker phasing in conjunction with a 50 cycles per second note. Channel reversal and Mixing facilities together with Function Switches, separate Volume and Baxandall Tone Controls. Size 14½in. x 10½in. x 4in.

OFFERED AT THE SPECIAL PRICE OF **£17.17.0**

THE EMPRESS IS PARTICULARLY SUITABLE TO OPERATE WITH OUR MULLARD "10 plus 10" POWER AMPLIFIER. AND WE OFFER THE TWO FOR ONLY **£36.0.0**

!! COMBINED PRICE OFFERS !!

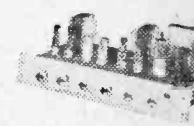
Includes small charge for special testing and PRECISE MATCHING of the ASSEMBLED PRE-AMPLIFIER (or Amplifier) to TAPE DECK

STP-1 (Kit) and "STUDIO" Deck	£39.0.0	Assembled £46.0.0
STP-1 (Kit) and Brenell Deck	£66.0.0	Assembled £75.0.0
STP-1 (Kit) and Truvox Deck	£51.0.0	Assembled £59.0.0
TYPE "C" (Kit) and "STUDIO" Deck	£26.10.0	Assembled £33.0.0
TYPE "C" (Kit) and BRENELL Deck	£43.0.0	Assembled £50.0.0
TYPE "C" Assembled and Wearite Deck	£70.0.0	Inc. Head Lift Trans.
HF/TR3 (Kit) and "STUDIO" Deck	£26.0.0	Assembled £33.0.0
HF/TR3 (Kit) and BRENELL Deck	£42.0.0	Assembled £50.0.0
HF/TR3 Assembled and Wearite Deck	£70.0.0	Inc. Head Lift Trans.

To build a complete TAPE RECORDER we offer HF/TR3 AMPLIFIER STUDIO DECK, PORTABLE CASE, ROLA 10 x 8in. SPEAKER MICROPHONE and 1,200ft. TAPE ALL for £35.0.0.

ALTERNATIVELY WE OFFER....THE COMPLETELY ASSEMBLED and GUARANTEED PORTABLE RECORDER ....(Model CR3/S)....FOR....£43.0.0.

MULLARD'S "10+10" STEREO AMPLIFIER



A high fidelity design providing up to 10 watts (per channel). Superb reproduction frequency response flat to within 3db from 3 c/s to 60 Kc/s at 50 mW Total Harmonic Distortion at 10 watts 0.1%.

Price (a) ASSEMBLED AMPLIFIER (as illustrated) **£24.0.0**

(b) KIT OF PARTS.......... **£20.0.0**

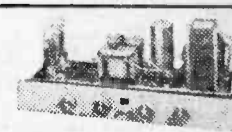
Built to the highest technical standards and presented strictly to MULLARD'S specification. Two specially designed GILSON OUTPUT TRANSFORMERS with 20% taps are used.

We can also supply the assembled MAIN AMPLIFIER only for operation with our DUAL CHANNEL PRE-AMPLIFIER: this provides a more versatile installation and is essential if a low output Magnetic Pick-up is to be used. When ordering specify loudspeaker impedance.

(a) THE ASSEMBLED MAIN AMPLIFIER and ASSEMBLED DUAL CHANNEL PRE-AMP...................... **£34.0.0**

(b) KIT OF PARTS for both Units...................... **£27.0.0**

THE "TWIN THREE" STEREO AMPLIFIER



ASSEMBLED AND TESTED

£9.0.0 (Carriage and Insurance 7/6 extra)

Based on a recent design by MULLARD LTD., is ideally suited for use in Portable RECORD PLAYERS for which purpose we offer a specially designed Case: incorporates MULLARD ECL 86 Valves, separate BASS and TREBLE CONTROLS and produces up to 3 watts per channel. Frequency response is 40 c/s to 30 Kc/s. size is only 11½in. x 3in. x 5in.

To construct a STEREO PORTABLE RECORD PLAYER we offer: Assembled AMPLIFIER with two ROLA 8in. x 5in. LOUDSPEAKERS and PORTABLE CASE for.................. **£16.10.0**

MULLARD DUAL-CHANNEL PRE-AMPLIFIER

A four Valve design for both STEREOPHONIC and MONOPHONIC operation. Operates equally well with any make of Amplifier requiring an input of up to 250 m/v.

KIT OF PARTS **£12.10.0** ASSEMBLED AND TESTED **£15.0.0**

THE "TUDOR" STEREO AMPLIFIER

PRICE **£15.0.0** (Carr. free)

A self-contained Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS.

Send S.A.E. for fully descriptive technical leaflets, or call at our showrooms and hear the equipment on demonstration.

Our Technical dept. will be happy to advise on the choice of matching PICK-UPS - Microphones - Loudspkrs.

CREDIT SALE TERMS ON ALL EQUIPMENT OVER £10

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STERN RADIO LTD.
6-12 TUDOR PLACE, TOTTENHAM COURT RD.
LONDON, W1. TEL. MUSEUM 6128/9

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ARP34	4/-
ARTP1	6/-
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ATP7	5/6
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B84A	5/6
BT45	15/-
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D41	3/3
D77	4/3
DA30	12/6
DAF70	35/-
DAF91	6/-
DAF96	7/6
DD41	4/-
DET5	15/-
DET20	2/-
DF73	7/6
DF91	4/-
DF96	7/6
DK96	7/3
DL92	6/-
DL94	6/-
DL96	7/6
EA50	1/6
EABC80	7/8
EAC91	3/6

EB34	1/6
EBC33	7/-
EBC41	7/9
EBC90	5/-
EBF80	9/-
EBF89	8/-
EC52	8/-
EC90	20/-
EC91	3/-
ECC32	5/-
ECC81	5/6
ECC82	6/6
ECC83	7/-
ECC84	7/-
ECC85	8/-
ECC91	4/-
ECF80	10/6
ECF82	8/6
ECH42	9/6
ECH81	7/6
ECL80	7/6
ECL82	9/6
ECL83	10/-
ECL86	11/-
EF36	3/6
EF39	4/-
EF41	8/-
EF50	1/6
EF54	3/3
EF55	7/-
EF70	4/-
EF73	6/-
EF80	5/6
EF85	6/6
EF86	7/-
EF89	7/-
EF91	3/6
EF92	3/-
EF95	5/-
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EF184	9/-
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EL33	7/-
EL34	12/-
EL35	6/-

EL38	12/6
EL41	8/-
EL42	8/-
EL84	7/-
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EL95	6/6
EM80	8/-
EM84	9/-
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EZ41	6/9
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PCF82	8/-
PCL82	8/6
PCL83	10/-
PCL84	9/-
PCL86	10/-
PEN45	4/6
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PL82	8/-
PL83	8/-
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SP41	2/6
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U18	6/6
U25	10/-
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U27	8/-

U52	5/-
U801	20/-
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UBF80	8/6
UBF89	8/-
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UCH81	9/-
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UL84	7/6
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VT4C	25/-
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X66	8/-
Y63	5/-
Y65	4/-
Y66	8/-
1A3	3/-
1A5GT	5/-
1C5GT	7/6
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1E7G	7/6
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1LD5	5/-
1R5	6/-
1S4	5/-
1S5	5/6
1T4	4/-
1W4/500	6/-
2A3	5/-
2A5	6/-
2A6	7/-
2C34	2/6
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2D21	5/-
2D21W	8/6
2X2	4/-
3A4	5/-
3B7	5/-

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3B28	15/-
3E29	50/-
3E29 (829B)	60/-
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5R4GY	9/-
5T4	9/-
5U4G	5/-
5V4GT	8/-
5Y3G	3/-
5Y3GT	6/-
5Z4	8/6
5Z4G	7/-
6AB7	4/-
6AC7	3/-
6AG5	3/-
6AG7	6/-
6AH	10/-
6AJ4	9/-
6AJ5	8/6
6AJ7	3/-
6AK5	5/-
6AK6	6/-
6AK7	6/-
6AM5	5/-
6AS6	4/-
6AM6	4/-
6AQ5	7/-
6AT6	5/-
6B7	5/-
6B8G	2/6
6BA6	5/6
6BR7	12/-
6C4	2/6
6C5GT	6/-
6C6G	3/-
6C8G	5/-
6CH6	5/-
6D6	3/-
6F5GT	5/9
6F5G	5/3
6F6G	4/-
6F7	5/-
6F8G	5/-
6F12	4/6
6F13	5/-
6F33	3/6

6G6G	2/6
6H6M	1/6
6J5	3/6
6J5G	3/-
6J6	3/6
6J7G	5/-
6K6GT	6/-
6K7G	2/-
6K7GT	4/9
6K8G	5/9
6K8GT	8/3
6K8M	8/6
6L5G	6/-
6L6	9/-
6L6G	6/-
6L7G	4/6
6L34	4/6
6LD20	5/9
6N7	6/-
6N7G	5/9
6Q7G	6/-
6R7	6/-
6SC7	5/6
6SC7GT	5/-
6SG7	5/-
6SH7	3/-
6SJ7	5/-
6SJ7GT	4/9
6SJ7Y	6/6
6SK7	5/-
6SL7GT	6/6
6SN7	4/6
6SQ7	6/-
6SS7	3/-
5U4GT	9/6
6V6G	4/-
6V6GT	6/-
6V6M	8/-
6X4	5/-
6X5GT	4/6
6Y6G	6/-
6Z4	5/-
6-30L2	10/-
7B7	7/6
7C5	12/-
7C6	7/-
7C7	5/-
7H7	7/3
7Q7	7/-
7V7	5/-
7Y4	5/-
7Z4	4/-
8D2	2/6

9D2	3/-
12A6	2/6
12AH7	5/-
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12AT7	5/6
12AU6	9/-
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12AX7	7/-
12AY7	10/-
12C8	3/-
12E1	20/-
12H6	2/-
12J5GT	3/6
12K7GT	4/6
12K8M	7/6
12Q7GT	4/4
12SA7	7/-
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7	3/6
12SK7GT	3/-
12SL7	5/9
12SN7	5/9
12SR7	5/-
12Y4	2/-
14L7	7/-
15D2	6/-
20A2	17/6
20P4	17/6
21B6	9/-
25L6GT	7/9
30	5/-
30C15	10/-
30F5	8/6
30FL1	9/6
30P19	11/-
30PL1	10/6
30PL13	10/6
35L6GT	8/-
35T	17/6
35Z4GT	7/-
37	4/-
42	5/-
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58	6/-
59	6/-
75	5/6
76	5/-
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78	7/-

80	5/6
81	9/-
83	8/-
84	8/-
85A2	7/6
89	6/-
90C1	8/-
210VPT 7-pin	2/6
220TH	4/-
250TH	£9
350B	8/-
368A	5/-
393A	15/-
705A	15/-
715B	60/-
717A	8/6
801	6/-
803	22/6
805	30/-
807 (selected)	5/6
807BR	5/-
808	8/-
810	80/-
813	60/-
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829A	30/-
829B	50/-
832	15/-
832A	45/-
843	7/4
866A	14/-
954	4/-
955	[illegible]/6
956	2/-
957	5/-
958A	4/-
1616	3/-
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1626	4/6
1629	4/6
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6120	4/-
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7191	1/9
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9002	5/6
9003	6/-
9004	2/6
9006	2/6

Cathode Ray Tubes

ACR1	15/-
ACR11	15/-
ACR13	50/-
CV995	15/-
CV1596 (09J)	55/-
E4103/B4	25/-
3FP7	25/-
5BP1	35/-
5CP1	42/6
5FP7	45/-
5FP7A	25/-
VCR97	28/-
VCR138	30/-
VCR139A	35/-

Photo Tubes

CMG8	9/-
GS16	12/6

Special Valves

2J31	45/-
3A/1481	45/-
3J192/E	£37.10
4J31	£35
4J50	£35
723A/B	50/-
725A	30/-
726A	27/6
ACT6	160/-
CV193	30/-
CV980	3/-
KR6/3	70/-
LS7B	30/-
WL417A	15/-

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves 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.

"CONNECT AND FORGET—CANNOT OVERCHARGE" "ESSTRON" MARK I AUTOMATIC BATTERY CHARGER. Initial charging rate 6-7 amps. The charging rate automatically adjusts itself to the charge in the battery. Automatic current and voltage control. Patented application of magnetic amplification to battery charging. Indicator lights show battery fully charged, receiving charge, incorrectly connected or faulty cells. Mains voltage 200/250 v. Built for 6 or 12 v. batteries. Measurements 7 x 5 x 5½in. Weight 8½ lb. Price **£7.19.6.** P. & P. 3/6.

CR 150 DOUBLE CONVERSION COMMUNICATION RECEIVER. Range 2 to 60 Mc/s in 5 bands, 2 RF stages (EF50), 1st Frequency changer (EF50), Oscillator (EF50), 2nd frequency changer (X65 or X66), Two IF stages (KTW 63), Detector (AVC), LF stage (DH 63), Noise limiter, crystal callibration (DH 63), BFO (KTW 63) output stage (L 63), voltage stabiliser (STV 280/40), electrical band spread, "S" meter, band pass 10,000—5,000—1,500—500—100 c/s, IF 1.6 mc and 465 kc. In as new and guaranteed condition, with original mains power supply unit **£70** or without power supply unit **£60.** Carriage 30/-.

P.C. RADIO'S Mains power supply unit for above 90/-.

CR 200 LONG WAVE RECEIVER. 15 kc—560 kc. **£7.10.0.** Carriage 30/-.

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

R.109 RECEIVER. Covering 2-8 Mc/s. 6 v. D.C. with set of spare valves and carrier. Brand new in original packing case. **£6.18.0** including delivery in U.K.

R.109A RECEIVER. Covering 2-12 Mc/s., **£7.18.0.**

53 TRANSMITTER SPARES. Full range. Price list on application.

H.R.O. Senior. Table Model. In excellent, fully checked, and tested condition (without coils and power pack), **£15.10.0.** As above but rack mounted model, **£14.10.0.**

Individual frequency coils for above **£1** each set or set of 9 **£8.** Either model carriage **£1.10.0.**

Power pack for above. British made, A.C. 110/200/250 v., **59/6.** Postage 4/-.

CARBON INSET MICROPHONE. G.P.O. type, 2/6. P. & P. 1/6.

80W 12V PETROL DRIVEN CHARGING SETS. Very compact, in fully guaranteed condition, **£12.10.0,** Carr. £1.

RE-ENTRANT LOUD HAILERS. 500 ohms, approx. 20w. **£6.10.0.** Carr. 10/-

R.107 COMMUNICATION RECEIVER. 1.2/17 mcs. 9 valves. "Wide" and "narrow" band switch. AVC and BFO, with internal speaker. 100/250 v. A.C. and 12 v. D.C. Meas: 24 x 13 x 17in. Price **£13.10.0.** Carriage 20/-.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS.

Please write your requirements.

AERIALS 11ft. long. 2ft. long when folded, 15/-. P. & P. 2/-.

VARIOMETER FOR No. 19 SET. 10/- each. P. & P. 3/-.

DOUBLE BEAM OSCILLOSCOPE TYPE 13. 4½in. screen. Time base 2 C/S-1 Mc/s. Callibration markers 1 microsec-10 microsecs, Y2 attenuation. 115/230 v. A.C. In excellent checked condition **£27.10.0.** Carriage £1.

R.209 RECEPTION SET. A 10-valve high-grade Superhet Receiver with facilities for receiving R/T (A.M. or F.M.) and C.W. frequency 1 Mc/s-20 Mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Dimensions: Length 12in., width 8in., depth 9in. Weight 23lb. In as new, tested and guaranteed condition, **£23.10.0,** including special headphone and supply leads. Carr. £1.

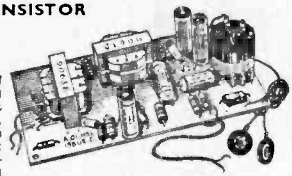
COMPLETE SET OF STRONG AERIAL RODS (American). Screw-in type MP49, 50, 51, 52, 53, total length 15ft. 10in. Top diameter 0.185in. Bottom diameter 0.615in., together with matched aerial base. MP37 with ceramic insulator, ideal for car or roof insulation, **£2.10.0.** Post free.

P. C. RADIO LTD

170 GOLDHAWK ROAD, W.12

Shepherd's Bush 4946

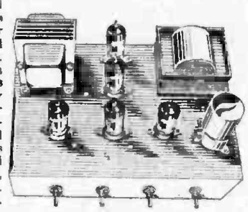
HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/- P. & P. 2/6.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded ultra output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.)

All parts sold separately. ONLY £6.19.6 P. & P. 6/6.

AMPLIFIER ON PRINTED CIRCUIT BOARD

Two valve. UY85, UL84 O.P. trans., use with 80 volt tap off motor. 39/6. P.P. 2/6 on above. Dropper res. for filaments if required. 2/6.

B.S.R. AUTO UNITS

160 v. Suitable for use with above. (Slightly soiled.) £4.4.0.

UNREPEATABLE OFFER!
BRAND NEW 8" x 5" 3 OHM SPEAKERS
By well known maker
10/6 each.
P. & P. 1/6 per speaker
A pair of these are ideal for Stereo

LARGE CABINET Suitable for above two items. Complete with 3 ohm speaker. £3.9.6. Carr. 5/-.

Superior CABINET Similar to above to take 8 x 5in. speaker, with motor board, will accommodate BSR UA14 or UA16. £3.9.6. Carr. 5/6. Speaker 15/- extra. P. & P. 1/6 extra.

BRAND NEW 3 OHM LOUDSPEAKERS

2½in. 12/6; 5in. 12/6; 6½in. 15/-; 8in. 21/-; 10in. 25/-; 12in. 27/6.

Goodmans 5in. tweeter ..	10/6
E.M.I. 2½in. tweeter ..	10/6
E.M.I. 13½in. x 8½in. high flux	32/6
Rola Celestion approx. 9in. x 6in. middle register speaker	10/6

Also 15 ohm 12in., 30/-
P. & P. 1/6 per speaker.

RECORDING TAPE

P.V.C. base, full frequency L.P. tape. 7in., 1800ft. (normally 50/-) 27/6; 5¾in., 1,200ft. (normally 35/-), 18/9. 5in., 900ft. (normally 28/-), 15/-. P. & P. 1/- per spool. Ideal for 2 or 4 track recorder.

TAPE DECKS

COLLARO STUDIO DECK
£10.10.0. plus 5/6 carr. and ins.
B.S.R. MONARDECK
(Single speed) 3¾in. per sec., simple control, uses 5¾in. spools. £6.15.0 plus 5/6 carr. and ins. (Tapes extra on both).

SPECIAL BARGAIN OFFERS!

TWO GANG .0005 TUNING CONDENSER. Geared precision reduction drive. Size 2⁷/₁₆ x 2 x 1¾in. Brand new and unused. 3/6 each. P. & P. 1/-.

MAINS TRANSFORMER. Impregnated and fully shrouded. Size 4½ x 3½ x 2¾in. Weight 6 lbs. Tapped primary 205, 225, 245v. Electrostatic screen. Output 360-0-360 v. at 120 m/a D.C. plus 1050 v. half wave at 3 m/a D.C. 6.3 v. at 3.5 amps, centre tapped 5 v. at 2½ amps and 6.3 v. at .6 amps PRICE ONLY 21/- each, P. & P. 5/-.

CARBON MIKE INSERTS. Brand new. 2¼in. dia., 3/6, P. & P. 9d.

GORLER F.M. TUNER HEADS. 10.7 Mc/s I.F., 15/-, plus 1/9 P. & P. (ECC85 valve 8/6 extra).

ELECTROSTATIC H.F. TWEETERS. Type L.S.H. 75. Size 3 x 3in., 2/6 each, plus 9d. P. & P.

MIDGET 2/GANG CONDENSERS. Capacity 195 and 100 pF. Polystyrene case with built-in trimmers. Size ¾ x ¾ x ½in. Not used but removed from P/C Boards. Two for 9/-, plus 1/- P. & P.

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

TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price 18/6. P. & P. 1/6.

TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output), plus 4 suitable Transistors giving approx. 1 watt output. 30/-. P. & P. 2/-.

3 PUSH-BUTTON TRANSISTOR SWITCH. D.P.—D.T. Each Switch 5/6 and 1/- P. & P.

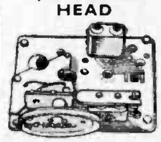
FURTHER HUGE PURCHASE

TELEFUNKEN HI-FI STEREO AMPLIFIER. 110/250 v. A.C. input. 5 watt undistorted output (10 watts nominal). Size 12 x 9 x 2in. Weight 9 lb. Complete with spec. and instructions. Now only £5.9.6. Carr. 5/-.
Also **Model S82.** Similar specification but with balance control. Now only £5.19.6. Carr. 5/-.

SPECIAL PURCHASE! TURRET TUNERS

by famous maker
Brand new and unused. Complete with PCC84 and PCF80 valves. 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied.
ONLY 25/- each. P.P. 2/6.

F.M. TUNER HEAD



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) and drum and spindle, 18/6 plus 1/9 P. & P. Valve 8/6 extra. Drum and spindle 3/6 extra.

E.M.I. 4-speed Player and P.U.

FURTHER HUGE PURCHASE enables us to offer these at **67/6** P. & P. 4/6.

Heavy 8¼in. metal turntable. Low flutter performance 200/250V shaded motor with tap at 45V for amplifier valve filament if required. Turnover LP/78 head.

RECORD PLAYER AMPLIFIER

2 valve, A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7in. w. x 2¼in. d. x 5¼in. h. 55/-, P. & P. 3/-. Suitable speakers: 6in. 15/- or 10 x 6in. 22/6. P. & P. 1/6 on each.

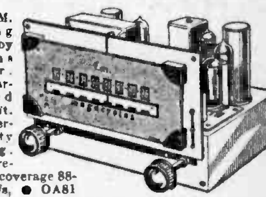
4-SPEED PLAYER UNIT BARGAINS

SINGLE PLAYERS
TU/12. £3.10.0. Carr. 3/6.
AUTO CHANGERS
B.S.R. UA14. £6.2.6.
Latest B.S.R. UA16 £7.2.6.
Latest Garrard "Auto-Slim" £6.17.0. Carr. 5/- on each.

SPEAKER & CABINET FABRICS

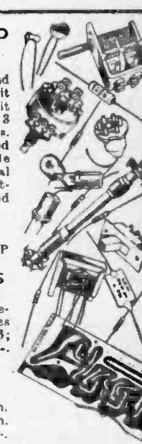
Speaker silks heavily woven in champagne and brown, 48in. wide. Originally 35/- per yard length. OUR SPECIAL PRICE 12/- per yard length. P. & P. 1/6. Also Oatmeal fabric for speaker or cabinet or Red rexine for cabinet, 54in. wide. 13/6 per yard length. P. & P. 1/6.

HARVERSON'S F.M. TUNER Mk.I



● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88-100 Mc/s. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. £5.19.6, plus 8/6 P.P. and ins. Circuit diagram and illustrations 1/6 post free.
Mark II Version as above but complete with magic eye, front panel and brackets. £6.12.6. P. & P. 8/6.
Mark III Version as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6.
Handsome Metal Cabinets. Choice of Grey, Black or Green. To fit Mark I, 25/-, P. & P. 2/6. To fit Mark II 17/6, P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET



A first-class 2 waveband transistor superhet in kit form. ● Printed circuit panel (size 8½ x 2½in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.

All parts sold separately

ONLY **£4.5.0** P. & P. 2/6

35 OHM SPEAKERS

Suitable for use with above.
2in. Goodmans. Ideal replacement for most pocket portables 8/6; 2½in. 10/6; 3½in. 12/6; 5in. P.M., 17/6; 7 x 4in. 21/-. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6½ x 3½in. Suitable for above using 3½in. speaker. 25/-. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling). 28/6 complete, post 1/-. 6 transistor printed circuit, board to match, 8/6, post 9d. Circuit diagram 1/6 extra.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. On/off controls.

PRICE 69/6 P. & P. 3/6

DITTO. Mounted on board with output transformer and 6½in. speaker.
Complete at 89/6, P. & P. 4/6.

TRANSISTORS

GET15 (Matched Pair) 15/-

OC71	5/-	PXA101 ..	6/6
OC72	6/-	XA103 ..	6/6
OC76	6/-	V15/10p ..	12/6

Set of Mullard 6 transistors, OC44, 2—OC45, OC81D, matched pair OC81. 25/-. All Post Free.

HARVERSON SURPLUS CO. LTD.

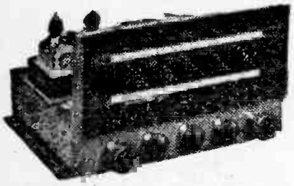
170 HIGH ST., MERTON, S.W.19. CHErrywood 3985/6

Open all day Saturday. Early closing Wed., 1 p.m.

A few minutes from South Wimbledon Tube Station. (Please write clearly)

Please Note: P. & P. charges quoted apply to U.K. only. P. & P. on overseas orders charged extra. (S.A.E. all enquiries).

ARMSTRONG AF208AM/FM RADIOGRAM CHASSIS



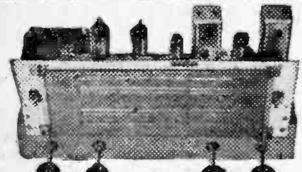
STEREO 12 Mk. 2 £40/5/-
8 watts push-pull output from each channel, 16 watts total; VHF, with automatic frequency control medium and long bands; A hi-fi system on one compact chassis.

STEREO 55 £29/18/-
Junior version of Stereo 12; 5 watts per channel. 10 watts total; VHF and medium bands; Inputs for tape, pick-ups and future stereo radio.

JUBILEE Mk. 2 £28/5/-
Mono; 8 watts push-pull output; VHF, automatic frequency control, medium and long bands; Separate tone controls; Pick-up and tape inputs.

AF208 (ILLUSTRATED) £21/4/-
An AM/FM mono chassis of 5 watts output covering VHF and medium bands. An inexpensive version of the Jubilee Mk. 2.

All carriage free. Write for free literature.



1963 RADIOGRAM CHASSIS

THREE WAVEBANDS — **FIVE VALVES**
S.W. 16 m.—50 m. LATEST MULLARD
M.W. 200 m.—550 m. ECH81, EF89, EBC81,
L.W. 800 m.—2,000 m. EL84, EZ80.

12-month guarantee.

A.C. 200/250 v. 4-way Switch; Short-Medium, Long/Gram. Ferrite Aerial A.V.C. and Negative feedback, 3 ohm output, 5 watts. Glass dial, horizontal wording, size 13in. x 4in. Aligned and calibrated. Isolated Chassis size 13½in. x 9in. high x 5½in. deep.

£8.19.6 Carr. & Ins. 4/6

BARGAIN SALE PRICES

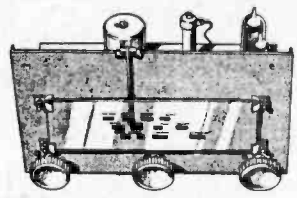
New Boxed VALVES 90-day Guarantee

0Z4	5/-	6K7G	5/-	EABC80	8/-	PCL82	10/-
1R5	6/-	6K8G	5/-	EB91	4/-	PCL84	10/-
1S5	6/-	6L6G	8/-	EBC41	8/-	PL81	10/-
1T4	3/-	6N7M	5/-	EBC81	8/-	PL83	8/-
2X2	2/-	6Q7G	6/-	EBF80	9/-	PY33	15/-
3S4	7/-	6SN7	5/-	ECH42	9/-	PY80	7/-
3V4	7/-	6V6G	5/-	ECH81	9/-	PY81	8/-
3Q4	7/-	6X4	5/-	ECL82	10/-	PY82	7/-
5U4	6/-	6X5	6/-	EF85	6/-	PQ25	7/-
5Y3	6/-	12AT7	6/-	EF89	8/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EL32	5/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EL84	7/-	U22	7/-
6AM6	4/-	12BH7	7/-	EY51	9/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EY86	9/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EZ40	7/-	UBF89	9/-
6BE6	5/-	12Q7	5/-	EZ80	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	EZ81	7/-	UCL82	10/-
6C4	5/-	35L6	9/-	HABC80	10/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HVR2A	5/-	UF89	9/-
6G6	4/-	807	5/-	KT33C	8/-	UL41	9/-
6H6	3/-	954	2/-	KT76	8/-	UY41	7/-
6J5	5/-	DAF96	8/-	MU14	7/-	UY85	7/-
6J6	5/-	DF96	8/-	PCC84	8/-	UU9	7/-
6J7G	6/-	DK96	8/-	PCF80	8/-	VR150	7/-
6K6	5/-	DL96	8/-	PCF82	8/-	W81	6/-

NEW ELECTROLYTICS — FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350V	2/-	50/350V	5/6	16/450V	5/-
2/350V	2/3	100/25V	3/-	32/350V	4/-
4/450V	2/3	250/25V	3/-	47/350V	6/6
8/450V	2/3	500/12V	3/-	100/270V	5/6
16/450V	3/-	1,000/12V	3/-	5,000/6V	5/-
32/450V	3/9	8+8/450V	3/6	32+32/350V	5/-
25/25V	1/9	8+16/450V	3/9	32+32/450V	6/-
25/50V	2/-	16+16/450V	4/3	32+32+32/350V	7/-
50/25V	2/-	32+32/350V	4/6	50+50/350V	7/-
50/50V	2/-			64+120/350V	11/6
				100+200/275V	12/6

COMPLETE RADIO CHASSIS £4.19.6. post free



4 Mullard valves, 5in. speaker.
Superhet Circuit. BRAND NEW.
Size 9 x 6 x 5½in. high. Tested by us ready for use. 200/250 v. A.C.-D.C. Mains. As illustrated with illuminated dial. Fully tunable with Medium and Long Wave. 12-month Guarantee. Only £4.19.6. post 5/-.

MAINS TRANSFORMERS 200/250 v. A.C.
Postage 2/- each transformer.

STANDARD, 250-0-250, 80 mA, 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier, 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350 .. 29/6
MINIATURE 200 v. 20 mA, 6.3 v. 1 a. 10/6
MIDGET, 220 v. 45 mA, 6.3 v. 2 a .. 15/6
SMALL, 220-0-220, 50 mA, 6.3 v. 2 a. 17/6
STD. 250-0-250, 65 mA, 6.3 v. 3.5 a. .. 17/6
HEATER TRANS. 6.3 v. 1½ amp. .. 7/6
Ditto, tapped 1.4, 2, 3, 4, 5, 6.3 v. .. 8/6
Ditto, sec, 6.3 v. 4 amp... .. .. 10/6
GENERAL PURPOSE LOW VOLTAGE, 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v. 22/6
AUTO TRANSFORMER. 150 w. .. 22/6
0, 115, 200, 230, 250 v., 500 w. .. 82/6
MULLARD "510" Mains transformer .. 30/-
PARMEKO MAINS TRANSFORMER. Made for special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA. L.T. 6.3 v. 1.8 amp. Size 4 x 3½ x 3in. .. 17/6

INTERVALVE TRANSFORMERS. 3:1 or 5:1, 9/-. **O.P. TRANSFORMERS.** Heavy Duty 50 mA, 4/6. Multiratio, 7/6. Multiratio heavy duty push pull. 10 w., 15/6. Miniature, 384, etc., 5/9.
L.F. CHOKES 15/10H. 60/65 mA, 5/-; 10 H., 85 mA. 10/6; 10 H., 150 mA, 14/-.

I.F. TRANSFORMERS 7/6 pair
465 K/s Slug Tuning Miniature Can, 2 x ½ x ¾in. High Q and good bandwidth. Data sheets.

FULL WAVE BRIDGE SELENIUM RECTIFIER: 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6. **CHARGER TRANSFORMERS.** Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps.. 15/6. 2 amps., 17/6; 4 amps., 22/6. Circuit included. **4 AMP CAR BATTERY CHARGER** with amp. meter Leads. Fuse Case. etc., for 6 v. or 12 v., 69/9
AMMETER 0 to 5 amp. 9/6.

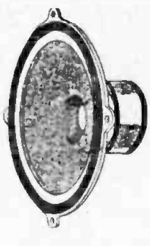
BOOKS list S.A.E.
40 Circuits for Germanium Diodes 3/-.
"W.W." Radio Valve Data, 6/-.
High Fidelity Speaker Enclosure, 5/-.
Valve and TV Tube Equivalents, 9/6.
TV Fault Finding, 5/-.
Quality Amplifiers, 4/6.
Radio Valve Guide. Books 1, 2, 3, or 4. 5/- each.
Transistor Superhet Receivers, 7/6.
Practical Radio Inside Out, 3/6.
Master Colour Code Chart, 1/6.
Transistor Controlled Models, 7/6.
Principles of Colour TV, 16/-.

4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER
Size 3 x 1½ x ½.
A ready built miniature push-pull amplifier with input and output transformers, 4 transistors. Ideal for use with record players, intercoms, BABY ALARMS, etc. Complete with full instructions and circuit.
Price **47/6** 9 v. Batt. 2/3, 2½in. Speaker 15/-

C.R.T. BOOSTER TRANSFORMERS
for heater cathode short circuit, or tubes with failing emission. Full instructions supplied, mains input. **Type A optional 25% and 50% boost 2v. or 4v. or 6.3v. or 10.8v. or 12.6v. State voltage required. PRICE 10/6.**

LOUDSPEAKERS P.M. 3 OHM. 2½, 3, 4in., 5in. Rola, 7in. x 4in. Rola, 15/6; 6½in. Rola, 16/6; 8in. Plessey 17/6; 10 x 6in. 22/6; 10in. Rola, 30/-; 4in. Tweeter, 25/-; 12in. R.A. 30/-.
13½ x 8in.. Double Cone E.M.I. 35/-.
STENTORIAN HF.1012. 10in. 3 to 15ohms, 10 w. 87/6; 35 ohm, 7 x 4in., 21/-; 5in., 17/6; 3½in., 15/6.

BAKER SELHURST LOUDSPEAKERS



12in. Baker 15w. Stalwart 3 or 15 ohms, 45-13,000 c.p.s. 90/-
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. .. £6.17.6
12in. Standard H.D. 20w. 40-14,500 c.p.s. .. £8.0.0
12in. DeLuxe 15w. 25-17,000 c.p.s. ..£9.10.0
12in. Bass 25w. 20-18,000 c.p.s. £12.12.0
15in. Auditorium, 35 w., Bass, 20 c.p.s. to 12kc/s. £18
Details and Enclosures, plans S.A.E.

TWIN GANG TUNING CONDENSERS. 365 pF, miniature 1in. x 1½in. x 1¾in., 10/-; 500pF Standard with trimmers, 9/-; midget, 7/6; with trimmers, 9/-; 500pF slow motion tuning, standard or midget, 9/-.
SMALL 3 gang 500 pF, 17/-. **SINGLE** 365 pF. 7/6. **SINGLE** 25 pF, 50 pF, 75 pF, 100 pF, 160 pF, 5/6. Solid dielectric 100, 300, 500 pF, 3/6.
CONDENSERS. New stock. 0.001 mfd. 7 kV. T.C.C., 5/6; Ditto. 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25, 1/6; 0.5/500 v., 1/9; 0.1/350 v. 9d.; 0.1/2.000 v., 0.1/1.000 v., 1/9; 0.1 mfd.. 2.000 volts, 3/6.
CERAMIC CONDS. 500 v. 0.3 pF to 0.01 mfd., 9d.
SILVER MICA CONDENSERS, 10% 5 pF to 500 pF, 9d.; 600 pF to 3,000 pF, 1/-. Close tolerance (±1 pF) 2.2 pF to 47 pF, 1/-. Ditto 1% to 50 pF to 815 pF, 1/-; 1,000 pF to 5.000 pF, 1/9.

465 kc/s SIGNAL GENERATOR
Price 15/-. Uses B.F.O. Unit, ZA 30038 ready made with valve 1S5. **POCKET SIZE** 2½ x 4½ x 1in. One resistor to change, full instructions supplied. Battery 8/6 extra. 69V 1½V. Details S.A.E.

WAVECHANGE SWITCHES
8 p. 4-way 2 wafer long spindle 6/6
2 p. 2-way, or 2 p. 6-way long spindle .. 3/6
4 p. 2-way or 4 p. 3-way long spindle .. 3/6
3 p. 4-way, or 1 p. 12-way long spindle .. 3/6
Wavechange "MAKITS", Wafers available: 1 p. 12 way, 2 p. 6 way, 3 p. 4 way, 4 p. 3 way, 6 p. 2 way, 1 wafer switch, 8/6. 2 wafer switch, 12/6; 3 wafer switch, 16/-; additional wafers up to 12, 3/6 each extra.
Toggle Switches, s.p., 2/-; d.p., 3/6; d.p.d.t., 4/-. **Rotary** s.p., 3/6; d.p., 4/6.

CRYSTAL MIKE INSERT, 6/6
Size 1in. dia. x ¼in.
ACOS MIC. 14, insert 1½in. dia. x ½in. 8/6
ACOS 39-1 DE LUXE STICK MIKE 35/-
TSL QUALITY STICK MIKE....25/-

Valveholders. Pax. int. oct., 4d. EA50, 6d. B12A. CRT, 1/3. Engl. and Amer. 4, 5 and 7 pin, 1/-. MOULDED Mazda and int. oct., 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 1/9. Ceramic EF50, B7G, B9A, int. oct., 1/-. B7G, B9A cans, 1/- each.

ADASTRA 3-3 AMPLIFIER. Ready built A.C. only, 200-250 v. Valves ECL86 and EZ80. 3 watt quality output. Mullard tone circuits, bass boost, treble and volume controls. Separate engraved front panel with de-luxe finish. Heavy duty output transformer 3 ohm. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. **Bargain Price £4.19.6.** Circuit supplied.

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Linear or Log Tracks. Long spindles. Midget 5 K ohms to 2 Meg. L.S. 3/-; D.P., 4/6; Stereo L/S10/6; D.P.14/6

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Semi-air spaced ¼in. Stranded core. **6d.yd.**
40 yds. 17/6
60 yds. 25/-
Fringe Quality Air spaced **1/-yd.**

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COAX PLUG .. 1/- **LEAD SOCKET** .. 2/-
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BALANCED TWIN FEEDER yd. 6d; 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
Wirewound Ext. Speaker Control, 10 Ω 3/-, 25 Ω 6/6.
WIRE-WOUND POTS. 3 WATT. Pre-set Min. TV Types. All values to 10 ohms to 25 K., 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K. to 2 meg., 3/-).
WIRE-WOUND 4 WATTS Pots. Long spindle. Value. 50 ohms to 50 K., 6/6; 100 K., 7/6.
PHILIPS TRIMMERS, 0-10 pF., 3-30 pF. 1/-.
TRIMMERS, Ceramic. 30, 50, 70 pF. 9d.; 100 pF, 150 pF. 1/3; 250 pF. 1/6; 500 pF. 750 pF, 1/9.
TV etc. TRIMMER. 1000 pF. with knobs, 2/-.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. High Stability. ½ w., 1%, 2/-. Preferred values 10 Ω to 10 meg. Ditto 5% 10 Ω to 22 meg., 9d.

5 watt	**WIRE-WOUND RESISTORS** 10 ohms—10,000 ohms	1/3
10 watt		2/-
15 watt		2/-
12.5K to 47K 10 w.		3/-

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Double Play	7in. reel, 2,400ft. 42/-	Spare Plastic Reels	
	5in. reel, 1,200ft. 25/-		
Long Play	7in. reel, 1,800ft. 35/-	3in.	1/6
	5¾in. reel, 1,200ft. 23/6	4in.	2/-
	5in. reel, 900ft. 18/6	5in.	2/-
Standard	7in. reel, 1,200ft. 25/-	5¾in.	2/-
	5in. reel, 600ft. 16/-	7in.	2/6

"Instant" Bulk Tape Eraser and Head Defluxer, 200/250 v. A.C., 27/6. Leaflet with full details, S.A.E.

CRYSTAL SET BOOKLET 1/-
CRYSTAL DIODE G.E.C., 2/-, GEX34, 4/-, OA81,3/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 15/- pr.
SWITCH CLEANER. Fluid squirt spout. 4/6 tin.

HIGH GAIN TV PRE-AMPLIFIERS BAND I B.B.C.

Tunable channels 1 to 5. Gain 18dB. ECC84 valve. Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred). Coils only 9/6.

BAND III I.T.A.—Same prices. Tunable channels 8 to 13. Gain 17dB. Circuit and Coils only. 9/6.

1/16in. **Paxolin Panels,** 10 x 8in., 2/-.
Miniature Contact Cooled Rectifiers, 250V 50mA, 7/6; 250V 60mA, 8/6; 250V 85mA, 9/6; **Selenium Rect.,** 300V-85mA. 5/-.
TV etc., Silicon Sub.Min. Rectifier, 125V. 300mA, 6/6; 250V, 450mA, 10/-.
RM4,RM5,14A100,14A116,10/-each.FC31, 20/-
Coils Wearite "P" Type, 3/- each.
Osmor Midget "Q" type, adj. dust core, from 4/- each. All ranges. List S.A.E.
Teletron D.W.R. L. and Med. T.R.F. with reaction, 4/-. Med. wave D.R., 3/6.
Ferrite Aerials, M., 8/9; M. and L., 12/6.
Osmor Ferrite Rod Aerials, L. and M. for transistor circuits, 10/- each.
Ferrite Rods, 8 x ⅜in., 3/-.
H.F. Chokes, 2/6. **Osmor QC1,** 6/9.
T.R.F. Coils, A/HF, 7/- pair; HAX, 3/-, Repanco DRR2, 4/6. DRX1, 2/6.
Radio Screwdriver, 5in., 6d.
Neon Mains Tester Screwdriver, 5/-.
Solder Radiograde, 4d. yd., ½lb. 5/-.

Aluminium Chassis, 18 s.w.g. Plain undrilled. 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7 x 4in. 4/6; 9 x 7in., 5/9; 11 x 7in., 6/9; 13 x 9in., 8/6; 14 x 11in., 10/6; 15 x 14in., 12/6; **Aluminium Panels,** 18 s.w.g., 12 x 12in. 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3; 8 x 6in., 2/-.

"6 + 1" TRANSISTOR RADIO MEDIUM AND LONG WAVE KIT

First class components to make a 6 transistor 2 waveband superhet chassis ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, *with car aerial coil,* printed circuit, 8½in. x 2½in., but EXCLUDING Speaker and cabinet.
Speakers, 35 ohms, 7 x 4in. 21/- 5in., 17/6, 3½in., 15/6. **£4.5.0**

BULGIN PLUGS AND SOCKETS. Non-reversible P74, 2-pin, 4/3; P73, 3-pin, 4/6; P194, 6-pin, 5/6. "DOMINA" plugs, 2/6; sockets, 2/6.
JACKS. English open circuit, 2/6. Closed circuit, 4/3. Grundig type, 3-pin, 1/3. Grundig lead jack, 3/6.
JACK PLUGS. English, 3/-; Screened, 4/-; Grundig, 3-pin, 3/6.
ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in., 10d. 0.3in. **FORMERS** 5937 or 8 cans TV1 or 2, ½in. sq. x 2½in. or ⅝in. sq. x 1½in. 2/- with cores.
SLOW MOTION DRIVES. 6 : 1. 2/3.
SOLON IRON, 25W, 200V or 230V, 24/-.
ANTEX SUB-MIN IRON, 15w. 200 or 240 v., 29/6.
BENCH STAND for above, 12/6.

JASON FM TUNER COIL SET 29/-. H.F. coil, aerial coil, oscillator coil, two I.F. transformers 10.7 Mc/s, detector transformer, heater choke. Circuit book using four 6AM6, 2/6.
Complete Jason FMT1 Kit. Jason chassis with calibrated dial, components and 4 valves, £6.5.0.
Model FMT2 with new shelf cabinet, 5 valves & power pack **£10**. Less power £8.15.0.

MAINS DROPPERS. Midget adjustable sliders 0.3A. 1,000 ohms, 5/-; 0.2A, 1,200 ohms, 5/-; 0.15A, 1,500 ohms, 5/-; 0.1A, 2,000 ohms, 5/-.
MIKE TRANSFORMER, 50-1 3/9.
P.V.C. Covered Wire, single or stranded, 2d. yd. Sleeving, 1 or 2 mm., 2d.; 4 mm., 3d.; 6mm., 5d. yd.
SPEAKER-FRET. Gold Cloth, 17 x 25in., 5/-; 25 x 35in., 10/-. Tygan, various colours, 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples, S.A.E. Expanded Metal, Gold, 12 x 12in., 6/-.

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Long and Medium Wave Aerial—RA2W On 6in. rod, 208pF tuning, with car aerial coupling coil	12/6
Osc. Coil P50/1AC. 176pF tuning.	5/4
1st and 2nd I.F.Trans.—P50/2CC. 470kc/s 11/16in. dia. by ⅞in.	5/7 each
3rd I.F. Trans.—P50/3CC.	6/-
Spare Cores	6d. each
Driver Transformer—LFDT4.	9/6
Wavechange Slide Switch.	3/6
Printed Circuit—PCA1. Size 2¼ x 8½in. Ready drilled, and printed.	9/6
Volume Control, 5K-DP.	4/6
35 ohm Speakers, 3½in., 15/6; 5in., 17/6; 7 x 4in., 21/-.	
24 Fixed Resistors.	10/6
16 Fixed Condensers.	21/-
Tuning Gang with trimmers.	10/6
6 Mullard Transistors and diode.	42/6
Constructor's Booklet.	2/-

NEW MULLARD TRANSISTORS OC71 6/-. OC72 7/6. OC81D 7/6. OC81 7/6. OC44 8/9. OC45 8/6. OC171 10/6. AF117 9/6

Sub Miniature Condensers. 0.1 mFd. 30 v. 1/3. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100 mFd. 15 volt 2/6 ea. Transistor Holders 1/3.

B.B.C. Pocket 2 Transistor. M.W. and L.W. Radio Kit, 22/6. Miniature earpiece, 7/6. Batt. 2/3. Circuit details, etc. S.A.E.

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Kit with ready built amplifier, speaker and cabinet.
carr. and ins. 5/- **£11.10.0**

Collaro deluxe auto-player kit

£11.19.6 Carr. and ins. 5/- detail S.A.E.

COLLARO QUALITY AUTO-CHANGER, 4-speed, with plug-in xtal head. Ready built 3 watt amplifier, Loudspeaker and contemporary styled Portable Player Case. All items guaranteed to fit together perfectly, can be assembled in thirty minutes, full instructions supplied.

4 Speed Autochanger. B.S.R., U.A.14	£6.15.0
B.S.R., U.A.12 Stereo/Mono	£7.10.0
Garrard Autoslim Changer	£6.17.6
Garrard AT6 stereo/Mono	£11.10.0
4 SPEED SINGLE PLAYERS:	
E.M.I. with auto stop	£5.15.0
E.M.I. with separate pick-up ..	£3.7.6
Garrard SRP10. £5.10.0; 4HF.	£16.10.0

Replacement sapphire stylii available from 5/3
Replacement Xtals from 15/-; Stereo from 31/6.
RECORD PLAYER CABINETS 70/-
Two-tone handsome rexine covered, size 18 x 14 x 8, all accessories, baffle, fret and mounting board 14in. x 13in. Space for amplifier, speaker and all modern Autochangers or single players, etc. Mounting board will be cut, free of charge! for any modern record player.
RECORD PLAYER AMPLIFIER. 95/-
2-valve 3w. A.C. amplifier and 6½in. speaker all ready mounted on baffle, 12in. x 7in., 3in. deep. Wired and tested ready for use with above cabinet.

SINGLE PLAYER KITS

£7.19.6 post 5/-.

With ready-built, 2 stage, 3 watts output amplifier. High flux 5in. speaker. Handsome portable case 13 x 10½ x 7½in. Collaro 4-speed junior motor. LP/Std. xtal pick-up for 7, 10, and 12in. records.

CABY MULTIMETER

Moving-coil Model M.1. 54/-

Measures D.C. or A.C. 6 v., 30 v., 120 v., 600 v., 1200 v. D.C. 30 mA, 300 mA. Ohms 0-100K. Leaflet S.A.E.

ARDENTE Transistor Transformers

Type D3035, 7.3 CT; Push-Pull to 3 ohms for OC72, etc., 1 x ⅞ x ⅞in.	9/6
Type D3034, 1.75 : 1CT. Push-Pull Driver for OC72, etc., 1 x ⅞ x ⅞in.	9/6
Type D3058, 11.5 : 1 Output to 3 ohms for OC72, etc., 1 x ⅞ x ⅞in.	9/6
Type D167, 18.2 : 1 Output to 3 ohms for OC72, etc., ¾ x ½ x ½in.	12/-
Type D239, 4.5 : 1 Driver Transformer,	10/-
Type D240, 8.5 : 1 Driver Transformer,	10/-

ARDENTE TRANSISTOR CONTROLS

5K or 1MΩ switched, dia. 0.9in..	5/3
Type VC1760, 5K with switch, dia. 0.7in..	10/6
Deaf aid earpiece xtal or magnetic.	7/6

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Practical Wireless

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Contents

The Transistor Revolution

THE radio hobbyist need never be lost for something to do. Whether he builds portable radios or elaborate communications receivers, matchbox-size amplifiers or high powered hi-fi set-ups, transmitters, test gear or electronic devices.

In any of these spheres of activity lies scope for experiment and improvement, due to the development of new and better components, circuitry, ideas and even new applications by the research laboratories of the industry. In fact, it is sometimes difficult to keep up-to-date on what is new.

One major development in recent years was, of course, the reappearance of the semiconductor device in the guise of the transistor. At first, many people were highly sceptical about the transistor, considering it an interesting, but limited, innovation.

And for a while it did appear that so far as the radio amateur was concerned the new device was indeed strictly limited, being suitable only for pocket portables and similar pieces of equipment where the criterion was simply that of miniaturisation.

The transistor had two big limitations—the limitation of power output obtainable and the limitation of frequency range. Thus, for a long time, transistors were used only in small, low-output, portables capable of receiving long and medium waves.

But things moved on. The laboratories produced bigger and better transistors; types that could operate on the short wave bands and, later, types suitable for use in v.h.f. receivers. And all the time the power ratings were pushed up.

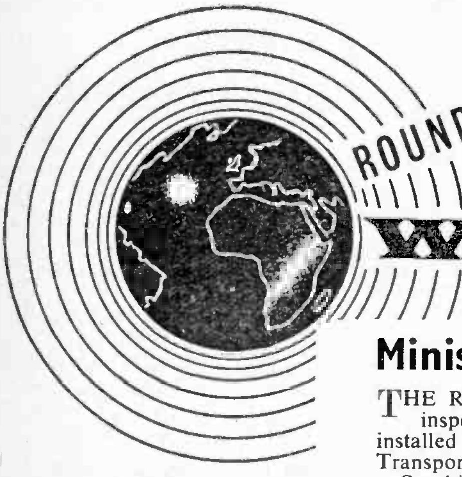
Even so, there were many applications where a transistor was incapable of doing the work of a valve. But now comes a new generation of transistors. These are capable of large audio power outputs and, as they operate at higher voltages (up to 50V), conventional (stabilised) power supplies are used.

A few weeks ago, Mullard Ltd. staged an enlightening demonstration. Four unclassified stereo amplifiers were switched in turn to reproduce extracts from carefully chosen musical test pieces. The audience, comprising members of the technical press, individually awarded marks to each amplifier.

Although it was sometimes difficult to differentiate aurally, the results of this informal experiment showed that two of the amplifiers ran neck and neck for honours. The actual "winner" was then revealed as a 10+10W transistor design. The runner-up was a conventional valve counterpart!

This would have seemed impossible, or at least unlikely, a few years ago. And whatever reservations may have once existed, the semiconductor now looks all set to win its battle not only for recognition but for supremacy.

Our next issue dated July will be published on June 7th



ROUND THE WORLD of WIRELESS

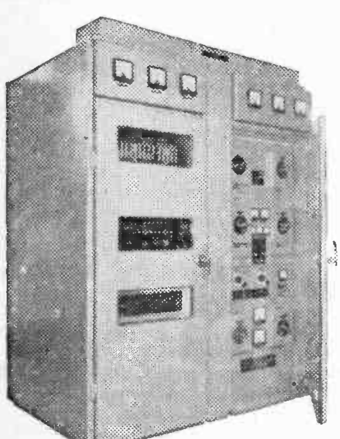
NEWS AT HOME AND ABROAD

New Transmitting Station in Bahrain

HAMALA, on the Persian Gulf island of Bahrain, is now the site of the most advanced transmitting station in the whole of the Cable and Wireless Limited organisation.

The station, which is equipped with Marconi transmitters, has taken over the Bahrain-London radio-telephone/telegraph services and provision has been made for the introduction of the Aden wireless telegraphy circuit.

Below: One of the Marconi HS31 transmitters recently delivered to Bahrain.



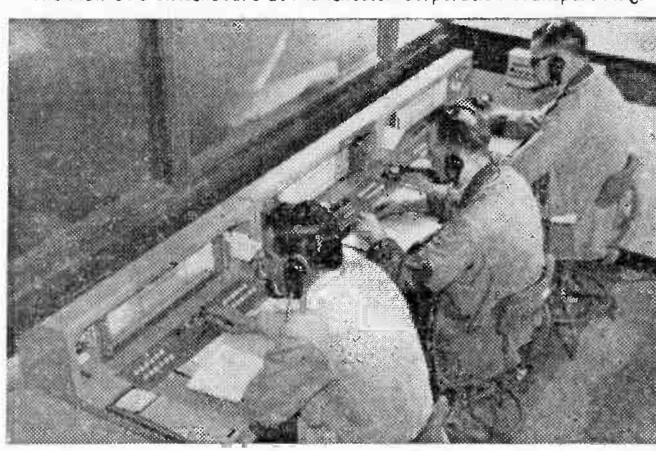
Minister Sees "Cordless" Exchange

THE Rt. Hon. Ernest Marples, Minister of Transport, recently inspected a cordless telephone exchange which has been installed in the new head office of Manchester Corporation Transport.

On this exchange (which was supplied by Standard Telephones and Cables Limited) the "switchboard operators" are all skilled traffic control engineers who are, under this system, in direct charge of the hour-by-hour running of Manchester's fleet of over 1,400 buses and trolley buses.

Besides the parent exchange in the new offices at Hyde Road. STC has also supplied three unattended satellite exchanges each of which meets the needs of two garages. Special arrangements prevent internal calls between garages and headquarters from hindering important incoming calls which may involve emergency action.

The New STC switchboard at Manchester Corporation Transport H.Q.



Equipment for H.M. Forces on Exhibition

AS part of the Government stand at the Radio and Electronic Equipment Exhibition, to be held at Olympia from the 21st to 24th May, the Ministry of Aviation will be showing how electronic equipment is designed and manufactured for use by H.M. Forces.

The exhibition will also provide a glimpse into the future of electronic equipment operating under the severe environmental conditions which apply in the case of airborne and space research operations and which can be expected to become more rigorous.

RADAR SPEED CHECK ON SHOW

AT the APEIX '63 Exhibition held recently at the University of London School of Pharmacy, the Marconi Company exhibited their portable electronic traffic analyser, known as "PETA".

PETA utilises the Doppler effect of frequency change in electromagnetic waves reflected from moving objects. A narrow beam of high-frequency radio energy is directed across the road at an angle, and in such a way that a vehicle entering the beam will cause some of the energy to be reflected back to the PETA aerial. This reflected energy will have suffered a change in frequency proportional to the speed of the vehicle, and by comparing the frequency of the transmitted signal with that of the reflected energy, a direct reading of miles-per-hour may be displayed on a suitably calibrated meter.

A police officer using Marconi PETA equipment.

Microwave Network for Spain

MICROWAVE radio link equipment, worth more than £1,750,000, has been ordered by the Compania Telefonica Nacional de Espana from Standard Telephones and Cables Limited of London and its associated Company in Spain.

This equipment will provide large numbers of long distance telephone circuits over a 1,150 mile network extending to Sevilla on the southern tip of Spain, to Bilbao in the north, Valencia on the eastern coast and Coruna in the north-west.

The microwave system linking Sevilla with Leon, a route distance of some 385 miles, will be supplied and installed by STC. On the other routes, the equipment will be assembled from STC components and installed by Standard Electrica, S.A., an STC associate Company.

Right: This map shows the various routes in the microwave link system of Spain.

SPAIN ORDERS TAPE EQUIPMENT

THE Spanish National Broadcast and Television Company of Madrid has placed a substantial contract for professional tape recording equipment with EMI Electronics Ltd. The contract was secured by Iberavia Limitada, EMI's Spanish agents, and includes the supply of two EMI TR90 studio tape recorder consoles and four TR90 replay machines.

New V.H.F. Aerial at Kinlochleven

THE BBC's new v.h.f. sound and television broadcasting station to serve Kinlochleven, Argyllshire, was brought into service on 8th April.

The television programmes are transmitted on Channel 1 and the v.h.f. sound programmes on the following frequencies: Scottish Home Service 94·1Mc/s; Light Programme 89·7Mc/s and Third Programme/Network Three 91·9Mc/s. The v.h.f. transmissions are horizontally polarised, thus requiring horizontally mounted receiving aerials.

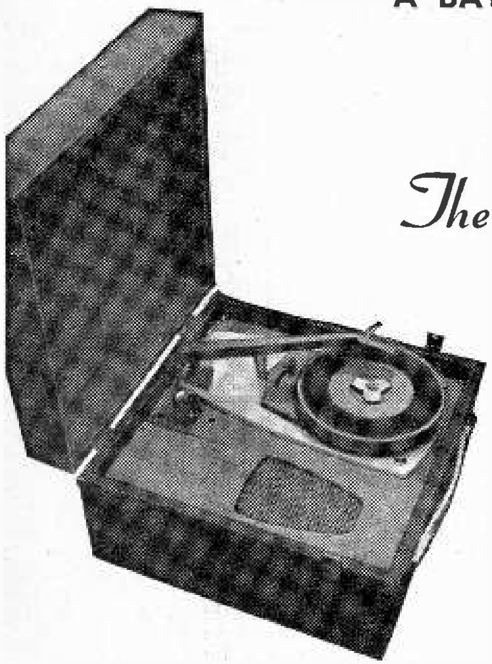
Equipment Manufacturers reach Agreement

THE Rank Organisation and the Westrex Company Ltd., a Division of Litton Industries Inc., have announced that they have reached agreement under which the Rank Kalee Division of the Rank Organisation will be granted the sole agency for the United Kingdom and many territories overseas for the sale of sound recording and reproducing equipment manufactured by Westrex.

A BATTERY-OPERATED PORTABLE RECORD PLAYER

by K. L. Surrey

The P.W. Spinette



THIS is a four-transistor self-contained record reproducer, with a two-speed turntable unit, and it has a maximum output approaching 1W. Both motor and amplifier are driven from a single 9V battery, and a fairly large oval loudspeaker in incorporated.

The case is of the usual record-player type, with closing lid, and has a drawer as storage space for a number of records. Ready-sawn wooden parts are available for the case, so that construction of this item is very much simplified.

The Circuit

The amplifier circuit is shown in Fig. 1 on the blueprint presented free with this issue, and has four transistors, these being employed as amplifier, driver, and push-pull output stage. The quiescent (no signal) current consumption of this circuit is about 6mA. With moderate to average volume, the consumption is some 20-30mA, rising to 80mA or so on peaks with loud volume. As is usual with this kind of circuit, current taken from the battery depends on the setting of the volume control. The motor consumption is steady at approximately 20mA.

R1 is used to obtain a high impedance input for the pick-up, and VR1 is the volume control. Tr1 is a high gain, low noise amplifier stage. Tr2 is the driver, and Tr3 and Tr4 the output pair. Negative feedback is applied via R13 from the output transformer secondary to the collector of Tr1.

The on-off switch S1 is incorporated in the turntable unit, and controls both motor and amplifier. The pick-up arm is moved outwards to switch on. Switching off is automatic when the pick-up enters the run-in groove at the centre of a record.

Amplifier Panel

All the amplifier components are mounted on a piece of $\frac{1}{16}$in., or similar, paxolin sheet, about $5\frac{1}{2}$in. x 4in. This sheet is shown actual size in Fig. 5 with all holes indicated. If the paxolin is placed behind Fig. 5, the positions of holes can be marked by means of a sharp pointed tool.

All the small holes can then be made with a $\frac{1}{16}$in. or similar drill. Six holes are large enough to clear 6B.A. bolts, as indicated. Four of these holes are used to secure the transistor heat sink plates. The remaining two are for wood screws to secure the amplifier in the case.

Two small slots take the lugs of the output transformer T2. These slots can be made by drilling three or four $\frac{1}{16}$in. holes close together. Fragments of paxolin can be cleared from all holes with a larger drill.

Heat Sinks

The two heat sink plates are of 16s.w.g. aluminium, approximately 3in. x $1\frac{1}{2}$in. (see Fig. 6). A flange about $\frac{1}{4}$in. to $\frac{3}{8}$in. wide is bent along each plate, and drilled to match the holes in the paxolin. Each plate is held with two $\frac{1}{4}$in. 6B.A. bolts. The transistor clips are placed so that they occupy the positions shown in Fig. 2, and they are tightly bolted to the plates.

All the components shown in Fig 2 can then be mounted. The wire ends of resistors and capacitors should not be bent sharply at right angles near the component, or they may be weakened unnecessarily. The resistors may be inserted either way round, each being checked to see that it has the correct value. All capacitors except C7 are electrolytics and must therefore be connected in the correct polarity shown in Fig. 2.

The transistors are positioned so that there is at least $\frac{1}{2}$in. of free lead between the transistor and paxolin. If desired, thin sleeving can be placed on the

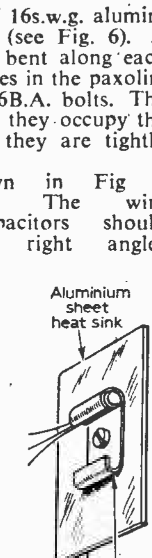


Fig. 6: The heat sink, as used for Tr3 and Tr4.

transistor leads. Failing this, a final check should be made, after wiring up, to ensure that the transistor leads are clear of each other. Emitter, base, and collector leads pass through the appropriate holes, as indicated by e, b and c.

T1 is so positioned that the coloured leads emerge as in Fig. 2. T2 is located with the two secondary leads near the panel edge; the centre tap of the primary is connected to the negative line. One outer primary lead goes to the collector of Tr3 and the other primary lead similarly provides the connecting point for the collector of Tr4.

T1 is held to the panel by its wire ends, while T2 is secured in position by twisting the lugs.

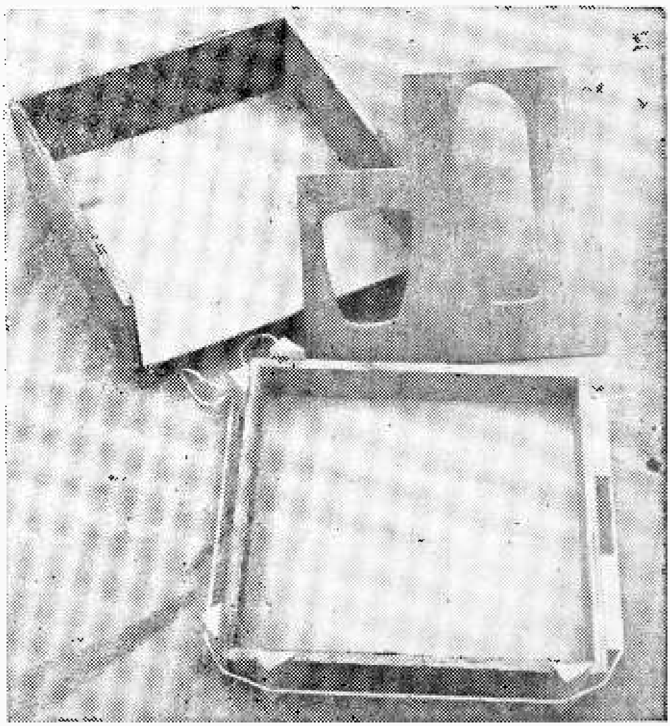
When all components have been placed as in Fig. 2, a final check of resistor values may be worth while.

Amplifier Wiring

All wiring is on the near side of the paxolin panel, as shown in Fig. 3. A simple procedure, which will help avoid errors and assure that no wire is overlooked, is to mark each lead on the diagram as it is fitted.

Thin tinned copper wire such as 26s.w.g. is convenient for the amplifier and, 1mm sleeving should be placed over all connections. The wire ends of resistors and other components are clipped off as required. Transistor leads should not be cut down unnecessarily, and joints should be soldered quickly, the iron being removed immediately the joint is made. If all leads are clean and bright, and a good cored-solder is used, with an iron which has been allowed to reach its proper working temperature, all joints should be satisfactory. If prior experience has not been gained, it is as well to leave the transistor leads until last.

Temporarily leave the secondary leads of T2 fairly long, and omit the connection from the secondary to R13. Wire one lug to the positive line, to earth the transformer core.



The lid under construction, with the motor deck and partially assembled case.

Motor and Switch Leads

Two of the holes, marked X in Fig. 5, are not used for components, but provide anchor points for the motor and switch lead, and outer braiding of the screened lead to the volume control. A loop of connecting wire can be passed through these holes, and the leads mentioned may be soldered on at either side of the panel.

Two pieces of thin flex, twisted together, are soldered to the secondary connecting points of T2. These will be taken to the loudspeaker.

Two further flexible leads, for motor and switch, and motor and battery negative, as in Fig. 3, are also soldered on. These will go to the turntable unit.

An insulated, screened lead about 9in. long is prepared, and its centre conductor is soldered to the positive tag of C1. The braiding is taken to X (positive line). The other end of this screened lead may be soldered to the volume control VR1, as shown in Fig. 4.

The underside of the turntable unit is shown in Fig. 4 (not to scale). Battery positive and negative leads should be fitted with battery clips, and polarity must be correct. Interconnection between turntable unit and amplifier is left until the unit has been fitted to the motorboard. The screened pick-up lead will be connected to R1 and VR1. Positive and negative wires from the amplifier are connected to the motor as in Fig. 4. It will be seen that the positive circuit to both the motor and the amplifier is completed through the switch S1.

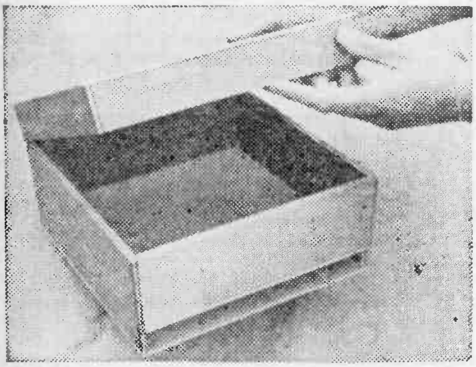
Initial Tests

The amplifier is first tested with no connection between R13 and T2, as described. If results are satisfactory, connect R13 as shown in Fig. 3. If this causes a reduction in volume (but improves quality) the connection is permanent. But if oscillation begins, switch off at once, and reverse the leads from the secondary of T2.

Assembling the Case

The cabinet is made from a complete kit which includes covering fabric and building instructions, the wooden parts are held together with a quick-hardening adhesive. Any good quality adhesive of this type, and intended for wood, will be satisfactory, if used as the maker directs.

The lid is made from a piece of $\frac{3}{16}$in. three-ply 11in. x 11in., with $\frac{3}{8}$in. five-ply sides 1$\frac{5}{8}$in. deep. The lid sides consist of two pieces 10$\frac{9}{16}$in. x 1$\frac{5}{8}$in. x $\frac{3}{8}$in., and two pieces 11in. x 1$\frac{5}{8}$in. x $\frac{3}{8}$in., shaped to form a corner joint. These pieces can be held firmly together by tying strong string round the whole, and pushing wooden blocks towards the corners to increase tension. These parts are assembled with the lid top on a flat surface, and weighted down until the adhesive is hard.



The case assembled, ready for its covering.

The case has two sides 11in. x 4$\frac{1}{2}$in. x $\frac{3}{8}$in., five-ply, grooved to take the false bottom, which is 10$\frac{1}{2}$in. x 10$\frac{3}{4}$in. x $\frac{3}{16}$in. three-ply. The front is 10$\frac{9}{16}$in. x 3$\frac{3}{8}$in. x $\frac{3}{8}$in., five-ply, and the false bottom rests flush with this. The back is 10$\frac{9}{16}$in. x 4$\frac{1}{2}$in. x $\frac{3}{8}$in., five-ply, and the bottom is $\frac{3}{16}$in. three-ply 11in. x 11in. These parts are fitted together in the same way as already described for the lid.

Two pieces 3$\frac{1}{8}$in. x $\frac{1}{2}$in. x $\frac{1}{2}$in. are glued to form a recess for the battery. Four angle pieces 3$\frac{5}{16}$in. x $\frac{11}{16}$in. x $\frac{7}{8}$in. are glued in the corners, inside. A similar piece is glued vertically near the battery space. The motorboard rests upon these five members.

The drawer front is 10$\frac{3}{8}$in. x $\frac{3}{4}$in. x $\frac{3}{8}$in., five-ply, and is attached to the drawer bottom, which is hardboard, 10$\frac{5}{8}$in. x 10$\frac{1}{8}$in. A countersunk 2B.A. bolt $\frac{3}{4}$in. long is inserted centrally in the drawer bottom, projecting upwards to receive records.

The motorboard is 10$\frac{1}{8}$in. x 10$\frac{1}{8}$in. x $\frac{3}{16}$in., three-ply, with a corner 3$\frac{1}{2}$in. x 3$\frac{1}{8}$in. removed to form the battery cover. The motorboard has an aperture large enough to receive the turntable unit, and a shaped cut-out for the loudspeaker. A $\frac{3}{8}$in. hole is required for the volume control.

When all glued joints are completely hard, the case should be smoothed at corners and other joints, using glasspaper held on a flat piece of wood. All dust must be cleaned away before covering the case.

Covering the Case

The author used a white and grey plastic material to cover the lid of the case, a piece 20in. x 20in. being required. The lid is placed centrally on this, and the material is cut so that a piece 11in. x 4$\frac{1}{2}$in. can be folded inwards, being mitred at the corners. They also cover the insides of the side members, remaining material being turned over to the lid top inside. A piece of the same material 10$\frac{1}{4}$in. x 10$\frac{1}{4}$in. covers the inside of the lid.

The case is covered in the same way, except that the material is only turned down the sides for about 1in. to 1$\frac{1}{2}$in. or so. In the author's model, grey and blue material was used. The material is 24in. x 24in. to allow the case to be covered with a single piece.

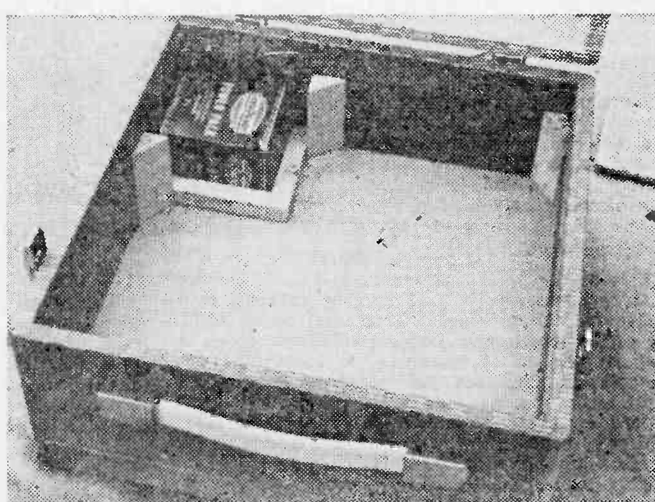
At the drawer opening, the material is carefully cut with a razor blade or sharp knife, and turned in. A little spare material is used to cover the drawer front. A small eye is screwed into the centre of the drawer front, and a hook to engage it is pivoted to the case by means of a $\frac{3}{8}$in. screw.

The hinges keep the lid in an open position, and each is secured with four $\frac{1}{4}$in. round-headed screws. Each of the two catches is also held with four $\frac{1}{4}$in. countersunk-headed screws. Four small feet are attached to the case bottom, using small screws.

The carrying handle is placed 1$\frac{1}{2}$in. from the lip of the case (centrally, if case is closed) and is held with 4B.A. nuts on the inside.

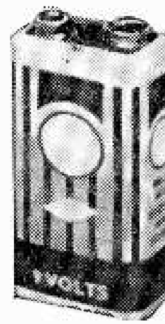
A piece of material 12in. x 12in. is used to cover the motorboard, and is cut to clear the turntable unit opening. The material is carefully cut round the loudspeaker aperture, and a narrow strip of matching material is fixed to cover the edge of the

—continued on page 157



Showing the motor board supports and the battery position.

battery economy



INCREASING THE LIFE OF TRANSISTOR SET BATTERIES

By F. G. Rayer

PERSONAL portables use small batteries which can only have a reasonable life when conditions are such that the receiver draws only moderate current. With many receivers battery life is unnecessarily short, and the defect causing this may also introduce other troubles, such as high background noise, or lack of sensitivity.

The working life of the battery depends on the type of receiver, and usual volume required, but the average 6 or 7-transistor superhet should run for 25-75 hours, using a miniature battery. With larger receivers using non-miniature batteries, a life of some 100-200 hours or more is to be expected.

Battery economy is particularly worth while with a pocket receiver in frequent use. The consumption of 5-transistor t.r.f. sets will generally be much the same as with a superhet. Excessive current drain can very easily arise from incorrect resistor values. If a battery only lasts a few hours, a fault of this kind should certainly be sought, while if battery life has appeared to be satisfactory, it may still be possible to increase it considerably. Faults causing high battery drain are most likely in the audio section, but it is worth giving early stages a check.

Mixer and I.F.

Typical mixer and i.f. stages are shown in Fig. 1. A meter inserted in series with R12 should not be expected to read much more than 4mA, of which a little under 1mA will be taken by the potential dividers R1 and R2, R4, R5, and R13, and R8 and R9.

If current is high, check each stage by inserting the meter at points 1, 2 and 3. If any transistor draws excess current, its base voltage is probably too negative. With Tr1, this arises because R1 is too low in value, and R2 too high. Similarly, with TR2 (R4 and R5) and TR3 (R8 and R9).

If 20% tolerance resistors are fitted, base voltages, as measured at points 4 and 5, for example, may differ considerably. Even with 10% tolerance resistors, an unlucky combination of values may cause quite an error in base voltage.

If a high resistance voltmeter is connected from point 4 to battery positive line, point 4 should become more positive when a local station is tuned in. If not, the diode may be wired wrongly. An unnecessarily high current in Tr1 can cause noise. Current may be very low—e.g., an emitter current of 0·25-0·3mA, for OC44.

Emitter resistors R3, R7 and R11 should be checked, if necessary. Low values should increase current, because the emitter-base voltage is quite critical. If emitter resistors are reasonably near the marked values, the current in Tr1 can be reduced by increasing the value of R1, or reducing the value of R2. A simple means of checking is to shunt another resistor across R2. Or a variable resistor may be added between R1 and negative line, and a fixed resistor substituted after finding the best value.

In the same way, the value of R4 or R8 may be increased (or R9 may be reduced). Optimum values will result in low consumption, good amplification, and freedom from noise in these stages.

Driver

TR4 is the driver, in Fig. 2, and the collector current, as measured at point 6, should not exceed 1·5mA (OC71 or similar transistor), and may be 1mA or less. If the current is high, R17 should be checked. If this is correct, R15 may be rather low in value, or R16 rather high.

The base voltage must not be made too positive, in an attempt to reduce current further, or distortion will result. It may also be worth checking R12. The typical 470Ω may be increased to 680Ω

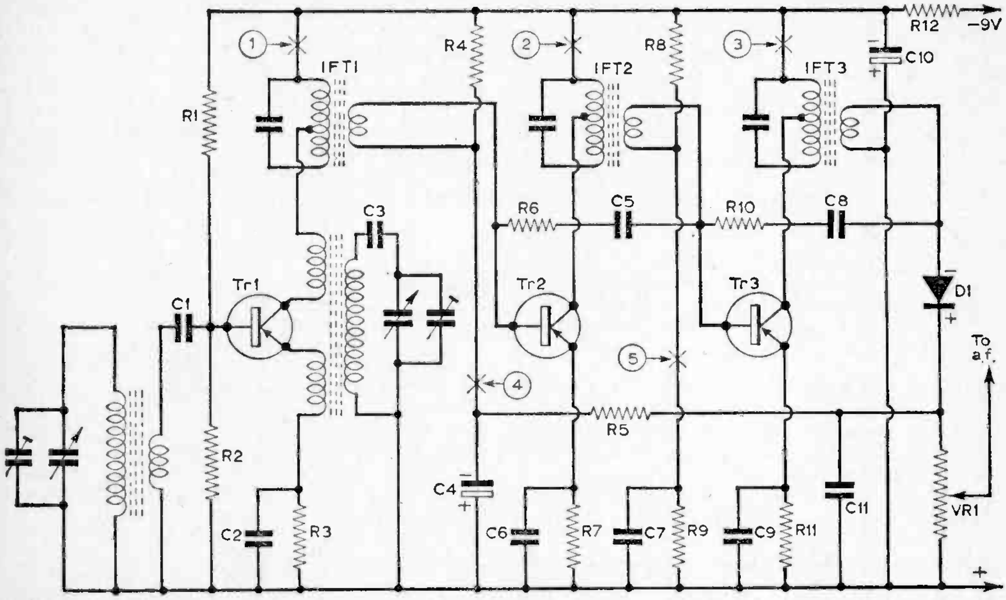


Fig. 1: The mixer and i.f. stages of a typical transistor receiver. The circled figures indicate test points referred to in the text.

in many sets. for maximum economy. In simplified receivers. R17 and C12 may be omitted. If so. the stage should give better results if these components are added, R15 and R16 being of recommended value.

Push-Pull Output

A push-pull output circuit (Fig. 2) is often employed, and wrong operation of this stage is a very frequent cause of short battery life. For OC72 and similar transistors. the combined collector current (point 7). may be only 2mA with no signal. But if R18 is too low in value. or R19 too high, point 10 is too negative.

With no signal, the current at point 8 should be approximately the same as that at point 9. With point 10 made slightly more negative. both currents (points 8 and 9) should increase by roughly the same amount. If not, the transistors are not matched. For this test, a variable resistor may be temporarily shunted across R18. care being taken not to make point 10 too negative. which could cause a very heavy current.

Reliable transistors obtained as a matched pair will be satisfactory for Tr5 and Tr6. But surplus transistors, or two transistors obtained separately, may be poorly matched and proper working of the stage at low currents. may be impossible, though results may be reasonably good at higher current values.

If consumption of the stage is too great, R18 is increased, or R19 reduced. This can be done to reduce the no-signal or low volume current without causing distortion. Normally, a current over 3-4mA should not be wanted, with no signal, and good volume obtained with current peaking up to 20mA on loud passages. With this type of output stage, current consumption increases as volume is

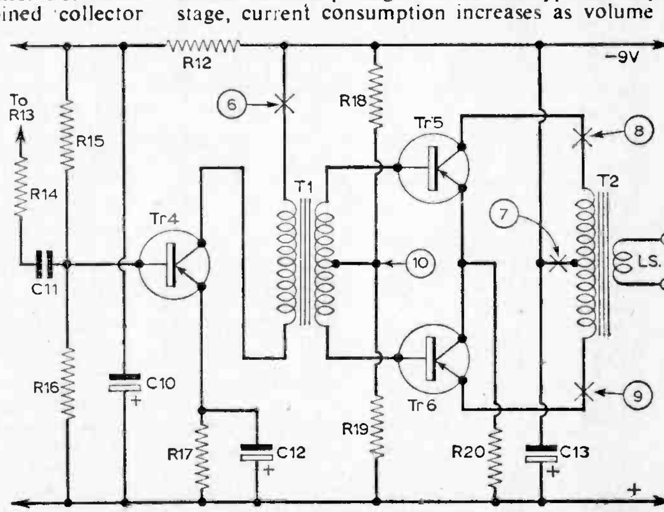


Fig. 2: A push-pull output stage.

raised. But if point 10 is too negative, current will be high, even with low volume, or no signal.

R20 tends to limit peak current. This can be observed by inserting the meter at point 7, and varying the value of R20, with the set operating at good volume. Sensitivity in the stage is high, with R20 omitted or of low value, but peak current is then also high, so R20 is generally desirable. By increasing the value of R20 the emitters become more negative, so R18 or R19 may also need subsequent modification in value. R20 is about 4·7Ω when using OC72's.

With larger transistors current peaks may rise to 50mA or more at maximum volume and this is excessive for miniature batteries.

Single Ended Push-Pull

A circuit of this kind is shown in Fig. 3. Components in the driver stage may be the same as in Fig. 2, or R17 may be higher, with reduction in output from Tr4. Each of the output transistors Tr5 and Tr6 receives half the battery voltage. A 75Ω or similar loudspeaker is used. Output is lower than with Fig. 2, but very economical working is possible, and the losses associated with the output transformer are avoided, so good volume may be obtained.

Point 7 may be regarded as the positive line for Tr5. R20 is the emitter resistor, and R18 and R19 the base bias potential divider. Tr6 is a duplication of Tr5, except that point 7 is the negative line for this transistor. The circuit may operate from a 9V supply as shown C14, being 100μF, or two 4·5V batteries may be employed in series, with the loudspeaker going from point 7 to the battery centre-tap thus made available.

For OC72's, R18 and R21 may be 2·7kΩ, and R19 and R22 may be 100Ω, 5% tolerance. R20 and R23 may be 5·6Ω.

Excess current can arise from the reasons previously indicated—base voltage being too negative, due to unsuitable resistor values. If the speaker is connected as shown by the dotted line, meters at 8 and 9 will show the collector currents of Tr5 and Tr6, which should be approximately equal.

A six-transistor superhet using this output stage should be expected to draw about 7-8mA with no signal, rising to 15mA with reasonable volume. It is thus a useful circuit for an economical portable.

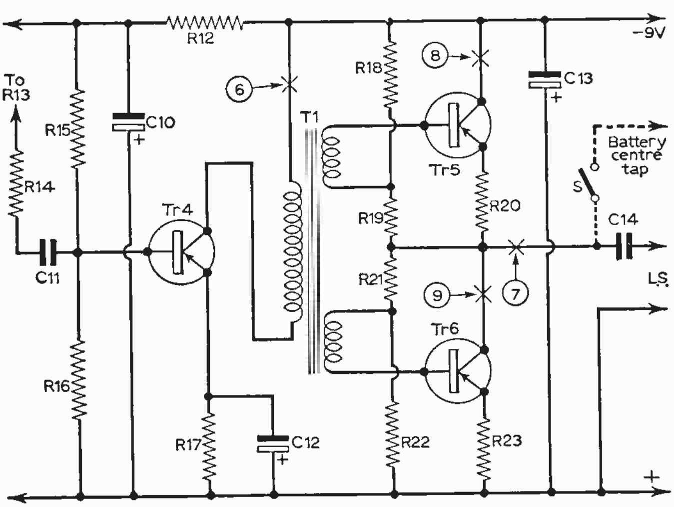


Fig. 3: The circuitry of a single ended push-pull output stage of a typical transistor receiver.

Other Points

Some receivers have a single transistor as a Class A output stage. Here, the current is fairly large (perhaps 20mA or more) even with no signal, or at low volume. This is unavoidable if reasonable loudspeaker volume is to be obtained.

If the receiver is home constructed, and space is available, the single output transistor could profitably be replaced by a push-pull stage, such as in Fig. 2 or Fig. 3, giving a larger output and reducing current drain.

In some receivers, the d.c. resistance of each half of the secondary of the driver transformer T1 is used instead of resistor R19 in Fig. 2, and resistors replacing R18 are wired from base to negative line. These resistors may have to be relatively low in value, resulting in a current drain of several milliamperes. Such circuits can frequently be changed to agree with Fig. 2 or Fig. 3.

Similarly, low value R18 and R19 will consume several milliamperes. Large power transistors are not wise for Tr5 and Tr6 when a miniature battery is to be used.

No current whatever should be drawn from the battery when the set is switched off, otherwise wiring is probably incorrect. A final test may include capacitors in parallel with the supply (such as C10 and C13). The leakage current of these should be small.

Most of the points described also apply to larger portables, except that a few extra milliamperes current consumption will be of no importance, because of the larger capacity of the battery. But even receivers of this kind should not be expected to draw more than 9-12mA, with no signal, rising to 25-35mA with good volume. ■

28Mc/s CONVERTER

Modifying the RF26 unit

By P. J. McGoldrick

MANY short-wave listeners on the amateur bands have receivers which are surplus equipment and only offer satisfactory reception to about 15Mc/s, either due to lack of sensitivity, or to their limited range. This means that for reception of the 21 and 28Mc/s amateur bands a front-end converter is needed.

Converter Action

A converter for this purpose usually follows the pattern shown in Fig. 1. If the receiver being used has satisfactory receiving characteristics at about 7Mc/s, the oscillator frequency for the 28Mc/s band can be either:

$28+6{\cdot}9$Mc/s or $28-6{\cdot}9$Mc/s

(6·9Mc/s is a quiet zone for reception).

As 21·1Mc/s is a less difficult frequency to generate, it is the obvious choice.

This oscillator is mixed with the already amplified signal at 28Mc/s to produce the 6·9Mc/s output at which the receiver is tuned.

Use of Surplus RF26 Unit

There is still on the market a surplus r.f. unit, Type 26, which sells for about 30s. This unit has the line-up of r.f. amplifier, mixer and h.f. oscillator described as being essential for a converter, but in its original form it covers frequencies much higher than those required (i.e. 50-60Mc/s).

The valve line-up of this unit is EF54 (r.f. amplifier), EF54 (mixer) and EC52 (oscillator) all using B9G valve bases. The EC52 is an exceptionally good glass envelope triode which is efficient up to some 300Mc/s. The EF54 used is akin to the famous EF50 valve.

The two controls on the front panel of the unit are the main tuning control, employing a three-gang variable capacitor with a Muirhead slow motion dial, and a small aerial trimmer control.

Modifications

The modifications needed are extremely simple and serve only to change the frequencies involved.

From the underside (Fig. 2), the three coils which require rewinding can be seen. These are L1 (directly in front of the first EF54), L2 (in front of the second EF54) and L3 (to the right of the EC52).

The new coils can be made from the details given in Table 1.

The replacement of the old coils is achieved by unsoldering them and inserting the new ones.

Power Supply

When the coil changes have been made, the power supply and the output lead to the receiver are connected to the Jones socket (Fig. 3). The aerial input is also connected, at the front panel, to the coaxial socket fitted originally.

The power supply required is 250-300V d.c. at about 30mA and 6·3V a.c. at about 1A for the heaters. This can usually be obtained from the receiver, so no separate power supply should be necessary. However, in case such requirements cannot be met by the receiver a suitable power supply is detailed (in Fig. 6).

The output lead should be coaxial cable, so that no pick-up at 6·9Mc/s occurs. The shielding of this cable should, of course, be earthed at both ends.

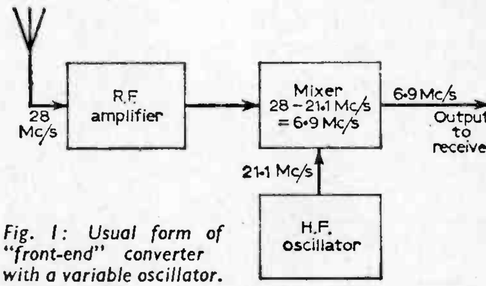


Fig. 1: Usual form of "front-end" converter with a variable oscillator.

TABLE 1

L1, L2 and L3 are wound on $\frac{1}{2}$in. ebonite formers with 14 threads per inch, and which are $1\frac{3}{8}$in. long, using 18s.w.g. wire.

	length of copper wire	approx. inductance
L1	$26\frac{1}{4}$in. or $66\frac{2}{3}$cm	$0{\cdot}54\mu$H
L2	$26\frac{1}{4}$in. or $66\frac{2}{3}$cm	$0{\cdot}54\mu$H
L3	$20\frac{1}{4}$in. or $51\frac{1}{2}$cm	$0{\cdot}41\mu$H

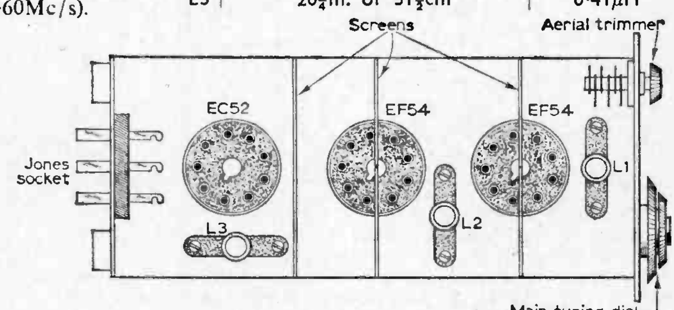
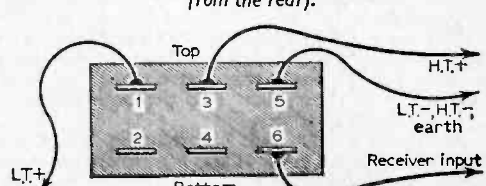


Fig. 2 (above): Underside view of the RF26 unit.
Fig. 3 (below): Connections to the Jones socket (viewed from the rear).



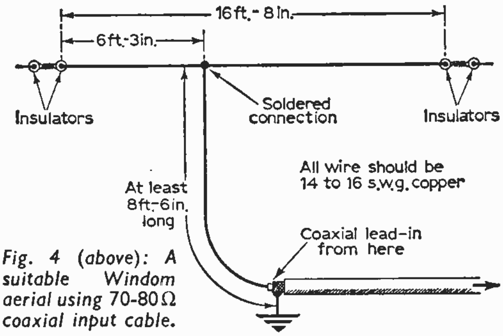
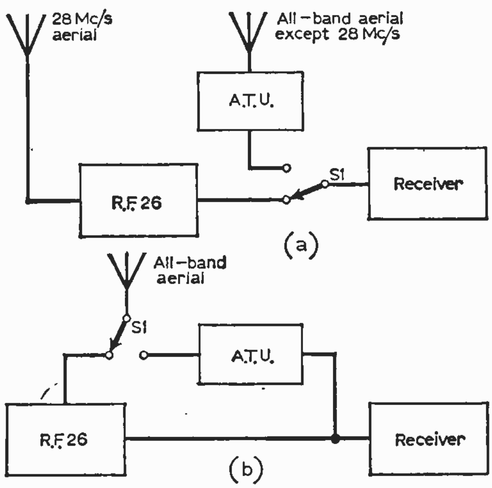


Fig. 4 (above): A suitable Windom aerial using 70-80Ω coaxial input cable.

Fig. 5 (below): Methods of connecting converter and receiver to different aerial arrangements. The aerial tuning unit (A.T.U.) peaks signals on different bands.



Alignment and Use

The three ceramic trimmers which are above the three-gang variable capacitor are altered *very slightly* until the maximum noise is heard in the loudspeaker of the receiver. Accurate measuring devices such as an output meter can be used.

Between 50° and 60° on the dial 28Mc/s signals should now be audible. Finally to peak-up on a station, the aerial trimmer should be used. Full use should be made of this control for best reception and it should be noticed that its best peak position will differ from signal to signal, day to day.

The frequency of 6·9Mc/s is not a rigid one and any frequency up to about 7·1Mc/s can be used as long as this does not coincide with a strong signal.

A frequency should, however, be chosen and adhered to as any change in receiver frequencies requires an alteration of the converter's trimmers. In addition, if the same frequency is used continually, the converter can be calibrated against a standard receiver or oscillator.

The 28Mc/s band is severely affected by sunspot radiations, with the result that on some days the band may appear to be quite dead while on others signals may be strong enough to cause cross-modulation in the receiver. It is therefore advisable to set the converter up beside a good 28Mc/s receiver to compare results.

Enhancements

When the modifications are complete, the user may like to add some "luxuries" to the unit. The first of these is control of the h.t. supply of the unit, by fitting a s.p.s.t. toggle switch on the front panel, in series with the h.t. supply, so that the main receiver can be used while the converter is at "stand-by".

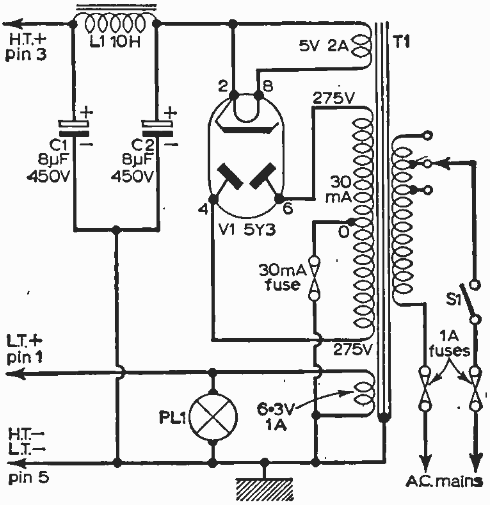
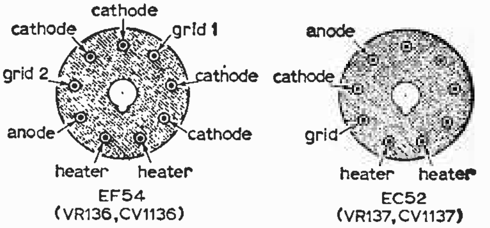


Fig. 6 (above): A suitable power supply. (T1 mains transformer with tapped primary, 200-250V; secondaries 275-0-275V, 30mA; 5V, 2A; 6·3V, 1A. L1 10H, 30mA l.f. choke).

Fig. 7 (below): The valve base connections.



If a fuse is not fitted in the receiver one should be fitted in the converter.

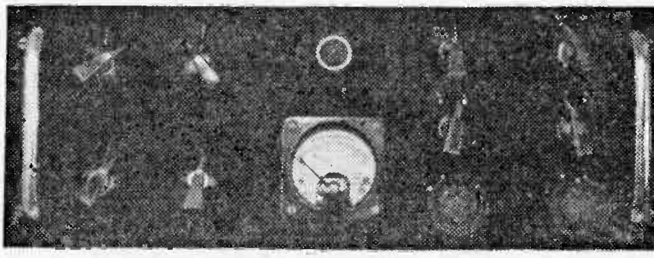
To improve results on 28Mc/s a separate aerial from that used on the other bands can be built. It is suggested that such an aerial can be a Windom, which is particularly suitable for one band operation and very small for this band (see Fig. 4) and can be easily accommodated in a loft or on the roof of a house. The earth connection should be a large copper spike or plate buried in wet ground. All the measurements given in the diagram can be doubled. The aerial will then operate on 14Mc/s.

Figures 5(a) and (b) show arrangements for connecting separate and an all-band aerial to the receiver and converter. S1 in both cases is the aerial change-over switch, and is preferably of the knife-edge type. ■

an electronic timer

A RELIABLE TIMING DEVICE FOR PHOTOGRAPHIC AND GENERAL PURPOSES

BY D. GILSON



MANY people at some time or another find the need to time something. The amateur photographer needs to time his exposures on the enlarger or contact printer; and there are no doubt countless other occasions when a given interval is required to be indicated for some particular process.

The writer had such a need for a timing device, but after careful examination of the various circuits it was decided to construct one specially for the job in hand.

Firstly, it had to be portable without trailing leads or wires and on this count mains operation was ruled out. However, the case was constructed allowing ample room so that should mains operation be desired at a later date there would be sufficient space to install a power unit. The writer is acutely aware of the alarming rate at which battery valves consume the precious milliamps, and with this point in mind valves were omitted from the list of possibilities. The only choice left after such ruthless pruning was our "new" friend the transistor. In the present circuit an XB112 is used and even when working full out only consumes a modest 5 to 8mA.

Component Problems

The degree of accuracy is a problem which must necessarily arise in all matters of timing. Electronic timers make use of the charge and/or discharge of a capacitor through a resistor, and this immediately poses the question of the reliability of these two components.

As far as timers are concerned, capacitors may be divided into two main groups, paper and electrolytic. Paper capacitors are favoured where accuracy is of importance, but have the disadvantage of their bulk. A $10\mu F$ paper type capacitor is no small physical size, so a $100\mu F$ would be immense—even if one were available. Electrolytics on the other hand, can be obtained easily and cheaply and their values, even in the $500\mu F$ range are still contained in a comparatively small size.

Unfortunately, electrolytics are notorious "leakers" when compared with paper dielectric capacitors and the snag is that the leak is not linear. Over a period of 30 seconds or so this may not be of sufficient consequence. However, over a period of minutes the matter might prove more serious. On the other hand, this can often be tolerated since usually the longer the timing period the greater the latitude of error. An example may help to clarify this:

Let us suppose that we can only be sure of 10% accuracy. Then, over a short timing period of, say, 20 seconds this represents an error of two seconds, i.e. 10% of 20 is two. Over two minutes however we find that for 10% accuracy we can allow 12 seconds, i.e. 10% of 120 is 12. This example is purely hypothetical and does not necessarily indicate tolerances found in practice. In the circuit to be described, accuracy is much superior to the 10% referred to in the above example.

The resistors present little worry if of good quality, since in the present design the usual bugbear—trackwear—is eliminated.

It might be reasoned, that a good idea would be to use a small paper capacitor and increase the value of the resistor, thereby gaining the apparent advantage of accuracy and size. However, the value of resistance required would be very large—many megohms—and would begin to compare with the internal resistances of the transistor and the capacitor itself, resulting in an unstable timing period.

Our next consideration is the relay, the current-sensitive device used to actuate the alarm and/or control external circuits. Such a device is dependent for its individual accuracy on the tension spring and wear of same, plus wear of moving parts.

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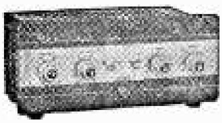

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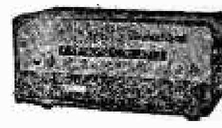

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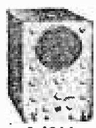

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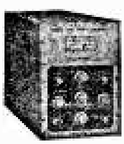
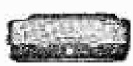
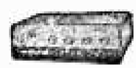


SB-10U

USC-1



TA-1S



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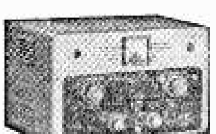

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Also, there may be slight differences in the value of current at which the relay will open and close.

The above arguments may seem, to some, to present so many doubts as to make one wonder if any reasonable degree of accuracy can be attained at all, that is using readily available components, also keeping a reasonable budget and without recourse to specialised pieces of equipment. Bearing in mind all that has been said so far, the writer constructed the timer to be described with little cost and using standard components, as advertised in the pages of this magazine.

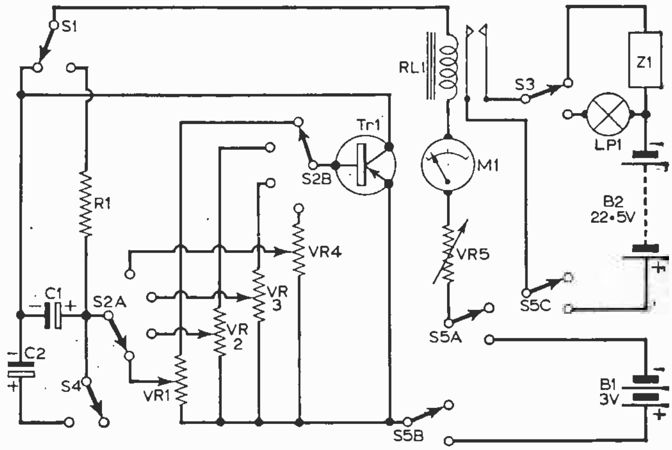
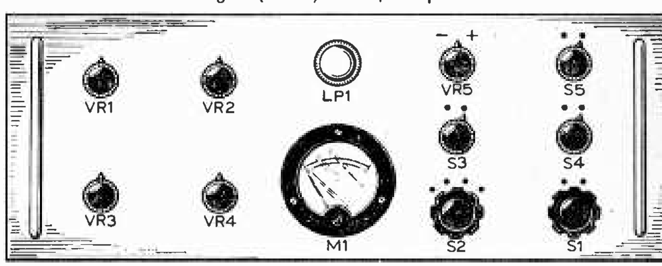


Fig. 1 (above): The circuit diagram.

Fig. 2 (below): The front panel.



The Circuit

Referring to the circuit of Fig. 1, when the switch S1 is in the "charge" position, the transistor draws some 5-8mA pulling in the relay and registering f.s.d. in the meter. When S1 is turned to "time" the current through the relay commences to fall and its decrease can be observed on the meter. At a particular value of current, 1·5mA in the writer's case, the relay falls out and sounds the alarm.

The layout can be seen in Fig. 2. The four controls to the left of the meter cutout are the timing potentiometers. Anyone of these may be selected by the range switch S2, and each potentiometer is variable from about three seconds to two minutes. As used by the writer, three of the potentiometers are preset to a particular interval and the fourth is used as a variable. This eliminates inaccuracies due to track wear.

The method of presetting is somewhat novel, and works very well. A small pointer is made from a paper clip, first straightening it and then bending it as in Fig. 3(a). The completed pointer is then fitted on to the potentiometer thread and held in position with a locking nut (Fig. 3(b). To calibrate or alter the timing period it is only necessary to calibrate the desired interval against a watch, loosen the locking nut, rotate the paper clip pointer until it coincides with the pointer of the knob, and tighten the locking nut. If the knobs are touched or knocked accidentally, they can be reset very simply and quickly by lining them up with the paper clip pointer again.

The four potentiometer knobs are colour-coded red, blue, white and yellow. The four positions of the range switch S2, which selects the desired timing intervals by switching into circuit the appropriate potentiometer, are similarly colour coded.

The Meter

The meter has a f.s.d. of 5mA and is shunted to read about 9mA. The original idea was that it should be used in conjunction with the variable resistor VR5 in order to ensure that a constant voltage is present, since if the voltage were to drop or increase then the charge of C1 (plus C2) would vary, thereby varying the timing period and distorting the accuracy of the instrument. A voltmeter suitably connected might prove preferable, but the mA meter as shown will indicate directly the current drawn by the circuit and is a further indication of the timing cycle. As explained earlier, when the needle drops to 1·5mA the relay falls out. It is important to note, however, that the relay de-energising at 1·5mA is true for the particular relay, meter, and circuit parameters in the writer's model, and this reading may may vary in other models. For those not possessing a suitable meter, the circuit will of course work equally well without its inclusion.

The visual/oral switch S3 switches the alarm to either the warning light LP1 above the meter to

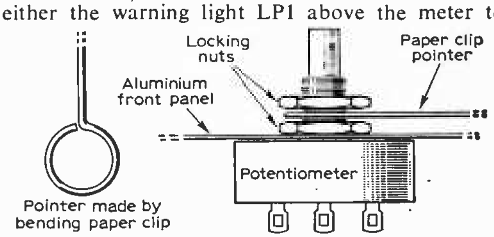


Fig. 3: Method used for assembling the potentiometers and pointers.

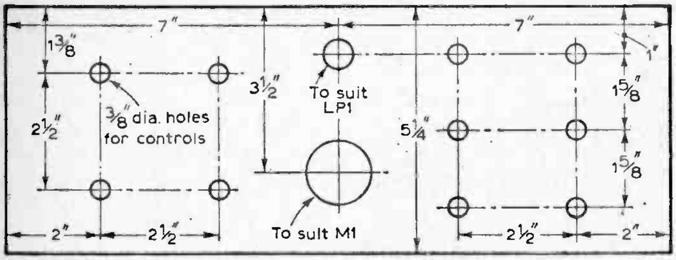


Fig. 4: The drilling details of the front panel.

give visual indication, or to the 3V Buzzer mounted underneath the front panel to give audible warning. This switch is particularly useful should the timer be used for photographic applications. If contact prints or ortho materials are to be processed, the red warning light may be used giving visual indication without fogging. If, however, panchromatic materials are used then it is only necessary to flick this switch to the "audible" position and take advantage of the buzzer to indicate the completion of the timing cycle.

External Circuits

There is no reason why the relay should not control external circuits directly and this could easily be done by selecting a relay with a further set of contacts and bringing these out to a plug at any convenient point on the case. S4 is a control marked "N" and "X2", and this merely switches a further $500\mu F$ capacitor and has the effect of doubling the timing period. It is very doubtful if the range will be exactly multiplied by two since all capacitors are plus or minus the value stated on the body or case. When one enters the realms of hundreds of μFs the plus or minus may be considerable and although switching in a capacitor in parallel of the same value should, in theory, double the capacitance it will not be exactly so.

The remaining controls are self-explanatory. The on/off switch S5 breaks the h.t. lead and also the small battery lead from the buzzer and warning lamp to the battery B2. This last function is necessary because the circuit is so arranged as to sound the alarm when the relay is de-energised. Since the relay is de-energised when the unit is switched off the presence of this switch is obviously a desirable feature.

The range switch S2 selects the appropriate potentiometer and is colour coded to coincide with the coding on the potentiometer pointer knobs. Lastly, the switch S1 for "charge" and "time". This calls for little comment, apart from the 100Ω resistor R1 in series with it. Since this switch is used constantly, the inclusion of R1 was thought necessary in order to eliminate surges and arcing at the contacts.

COMPONENTS LIST

S1 1-pole 2-way (charge/time)
S2 2-pole 4-way (range selector)
S3 1-pole 2-way (visual/aural)
S4 1-pole 2-way (normal/ x 2)
S5 3-pole, 2-way (on/off)

C1 $500\mu F$ } electrolytic 25V
C2 $500\mu F$ }

M1 0-5mA shunted to read 10mA
RL1 Relay $2k\Omega$ (1 break)
Z1 3V buzzer
LP1 3V 0·3A bulb
Aluminium for case and front panel
2 squares of wood for ends
2 handles
2 doz. chrome-headed screws
10 knobs (type to individual taste)
R1 100Ω ½ watt
VR1, VR2, VR3, VR4 } $2k\Omega$ wire-wound potentiometers
VR5 $1k\Omega$ wire-wound potentiometer
B1 3V battery
B2 18V or 22·5V battery
TR1 XB112 (or equivalent)

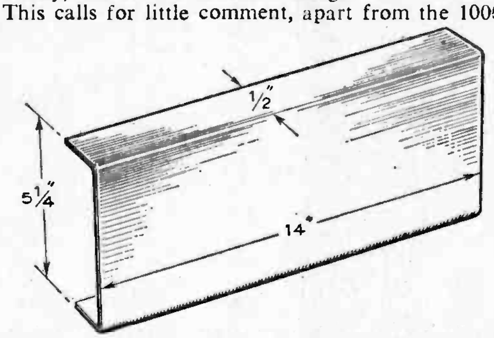
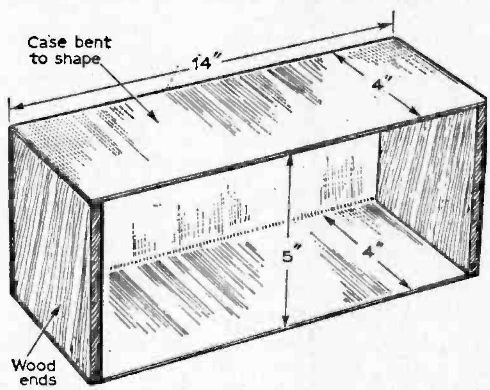


Fig. 5 (above): The overall dimensions of the front panel.

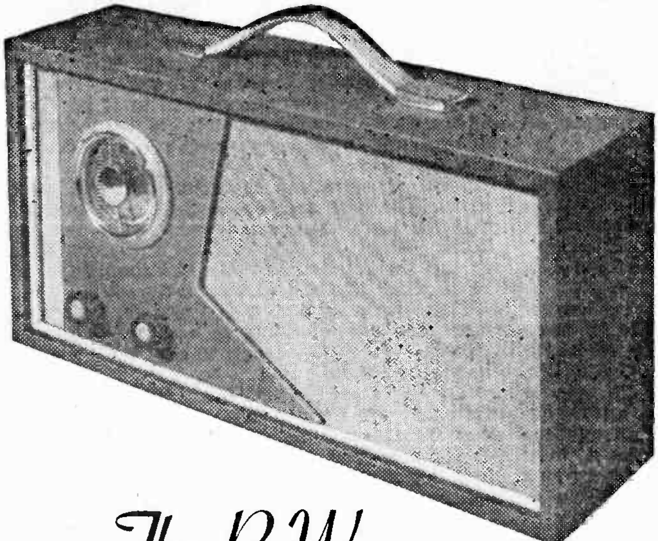
Fig. 6 (below): The construction of the cabinet.



Construction

The unit could, of course, be smaller, very much smaller, but as explained earlier a mains power unit was envisaged at a later date and the present layout is uncramped and allows much appreciated breathing space for easy wiring and soldering. As

—*continued on page 136*



A SEVEN-TRANSISTOR PORTABLE RECEIVER

By K. L. Surrey

The P.W. Celeste

THE Celeste is a seven-transistor portable, tuning medium and long waves. It has good sensitivity and volume, an output approaching 1W being obtainable, and the 7in. x 4in. oval loudspeaker gives good quality reproduction.

Normally, the receiver operates from its internal ferrite rod aerial. However, when the directive properties of this aerial would be troublesome, or when using the set in a screened locality, an external aerial can be connected. An example of these circumstances arises when the receiver is used in a car. The external aerial coupling winding is quite separate from the other windings on the ferrite rod. One tag of this winding is connected to the "earth" line (battery positive) of the receiver, the other tag being taken to a coaxial socket situated at the side of the cabinet.

Description of the Circuit

The circuit is shown in Fig. 1 on the blueprint. Tr1 is the usual self-oscillating mixer. For m.w. reception, the l.w. portion of the ferrite rod aerial is shorted. For l.w. tuning, the ferrite rod windings are in series, and C2 and TC2 are in parallel with the oscillator coil.

Tr2 is the first i.f. amplifier, automatic volume control bias being obtained from the diode D1 and applied to the base, through R11. Tr3 is the second i.f. amplifier, and operates with fixed bias only.

The diode D1 provides demodulation, VR1 being the audio volume control (incorporating an on/off switch).

Tr4 is a low noise, high gain audio amplifier. Tr5 is the OC81D driver stage, T1 being the driver transformer. Tr6 and Tr7 are a matched pair of OC81 output transistors, mounted on small heat sinks. The heat sinks are made from 18s.w.g., or preferably 16s.w.g., aluminium, as shown in Fig. 4.

The receiver will give exactly the same performance, at good volume, without the heat sinks but if these are temporarily omitted, maximum volume should not be used, or the output transistors will overheat.

It is advisable to obtain the package LFH which contains three specially selected and matched transistors for the a.f. stage.

Paxolin Panel

The receiver is constructed on a paxolin panel $10\frac{1}{2}$in. x $6\frac{1}{4}$in. and all holes should be drilled before mounting any components. The receiver is a complete, working unit when assembled on this panel. This, and the ample space available, simplifies construction and testing. When the set is inserted in its cabinet, most wiring is on that side of the panel facing the front (see Fig. 3), nearly all components being behind—that is, on the near side of the panel.

The positions of components can be seen from Fig. 2. Resistors and capacitors are mounted by passing their wire ends through small holes. A $\frac{1}{16}$in. drill will do well for these. All electrolytic capacitors must be connected in the correct polarity, as indicated in the circuit and Fig. 2.

An $\frac{1}{8}$in. drill will be satisfactory for the 6B.A bolts holding the heat sink plates, and also for the oscillator coil and IFT pins. For the IFT can tags $\frac{1}{16}$in. holes are used. The oscillator coil is placed with its coloured identification mark facing the variable capacitor. White spot IFT's are used in first and second positions, with a blue spot IFT in the third position.

Four holes to clear 2B.A. ($\frac{7}{32}$in.) are positioned as shown. Long bolts hold the loudspeaker in position, and the finished receiver is mounted on these bolts.

The aperture to clear the loudspeaker magnet can be made by drilling an oval of small holes, breaking out the paxolin, and clearing up with a half-round file. Alternatively, this opening can be made with an adjustable washer-type cutter, by cutting two semicircles at 3¼in. radius, and two at 1½in. radius, to form the oval.

Holes ⅜in. in diameter are required for the wavechange switch S1 and VR1. The spindles of these two components should be about 1¾in. in length and should be cut down, if necessary. This is best done by holding the unwanted end of the spindle in a vice, and using a sharp hacksaw, afterwards clearing away burr with a file. The component should be protected against metal fragments, while sawing, and the spindles should not be cut down with the components fitted to the circuit board.

The three trimmers TC1, TC2 and TC3 are mounted by passing their tags through small holes, a central hole under each trimmer clearing the adjusting screw. Short 6B.A. bolts secure two tags to take a 20s.w.g. bare "earth" circuit wire. The ferrite rod mounting is held by a short 4B.A. bolt and nut.

Particular care is necessary when mounting the variable capacitor, because if the bolts project, they may easily damage the component. Very short 4B.A. bolts are used, and they should project about the thickness of the capacitor plate. If the bolts are too long, washers should be placed under their heads.

When the panel is turned over, one end is supported by the heat sink plates. A bracket about 1½in. long is fitted under one bolt holding the variable capacitor. This bracket supports the other end of the panel, and prevents it resting on the transistors.

The driver transformer T1 secured by its wire ends. The insulation is removed from these, before inserting them through the holes in the panel.

The output transformer T2 has projecting feet, which pass through small slots in the panel. These slots can be made by drilling $\frac{1}{16}$in. holes close together, and the feet are twisted to hold the transformer in place.

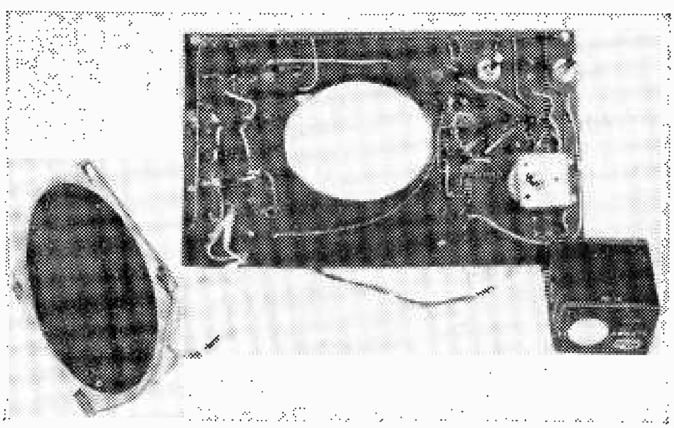
Wiring

A bare 20s.w.g. wire is run from the positive end of C18 to the bottom of the panel, then along near the bottom of the panel, and up to the tuning capacitor. Tags support this wire at convenient points, and it ends at one bolt securing the variable capacitor. Similar 20s.w.g. wires pass from the other bolts, to the trimmers, and to IFT2. Loops of 20s.w.g. wire under the nuts holding the volume control and wavechange switch are soldered to the earth line.

Most resistors and capacitors rest flat on the panel. The wire ends are bent at right angles, so that the leads can pass down through the small holes. Wires should not be bent immediately against the component body, nor should the bend be so sharp that the wire is fractured.

Some resistors and capacitors stand vertically. Here, the one wire end is bent at right angles, then at right angles again, so that both wires can be inserted in the holes.

The oscillator coil and the IFT's are secured by spreading out the can tags. One can tag of each component must be earthed. The earth cricuit should *not* be completed by soldering one earth lead to one can tag, then running another earth lead on from the second tag. If this is done, poor contact between tags and cans will cause noises and other trouble. Oscillator coil pin 3 must be wired directly to the gang capacitor frame tag, to avoid instability.



The chassis, battery and loudspeaker ready to be mounted in the cabinet.

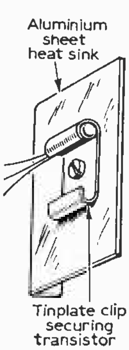


Fig. 4: The transistor heat sink for Tr6 and Tr7.

Transistors

There is no point in cutting the leads of these very short. If pieces of 1mm sleeving about ½in. long are cut, and placed on the centre transistor lead, this will prevent shorts between leads, and also hold the transistors at about the right distance from the panel.

It is essential that collector, base and emitter wires are in the correct position, as shown by c, b and e in the diagrams. With the specified transistors, a red spot indicates the collector lead. The centre lead is for base, and the remaining lead for emitter.

Soldered joints should be made fairly quickly, as lengthy heating may damage the transistors. If the iron is clean, and has gained the correct temperature, each joint can be made in a second or so, and this will not cause damage. The same care should be taken when soldering the diode D1, and its leads should be at least ½in. long. It must be connected in the polarity indicated.

The output transistors are held in clips, which are tightly bolted to the heat sinks.

Other Wiring Points

Capacitors normally have the value marked on them. Resistors are usually colour coded.

R22 and R23 should be within 5% of the marked value, so these should be checked with a meter, or have gold bands. All other resistors should be of 10% tolerance, so should have silver bands. Resistors outside this tolerance are not recommended.

Though R23 is a normal value (39Ω) some resistor stockists do not seem to have it readily available. If preferred, R22 may be 4·7kΩ 5%, and R23 may be 82Ω. 5%. It is essential, however, to select both R22 and R23 to match; that is, use 2·2kΩ and 39Ω, *or* 4·7kΩ and 82Ω.

Rod Aerial

Aerial connections are most easily identified by soldering coloured flex to the tags, before mounting the aerial. Connections, as seen from the tagged ends of the windings, are shown in Fig. 5. If leads are soldered on after mounting the aerial, particular care should be taken to get them correct.

The rod is attached to its mounting cradle by means of elastic or insulating tape. The coupling coil for the external aerial should be positioned close to the anchoring device on that half of the rod occupied by the l.w. coil.

Initially, both the l.w. and the m.w. tuned windings can be positioned roughly level with the ends of the rod.

The trimmers can be fully unscrewed, and the cores of the oscillator coil and the third i.f. transformers placed approximately level with the tops of the cans.

Battery and Loudspeaker Connections

Red and black flexible leads are provided for battery connection purposes. A non-reversible battery plug or clips should be added, as the battery must always be connected in the correct polarity.

Either a 9V or 7·5V battery can be used, the latter being adequate.

About 12in. of thin twin flex is soldered on for the loudspeaker connections. The receiver should be tested before inserting it in its cabinet, but all trimming and alignment can be done from behind, with the set installed.

A check should be made that all wiring is correct, and that insulated sleeving has been placed on any wires which may touch each other, or components or metal parts.

Initially, a meter should be included in one battery lead. This should indicate about 7mA to 10mA or so, with no signal, or at low volume. Current will rise to 15mA to 25mA or so, with good volume, and 45mA or more, with maximum volume. If the meter shows more than 15mA or so, at low volume, R22 and R23 may be incorrect, or a fault may be present. If the meter shows a very high current, the set should be switched off at once, and a fault traced.

Alignment Instructions

Alignment is carried out in the following order—i.f. amplifier, m.w. band, l.w. band. Satisfactory alignment is possible without a signal generator, though this item simplifies adjustments.

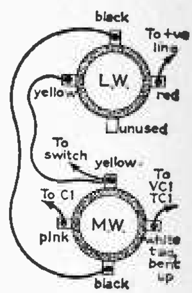


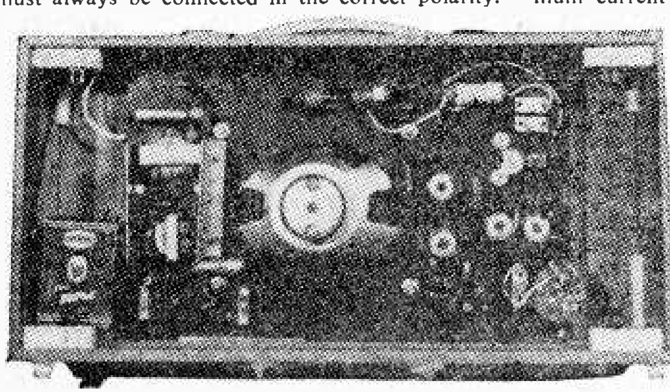
Fig. 5: The connections to the aerial.

If a generator is available, the three IFT's are tuned to 470kc/s by rotating the cores. A strip of paxolin, filed to engage with the core slots, may be used, care being exercised to avoid breaking the cores. If no generator is to hand, tune in any station, and adjust the IFT cores for best results. Each core should tune fairly sharply. Initially the cores can be set roughly level with the can taps, before adjusting them for best volume.

Once the i.f. stages are aligned, they are left untouched. If the test signal is modulated, adjustments may be directed towards obtaining maximum current reading on a meter in one battery lead. For adjustment by ear, set VR1 at maximum volume, and reduce the generator input, or choose weak stations. More accurate adjustment is then possible.

To adjust m.w. aerial and oscillator circuits, unscrew TC1 and TC3 fully, checking that the plates are well apart. A low wavelength station (such as Radio Luxembourg, 208m) is then tuned in, and TC1 and TC3 are adjusted for best volume. If volume is too great, rotate the receiver to reduce signal pick-up, or choose a weaker station, for the reason given.

A high wavelength station is then tuned in, and the oscillator



The paxolin chassis assembled in its case.

coil core is adjusted for correct band coverage, the m.w. aerial winding being moved along the rod for maximum volume.

The receiver should tune to about 550m with the gang capacitor fully closed. If this wavelength is not reached, the oscillator coil core should be screwed in slightly, and the m.w. aerial winding pushed a little farther on the rod. On the other hand, if this wavelength is exceeded, the oscillator coil core is too far in, and the m.w. aerial winding is too far on the rod. If trouble arises with these adjustments, C4 should be checked. Good alignment is possible with quite large changes in actual band coverage, but instability will arise if wrong adjustments allow the aerial circuit to tune near the intermediate frequency.

If a sufficiently low wavelength (around 200m) cannot be reached, this shows that TC1 and TC3 are probably set at too high capacity. They should then be unscrewed, and the trimming procedure repeated.

For l.w. alignment, first adjust TC2 and the l.w. winding on the rod until the Light Programme (1,500m) is found with the gang capacitor about half closed. In many areas other l.w. stations should be received. The l.w. winding can then be adjusted on the rod, for best results around 1,700 to 1,800m, while TC2 is adjusted around 1,300m. Long wave tuning coverage is also considerably influenced by the oscillator coil core position.

All adjustments can easily be given a final touch after the set is fitted in its cabinet, as cores and trimmers can be reached from behind.

A metal tool should not be used for any alignment adjustments. Rough alignment is readily made with local stations, but weak transmissions should be used for final adjustments.

If oscillation accompanies reception, this is probably due to instability in the i.f. amplifier; the first or second IFT core may be very slightly detuned to eliminate this trouble. Only a small part of a turn should be given to the cores. This action may be necessary due to slight differences in the neutralising values of components and the stray capacity effects of particular transistors.

Cabinet Fitting

The complete receiver is inserted from behind and held by nuts on the four bolts which secure the loudspeaker. Additional nuts will be required on these bolts, or spacing sleeves may be placed between loudspeaker and receiver panel.

There is sufficient free space to make fitting easy, but the receiver must be so placed that the knobs fit correctly, and do not rub the cabinet front.

The cabinet can accommodate various batteries, but a higher voltage than 9V must not be used. A reasonably large battery is more economical, as its life will greatly exceed that of a miniature battery. A 7·5V battery can be expected to give adequate volume.

Current consumption should be around 7mA to 10mA or so, with very low volume, or with no signal. If it much exceeds this, R22 and R23 should be checked. When volume is increased, current rises, being around 15mA to 25mA with good volume, and exceeding this at maximum volume.

Use in a Car

When using a portable receiver of this type in a car, the effectiveness of the internal rod aerial is reduced considerably due to the screening effect of the vehicle body. Furthermore the directional properties of the rod are to some extent a disadvantage since the orientation of the car in relation to the transmitting station will be constantly altering.

If it is intended to use this receiver regularly in a car it is recommended that a normal type car aerial be permanently installed on the outside. Such aerials are generally equipped with a length of screened coaxial cable and fitted with a standard type coaxial plug which can be easily fitted into the socket at the side of the receiver case. When installing a car aerial follow carefully the maker's instructions.

The receiver itself is not screened, and it is possible that electrical interference may be picked up from the ignition system. This can be minimised by placing the receiver as far from the front of the car as possible.

Operation from the Mains

A mains operated power supply unit can be fitted in the right of the cabinet, viewing the receiver from behind. This allows running the receiver from the a.c. mains when indoors, while the battery can still be used for portable listening. ■

ELECTRONIC TIMER

— continued from page 132 —

will be seen from the diagrams, the construction is simple and the only component not on the front panel is the relay, which is mounted on one of the wooden walls.

A piece of aluminium for the front panel is bent as shown in Fig. 5. A further piece for the case receives treatment as Fig. 6. The side panels are made of wood, this allows chrome-headed screws to be used to fix the front panel and case together very easily. After adding the handles and "panling" the unit the wooden ends looked rather out of place so two squares of thin aluminium were cut to size and after a coat of panl were fixed in place with more chrome-headed screws.

Conclusion

In closing a few hints and observations may not come amiss. First it is as well to ascertain whether the wipers of the potentiometers are connected to the spindles. If this is so the use of insulating washers is essential in order to prevent the potentiometers shorting with one another via their spindles and the front panel. The writer found this out the hard way. A further tip is to use colour-coded wires from the potentiometers to the range switch S2 otherwise wiring up tends to become a bit confusing. The batteries used in the prototype are 4·5V cycle batteries connected in series.

Power supplies were derived from 4·5V cycle-lamp batteries. Two such batteries are used in series for B1, and a total of five for B2. These larger batteries were chosen as there is ample room in the case without the power unit, and the larger batteries have a longer life. If however a miniature version is to be constructed, then a couple of the small 9V batteries intended for transistor pocket portables might suit for B2. ■

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3	8500	3	8/6
3	8500	5	8/6
3	8500	10	8/6
3½	7000	35	8/6
4	5000	3	7/6
4	6000	3	8/-
4	7000	3	8/6
4	9500	3	9/6
4	9500	5	9/6
4	10000	3	10/-
4	6000	25	10/6

Diameter in inches	*Gauss in lines*	*Imped. in ohms*	*Price*
4	7000	25	11/6
4	6000	35	10/6
4	7000	35	11/-
4	9300	35	11/6
4	9500	35	11/6
4 tweeter	6000	3	7/6
4 „	7000	3	8/-
4 „	7000	5	8/-
4 „	8500	3	8/6
4 „	8500	5	8/6
4 „	9500	5	9/6
5	6000	3	8/-
5	7000	3	8/6
5	7000	5	8/6
5	7500	3	9/-
5	8500	3	9/6

Diameter in inches	*Gauss in lines*	*Imped. in ohms*	*Price*
5	8500	5	9/6
5	9500	3	10/6
5	9500	5	10/6
5	10000	3	11/6
5	12000	3	12/6
5	6000	25	10/6
5	6000	30	10/6
5	6000	40	10/6
5	9500	25	11/6
5	9500	30	11/6
5	9500	33	11/6
5	9500	50	11/6
5	10000	25	12/-
5	10000	35	12/-
6½	6000	3	10/6

Diameter in inches	*Gauss in lines*	*Imped. in ohms*	*Price*
6½	7000	3	11/-
6½	7000	5	11/-
6½	8500	3	11/6
6½	9500	3	12/-
6½	12000	3	13/-
8	6000	3	11/6
8	7000	3	12/-
8	7000	5	12/-
8	8500	3	12/6
8	8500	5	12/6
8	10000	3	13/6
8	10000	5	13/6
8	10000	8	13/6

Elliptical Size	*Gauss in lines*	*Imped. in ohms*	*Price*
5 × 3	6000	3	7/6
5 × 3	7000	3	8/-
5 × 3	7000	5	8/-
5 × 3	9000	3	8/6
5 × 3	9000	4	8/6
5 × 3	9000	5	8/6
5 × 3	6000	25	9/6
5 × 3	7000	25	10/-
5 × 3	7000	35	10/-
5 × 3	9000	25	11/-
5 × 3	9000	35	11/-
6 × 4	6000	3	8/6
6 × 4	7000	3	9/-
6 × 4	8500	3	9/6
6 × 4	9500	3	10/-

Elliptical Size	*Gauss in lines*	*Imped. in ohms*	*Price*
6 × 4	9500	5	10/-
6 × 4	12000	3	11/-
7 × 3½	6000	3	9/6
7 × 3½	7000	3	10/-
7 × 3½	9500	35	11/-
7 × 4	6000	3	9/6
7 × 4	7000	3	10/-
7 × 4	7000	4	10/-
7 × 4	7000	5	10/-
7 × 4	8500	3	10/6
7 × 4	9500	3	11/-
7 × 4	9500	4	11/-
7 × 4	9500	5	11/-
7 × 4	9500	30	11/6
7 × 4	9500	35	11/6

Elliptical Size	*Gauss in lines*	*Imped. in ohms*	*Price*
7 × 4	9500	50	11/6
7 × 4	10000	3	12/-
7 × 4	10000	5	12/-
7 × 4	10000	15	12/6
7 × 4	12000	3	13/-
7 × 4	9500	3*	13/6
8 × 2½	6000	3	8/6
8 × 2½	7000	3	9/-
8 × 2½	7000	5	9/-
8 × 2½	6000	6	8/6
8 × 2½	6000	30	9/6
8 × 2½	8500	5	9/6
8 × 2½	9500	3	10/-
8 × 2½	9500	4	10/-
8 × 2½	9500	5	10/-

Elliptical Size	*Gauss in lines*	*Imped. in ohms*	*Price*
8 × 2½	9500	30	10/6
8 × 2½	9500	50	10/6
8 × 2½	10000	3	10/6
8 × 2½	10000	5	10/6
8 × 5	6000	3	8/6
8 × 5	7000	3	9/-
8 × 5	8500	3	9/6
8 × 5	8500	5	9/6
8 × 5	8500	35	12/6
8 × 5	9500	3	10/-
8 × 5	9500	15	13/6
8 × 5	10000	3	10/6
8 × 5	12000	3	11/-
8 × 5	12000	5	11/-
8 × 5	12000	15	14/6

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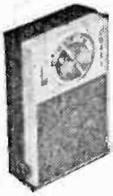

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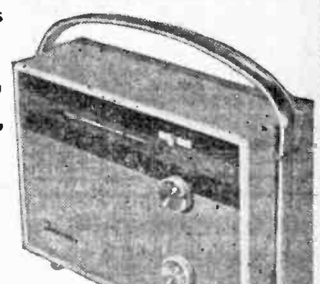

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Continued from page 52 of the May issue.

Double Conversion Communications Receiver

MECHANICAL CONSTRUCTION AND LAYOUT

BY P. R. LEWIS

THE three-gang tuning capacitor is mounted on a "floating" plate to eliminate microphony. A cut-out is made in the mains chassis and the capacitor mounting plate (some ½in. larger all round than the cut-out) is fastened beneath it with 4B.A. bolts, using rubber grommets between the plate and the chassis (see Fig. 3).

The capacitor mounting plate is also used to support another plate, and this is cut out to take the sockets for the plug-in coil units (see Fig. 3). Three 6-way Jones-type sockets are fastened to this plate. Precise dimensions for the cut-out are shown in the diagram and must be closely controlled to give satisfactory mating.

Plug-in Coil Units

The plug-in coil units are constructed as shown in Fig. 4. The basis of each is a 4¾in. x 1½in. plate, with cut-outs to the same dimensions as on the socket mounting plate. Three 6-way Jones-type plugs are mounted on each plate and the Denco coil pins soldered to the selected terminals (full details of coil connections are supplied with the coils and the connections on to the Jones plugs are at the discretion of the constructor. However, consideration of the relation between the mounted sockets and orientation of the appropriate valve-holder will soon suggest the best possible coil connections).

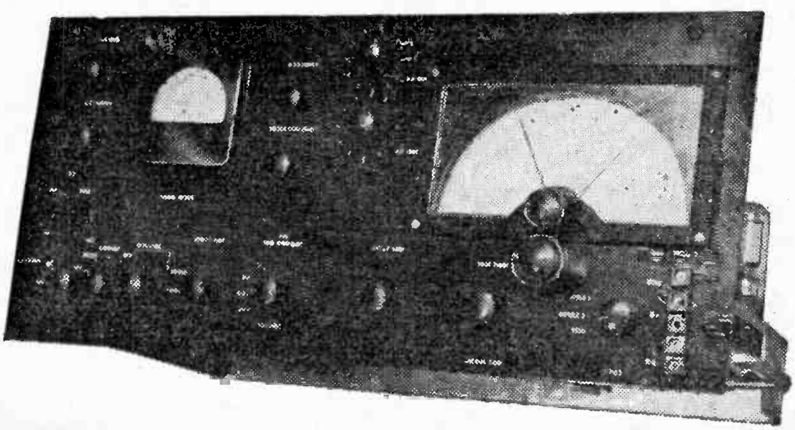
The screening cans supplied with the coils (1 3/16in. diameter) are drilled centrally (¼in. diameter hole) at the bottom to take the threaded portion of the coil former. The cans are fitted over the coils and fit snugly on the bases of the plugs. They are held in position by tightening the OB.A. moulded nuts which fit on to the top of the coil formers.

A stout handle is fitted to each coil so to facilitate entry and extraction via the cut-out in the side of the chassis (and of course, the case).

Front Panel Composition

Layout of the front panel is shown in Fig. 5. Note from the dimensions of the panel previously given that it protrudes approximately ¾in. beyond the main chassis at the sides and bottom to allow insertion into the case.

Note also that the two panel mounted r.f. trimmers are mounted in a small box, since it is



Front view of the finished receiver

essential that they should be screened from all other parts of the receiver and from each other. A roughly formed box constructed from 20s.w.g. tinned copper sheet to the approximate dimensions 3½in. x 1¾in. x 1in. deep and fitted with a centre partition between the two trimmers, serves the purpose adequately.

Enclosing the Receiver

A metal case is essential for good screening of the equipment. The case should be well ventilated and, to allow adequate air flow, should be mounted on rubber legs to raise the underside of the case off bench level.

The loudspeaker can be mounted in a separate case if desired. However, the author found it convenient to fix the loudspeaker inside the roof of the case, using rubber grommets between the two to damp out any resonance.

Wiring-up

All mechanical work (including mounting of valveholders, tag-strips etc.) must be completed before wiring can be commenced. (Note: the mains transformer and smoothing choke, being close together on the top of the chassis, must be orientated so that their fields are at right angles). Ceramic valveholders should be used if possible for V1, V2, V11.

Heater Supply

First connect all heater decoupling capacitors, then wire up the heater chain using twisted P.V.C. covered flex. Wire the heaters in groups (Group 1—V1, V2, V11; Group 2—V3, V4, V5, V6; Group 3—V7, V8, V9, V10; and V12 separately) taking twisted feeders from each group back to the mains transformer. This minimises inter-stage coupling in addition to avoiding overload on the heater wiring, as would occur at the end of one long chain.

Next make connections to the coil input sockets and all IFT's, following this by working along the receiver putting in all other components. Wire components directly across valveholders wherever possible and use adjacent tie-on points on the tag-strips whenever needed to avoid long leads. If these are unavoidable, do not use stiff wire. Stiff long wires are unsatisfactory since they can be made to vibrate; on the other hand stiff short leads are excellent as they cannot vibrate and should in particular be used for connection to the coil input sockets. Wire components directly associated with valveholders within ¼in. of the pins, particularly in the case of grid stopper resistors.

All wiring and components should be as near to chassis level as possible and should follow the

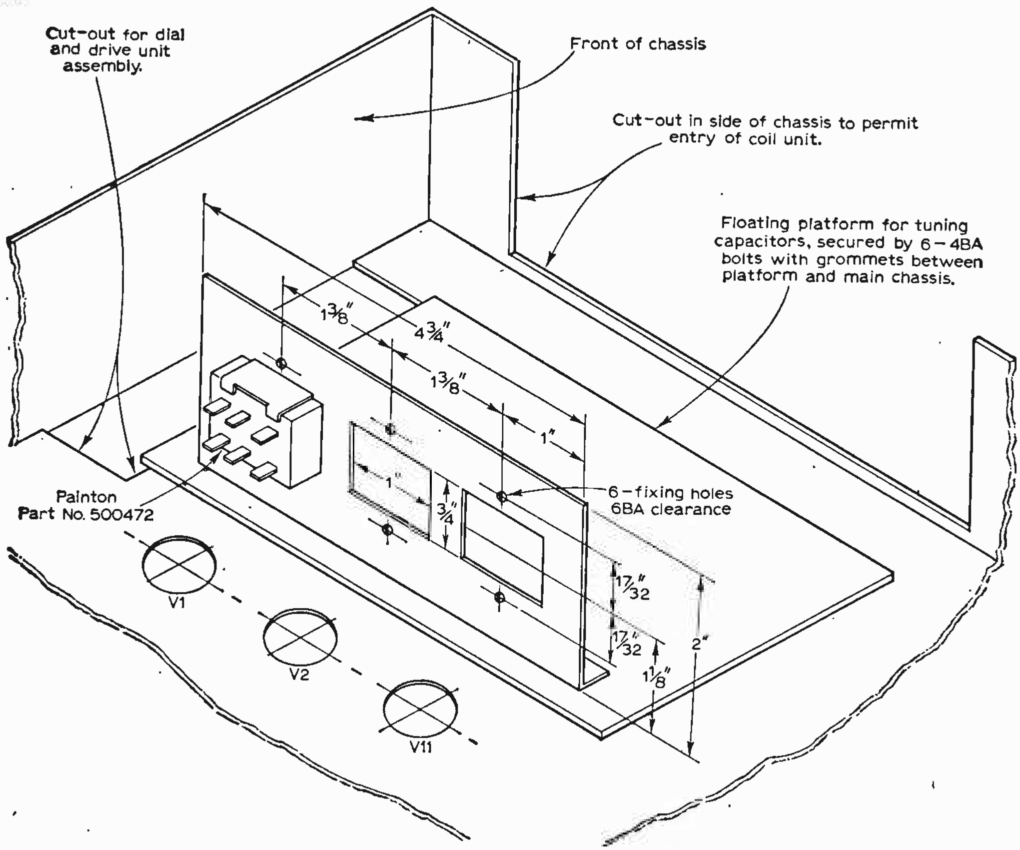


Fig. 3: Capacitor and coil mounting plate details.

COMPONENTS LIST

Resistors:

R1	10Ω
R2	10Ω
R3	200Ω
R4	22kΩ 1W
R5	33kΩ 1W
R6	10kΩ 1W
R7	22kΩ
R8	1kΩ
R9	100Ω
R10	6·8k 1W
R11	100kΩ
R12	33kΩ 2W w-w
R13	1kΩ
R14	68Ω
R15	68k 2W w-w
R16	100kΩ
R17	15kΩ 2W w-w
R18	27kΩ 1W
R19	1kΩ
R20	150Ω
R21	680Ω
R22	10Ω
R23	10kΩ 1W
R24	47kΩ
R25	47k 1W w-w
R26	33kΩ 2W w-w
R27	180Ω
R28	820Ω
R29	68Ω
R30	68kΩ 2W w-w
R31	100kΩ
R32	1MΩ
R33	2·2MΩ
R34	47kΩ 1W
R35	100kΩ
R36	100kΩ
R37	1MΩ
R38	1MΩ
R39	47kΩ
R40	180 kΩ
R41	2·2kΩ
R42	150Ω
R43	680kΩ
R44	4·7kΩ
R45	220Ω $\frac{1}{2}$W
R46	47kΩ
R47	10Ω
R48	4.7kΩ $\frac{1}{2}$W
R49	1MΩ
R50	47kΩ
R51	33kΩ $\frac{1}{2}$W
R52	1·2MΩ
R53	4·7kΩ
R54	220kΩ
R55	2·7kΩ
R56	33kΩ
R57	2·7kΩ

All the above are 10% $\frac{1}{4}$W carbon resistors, except where otherwise stated.

Variable Resistors:

VR1	25 kΩ carbon potentiometer
VR2	1kΩ wire-wound potentiometer
VR3	100Ω wire-wound
VR4	25kΩ carbon potentiometer
VR5	500kΩ carbon potentiometer
VR6	5kΩ wire-wound

Capacitors:

C1	0·001μF paper
C2	470pF mica or ceramic 200V
C3	470pF mica or ceramic 200V
C4	0·1μF paper
C5	0·1μF paper
C6	0·001μF mica or ceramic
C7	470pF mica or ceramic 200V
C8	470pF mica or ceramic 200V
C9	5pF silver mica
C10	0·001μF mica or ceramic
C11	0·001μF mica or ceramic
C12	0·01μF paper
C13	0·1μF paper
C14	0·1μF paper
C15	0·01μF paper
C16	0·01μF paper
C17	0·01μF paper
C18	0·1μF paper
C19	0·01μF paper 200V
C20	0·01μF paper 200V
C21	0·1μF paper
C22	300pF silver mica
C23	100pF silver mica
C24	100pF silver mica
C25	0·01μF paper 150V
C26	0·1μF paper 150V
C27	0·35μF paper 150V
C28	0·75μF paper 150V
C29	0·05μF paper
C30	0·1μF paper
C31	0·01μF paper
C32	0·1μF paper
C33	33pF mica or ceramic
C34	100pF mica or ceramic
C35	100pF mica or ceramic
C36	100pF mica or ceramic
C37	0·001μF mica or ceramic
C38	0·1μF paper
C39	0·001μF mica or ceramic
C40	0·002μF mica or ceramic
C41	0·1μF paper
C42	0·002μF mica or ceramic
C43	0·05μF paper
C44	0·01μF paper
C45	8μF electrolytic 350V
C46	0·1μF paper
C47	50μF electrolytic 12V
C48	0·01μF paper
C49	8μF electrolytic 350V
C50	50μF electrolytic 12V
C51	0·01μF paper
C52	340pF silver mica (Range 3) 960pF silver mica (Range 4) 2,000pF silver mica (Range 5)
C53	150pF silver mica
C54	47pF silver mica
C55	56pF silver mica
C56	470pF mica or ceramic 200V
C57	470pF mica or ceramic 200V
C58	0·1μF paper
C59	140pF mica or ceramic
C60	100pF mica or ceramic
C61	100pF mica or ceramic
C62	See text
C63	0·001μF mica or ceramic 200V
C64	0·1μF paper
C65	16μF electrolytic 450V
C66	32μF electrolytic 450V
C67	8μF electrolytic 350V

All the above are 500V rating, except where otherwise stated.

VC1	50pF air-spaced variable
VC2	300pF } 3-gang variable
VC4	300pF } 3-gang variable
VC6	300pF } 3-gang variable
VC3	50pF air-spaced variable
VC5	50pF air-spaced variable
TC1	30pF concentric trimmer (one per coil-set)
TC2	30pF concentric trimmer

Transformers:

T1	Mains transformer. Normal tapped primary. Secondaries: H.T. 250-0-250V 150mA; L.T. 3·15-0-3·15V 5A
T2	Output Transformer. Primary 5,000Ω. Secondary to suit loudspeaker.
IFT1, 2, 3	I.F. transformer (Denco IFT6/1·6Mc/s)
IFT4, 5	I.F. transformer (Denco IFT11/465kc/s)

Switches:

S1	2-pole, 3-way, ceramic wafer switch
S2	Single-pole, 4-way switch (Minibank C)
S3	3-pole, 4-way switch (Minibank C)
S4	4-pole, 2-way wafer switch
S5	4-pole 2-way wafer switch

Inductors:

L1	Miniature dual-purpose coil (Denco "Blue")
L2	Miniature dual-purpose coil (Denco "Yellow")
L3	Miniature dual-purpose coil (Denco "White")
L4	2·5mH r.f. choke (Denco RFC5)
L5	B.F.O. coil (Denco B.F.O.2/465)
L6	2·5mH r.f. choke (Denco RFC5)
L7	3H choke (low current)
L8	25H choke, 150mA

Valves:

V1	EF95
V2	6BE6
V3	EF93
V4	ECH81
V5	EF93
V6	EB91
V7	12AT7
V8	EB91
V9	EF86
V10	EL84
V11	EF95
V12	EZ81
V13	VR150/40

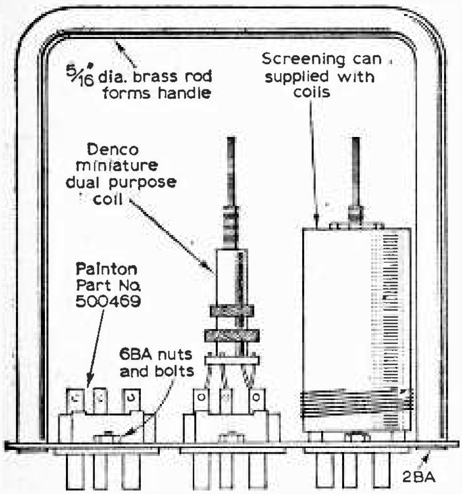


Fig. 4 (above): Side view of the plug-in coil unit.

taken through a ¼in. hole drilled close to V4 holder. Note that connection between triode and heptode on the ECH81 is *not* internal; pins 7 and 9 must be linked externally.

Similarly the signal meter lead from the junction of R27 and R28 is taken through the chassis up to the meter. The resistors associated with the bridge circuit are wired between the meter and the wire-wound potentiometer.

The detector switch S4 should be orientated such that the A and B wipers almost touch the output leads of IFT5.

The r.f. by-pass capacitor serving the a.f. section C48 should be wired directly to the h.t. point feeding V9 and V10.

Do not forget to make a good earth connection of several short stiff wires between the tuning capacitor plate and the main chassis. Also it is essential to earth the coil screening cans. This is most conveniently achieved by drilling the side of each can and then fastening on a solder tag with a 6B.A. bolt. The three cans of each coil set can thus be connected, the link wire then being taken to a spare pin on one of the Jones plugs and earthed via a suitable connection to the mating socket.

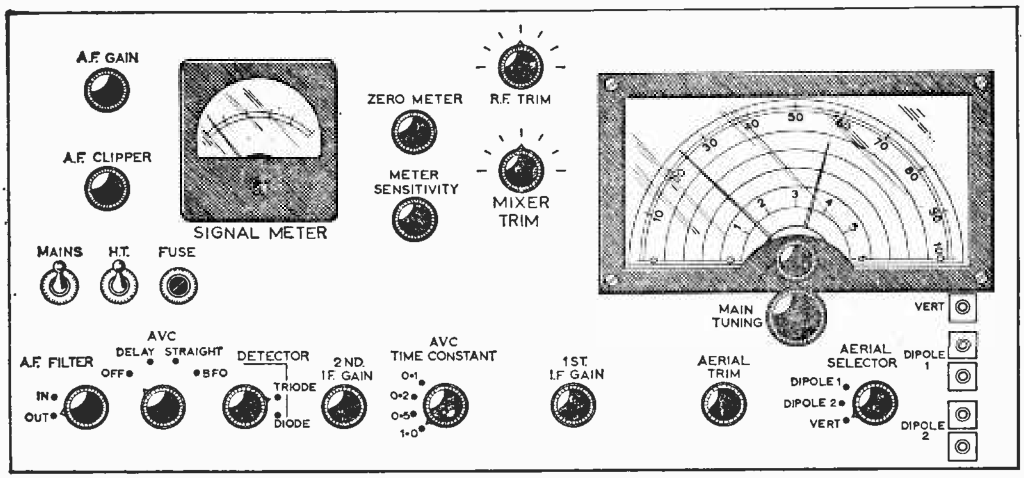


Fig. 5: The front panel layout.

direct line between soldering points. Squared off wiring, whilst looking neater, results in longer leads than necessary.

The grid leads from i.f. transformers should be screened, as of course should long leads associated with the a.f. gain control, as indicated on the circuit diagram. The a.f. choke L7 can be wound on a ferrite core since its current rating is so low. (Mullard Vinkor type LA2503, 2,800 turns of 0·002in. enamelled copper). If, however, a larger choke is used such that it has to be mounted above the chassis, then leads to this should be screened.

The leads from the screening box containing the r.f. trimmers should be low loss coaxial and must be taken as directly as possible to the first and second gangs of the tuning capacitor.

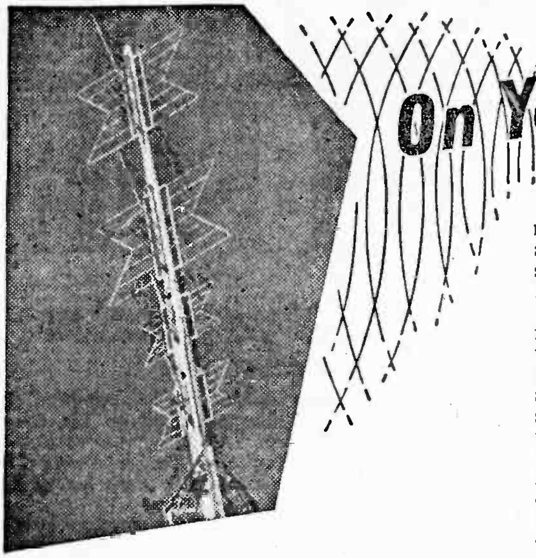
The outer braid of all screened leads should preferably be earthed at either end.

The second oscillator coil L5 is mounted on top of the chassis and connections to it should be

Oscillator Coils

The oscillator coil connections pose one small problem. The anode, earth and grid connections take up three of the six available plug pins. Following the Denco suggestion, the padder leads from the three different coils can be taken to separate pins, enabling the appropriate padding capacitors to be wired on to the corresponding socket pins. However, if it is desired to fit oscillator trimmers (see discussion in paragraph dealing with first mixer stage under Circuit Description), these must be fitted to the individual coil-sets. It is suggested that an earthing tag is fitted underneath the nut retaining the oscillator coil Jones plug. This tag can be wired to the can earthing wire (see above) and the centre connection of a Philips 3·30pF concentric trimmer soldered to it. A lead is taken from the other trimmer connection under the screening can to the grid connection of the coil.

TO BE CONTINUED



On Your Wavelength

By THERMION

SOME time ago I remarked on the need for readers writing to advertisers to make sure that a stamped addressed envelope was enclosed with any query they sent, or to comply in other ways with any requests which were made by the advertiser.

There are one or two other points about postal matters which need emphasising, and one of these may seem almost too good to be true. Twice in recent weeks advertisers have written to say that they have received orders enclosing remittances and elaborate details of requirements, but no address from which the letters had come. Naturally they are unable to forward the goods ordered and paid for, and the readers will no doubt accuse the firm of being slow or failing to meet their advertising offer.

The other point, and one which I feel is just as important, concerns requests which we have published from time to time in our Letters pages, asking for assistance from other readers—in the present case asking for back numbers. Several readers have written to say that they wrote to these enquirers, stating that they had certain of the issues available (in some cases offering them free of charge) and they did not hear anything from the enquirers, not even a postcard expressing thanks for the offer and saying that they had obtained the information or copies from some other source.

These complaints seem very justified, as the readers went to the trouble of replying to the request and even, as stated above, in some cases offering them free of charge, and one would have expected at least a word of thanks. So come along readers, try and tighten up these postal courtesies and avoid giving our readers a bad name.

Transistor Oscillators

There still seems to be a very keen interest in electronic musical instruments and I have had a few letters lately asking what transistorised electronic organs are now available. They are being made, of course, and as mentioned previously they are on the market in other countries and I understand that there will very shortly be one on the English market, made by an English firm.

I refer, of course, to the full polyphonic type of instrument, not a single keyboard unit. There is very little difficulty in designing one of these instruments, except so far as concerns the power and the tone changer circuits. The oscillator is a simple arrangement and for anyone who is anxious to try this all that is needed is a resistor from base to battery positive and another resistor (approximately 10 times as great) between positive and emitter. The collector goes through another resistor to battery negative, and a capacitor between emitter and collector completes the circuit of the oscillator, taking the signal through a capacitor from the emitter.

For really good musical results, more elaborate arrangements are, of course, desirable, and it is possible to use these cheap components in a frequency dividing unit where a single transistor can deliver four or five notes (monophonic instrument), but I have not been able to obtain a very wide range of notes from a single transistor of the type mentioned above without running into difficulty.

More Tips

I have received quite a host of hints and tips since I started mentioning these, and some of them are good, but the majority are more or less either well-known or hopeless. One often finds a simple way of doing some job which one thinks might interest others, but this is probably the only occasion when the particular idea can be used and it is not what might be called of "general interest".

Here, however, are two simple ideas which undoubtedly will find application at some time or another in every ham "den". Firstly, the foil which is on sale in the popular stores for use in the kitchen is, in most instances, actual sheet aluminium and as such it can be used for screening—in some cases permanently.

A small piece may be wrapped round a glass valve, trapping as it is wrapped a piece of bared wire, and forms an adequate and effective screen for test purposes. It may also be laid on a piece of wood and held in place by components to form an improvised chassis—and is much cheaper. It may also be cut into narrow strips and wrapped round covered wires or leads to provide quite an effective screened cable.

Doubtless many other ideas for using this material will occur, and being actual metallic sheet it can be used in place of metallic paint which is normally useless for screening as it consists of metallic powder in a medium which, when it dries leaves the grains of metal effectively insulated. This can be proved by testing with an ohm-meter.

CONCRETE SPEAKER ENCLOSURE

BY E. ROWEN

FOR the past 12 years I have been building amplifiers and loudspeaker cabinets in search of good sound reproduction in the home, and although this in itself is not unusual, I find that the experience gained has led me to some pretty definite conclusions, the primary one concerning the weakest link in the chain—the loudspeaker.

Nowadays you have only to thumb through any hi-fi or electronics magazine to find out that you can get true bass without boom, true treble without tizz and true middle without muddle in cabinets ranging from a square-shaped cubic foot to an elongated grandfather clock you can hang on the wall.

In the past decade I have constructed cabinets of all sizes and shapes using many kinds of materials and mathematical formulae, and I have found only one cabinet capable of giving true boomless bass. In my house now I have a concrete column, and a wooden column, and I have made reflex cabinets, sandfilled baffles, labyrinth boxes and many other types of " perfect " enclosures.

Many of these produced excellent treble, but the two pre-requisites of natural bass without loss of power are size and solidity and I maintain that only a concrete or brick enclosure will give you these.

For those readers who have not visited scores of homes and listened to hundreds of loudspeakers in cabinets ranging from beer-barrels to flower-pots; for those who have not spent scores of hours every year in plush showrooms listening to every conceivable type of unit dreamt up by imaginative but slightly-deaf draughtsmen, let me categorically and at once state that it is extremely difficult to compare two or more loudspeakers together for performance, even with instantaneous switching.

It is impossible to carry these loudspeaker sounds in your head to compare with your own loudspeakers when you get home. It is difficult in a showroom with switching facilities because no two loudspeaker units are the same, even from the same manufacturer, and I have known friends who have bought units after hearing the same type in the showroom to be bitterly disappointed when they fitted the unit in a similar cabinet at home. The results are often more like P.A. than hi-fi.

Furthermore, many cabinets are designed to suit only one type of unit, and this is annoying when a person acquires a second-hand loudspeaker—few people can afford to buy a new loudspeaker every time they want a change—and I have found from experience that the only loudspeaker cabinet that will give a full natural range with *any* 12in. loudspeaker is the 9 cubic ft corner cabinet.

MERITS OF THE DESIGN

Yes, the design is not new and it is not mine. It is exactly the same as that described by Mr. Briggs of Wharfedale Wireless Works, but my version of the design has some important constructional ideas which will save the constructor some £30-£40 in cost!

To encourage readers who will at once say that 9cu. ft is too large for modern homes, may I for a moment put forward a few arguments in favour of the large cabinet?

Firstly, you cannot alter fundamental mathematics on air-loading, and for true bass you must have the requisite space. You will go on for years experimenting and wasting money to find the ultimate, and you will fail without the size and the rigidity. If you can produce true bass in tiny spaces, why don't they make 'cellos as small as violins?

Secondly, with regard to space, you will find that often the corners of a room are unused and a cabinet filling this space would be materially useful.

Thirdly, although Mr. Briggs may have designed this cabinet primarily for Wharfedale units I have tried with equal success in my cabinets units by Wharfedale, Vitavox, Duode and Goodman's and I am sure other good 12in. and 15in. units would satisfy. And, of course, your 8in. unit will sound proportionately better.

Fourthly, and perhaps most important, the concrete cabinet described requires no skill to make, costs only a few shillings, and can be made in a few hours, excepting the time allowed for the concrete to dry. It has the one advantage over the wonderful brick enclosure in that it is portable.

This article is non-technical, but I should like to mention that although the school in which I now teach has no hi-fi equipment, in my previous home town all our new schools were equipped with 9cu. ft brick enclosures in the main halls, fitted exclusively with Wharfedale 15in. whoofers and other Wharfedale units, and in *every* case the sound reproduction was superb. We used, of course, complementary amplifiers and equipment.

BUILDING THE FRAMEWORK

Now for the details of this cheap ultimate in loudspeaker cabinets. and let me say at once that if you don't like cutting wood you can get all this cut and shaped at any builder's yard or Do-it-yourself shop; so that all you have to do is to screw it together.

Cut the lengths of softwood as shown in the

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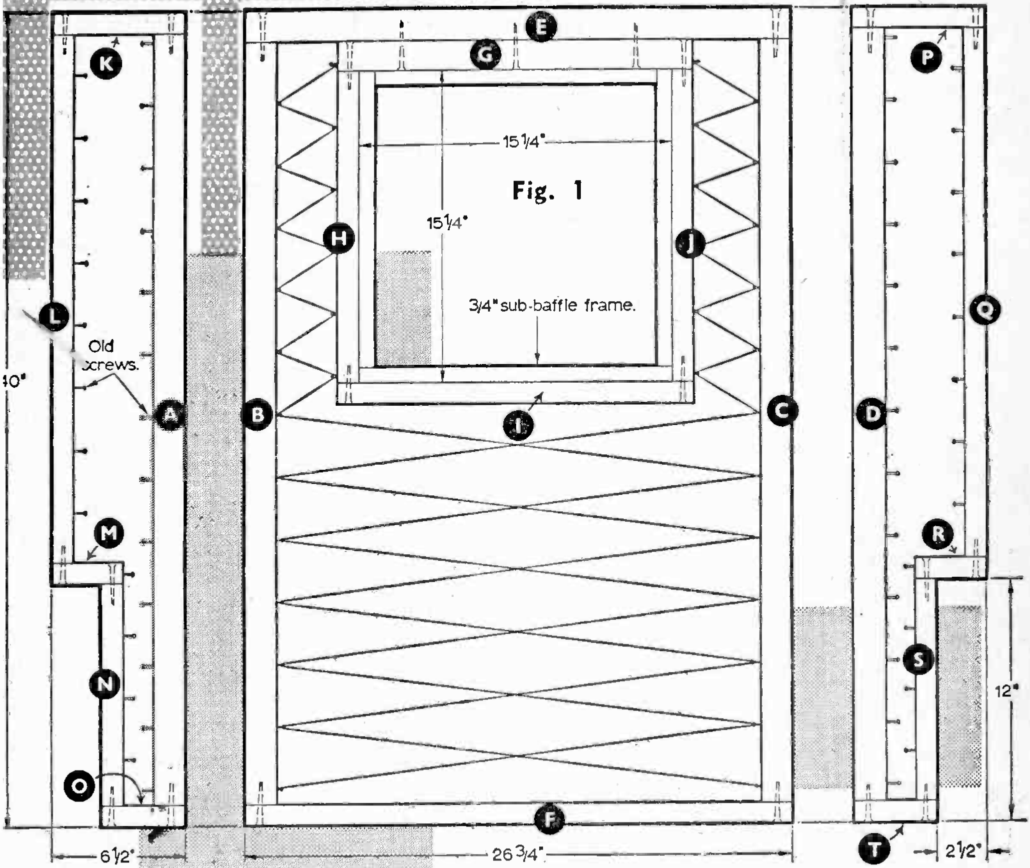

Fig. 1

CUTTING LIST

Lid on top battens; size according to position in room.

All 1in. x 1½in.	2 off	6½in. long	K & P
	2 off	3½in. long	M & R
	2 off	4 in. long	O & T
	2 off	26 in. long	L & Q
	2 off	12 in. long	N & S
	1 off	26¾in. long	F
	1 off	17¼in. long	I
	2 off	15¼in. long	H & J
	1 off	24 in. long	Wall battens
	1 off	23 in. long	Wall battens
	2 off	38 in. long	A & D
	2 off	37½in. long	B & C
	1 off	26¾in. long	E
	1 off	17¼in. long	G

Approx. 1 gross screws and 30 feet galvanised wire

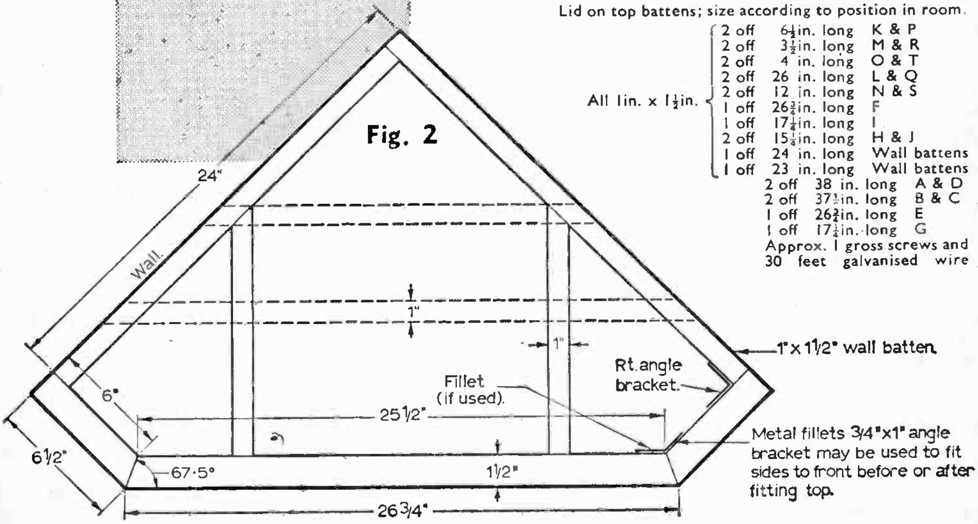

Fig. 2

cutting list, and if you have not had this done at the shop, plane down the chamfered pieces A, B, C and D with a plane or Surform tool. Remember that pieces K, O, E, F, P, T must also be cut at the ends to fit, but this is an easy matter when A, B, C and D are cut. All pieces are butt jointed, though you can make any joint you like.

Drill holes to take 2in.—2½in. screws right through the points shown in Fig. 1, but before you glue the pieces together find all the old screws you have always wanted a use for and screw them at 3in. intervals on the inside faces of the wood as indicated in the drawing. You have no need to be exact about this, and I found that screws are better than cup-hooks. If you have no screws buy a gross of 1½in. or 1¾in. 8's or 10's at a cost of about 4s. 6d.

This done, put contact glue on all joints and screw and glue together. You can do this easily if you lay each frame on the table or floor and press against the wall or skirting board. If the ends have been cut true the whole thing will be true, but if you have clamps use them. Screw together the loudspeaker frame G, H, I and J and screw this through G, to the top member E.

Now tie galvanised wire, obtainable at any ironmonger, 16 gauge or thereabouts to the screws and stretch across the main frame as shown in Fig. 1. Keep this taut if possible—you can use pliers to do this—and if the frame is not square, tighten or loosen the screws accordingly and the wire will square the frame for you. No wire is needed in the side pieces as the screws will hold the concrete to the frame.

MIXING THE CONCRETE

The next stage is even more simple. Buy one cubic foot of *sharp* sand and ½ bag of cement—you won't need all this but these are about the smallest amounts you can buy—from a builders' merchant (total cost 3s. 6d.) and mix on a board or concrete floor three spadefuls of sand and one spadeful of cement. Turn over at least four times.

Lay the frames on a *flat* surface and use a base of hardboard, if you have it, smooth side inwards. You need not grease this. With moderate care you can fill the frames inside the house, say on the front-room floor. Put newspapers down first.

When the frame is in position pour a kettleful of warm water into a hole you have made in the top of your little mountain of sand and cement and mix in from the outside. You may need another kettleful or more, depending on how wet your sharp sand is, but don't overdo the wetness. The drier the better with the right mixing consistency.

When the sand, cement and water are in a damp, mixable state, shovel the mixture carefully into the frames, or if you work in the house use a bucket to carry the stuff in. Don't rush, you have an hour or so to get it right.

After you have got the concrete roughly level with the top of the frames, obtain a wooden straight edge about 1 in. thick which will span the large frame and bang this up and down on the frame at the same time as you move it along to cover the whole of the concreted areas.

This presses the mixture into the corners and you finish off with a sawing movement. Leave about four days and if you can put up with the small amount of mess you will find the area much easier to clean when the cement is hard. Wash the bucket and spade at once, of course.

ASSEMBLING THE CABINET

Again, no skill is needed to put the frame together. Plug the two wall battens to the wall at the correct height and place the end pieces against this and fix at the top with two ordinary angle brackets. The unit will stand all right, if you do not want screws in your skirting board. Before you fit the front, make the top.

This top, obviously, can be made in a similar way with concrete, but you can use any inch-thick timber or chipboard. In case the walls are not true, make a paper or cardboard template and get the wood shop to cut to size. Overlap at front and sides about half-an-inch.

An easy and secure way to fix the top is to fix to battens 1in. x 1½in. running north to south, as shown on the drawing, and at right angles to them screw one or two battens on to the first battens so that the ends fit under the wall battens, as shown dotted in Fig. 2. Screw the bottom battens to the wall battens.

Before you fit the front, place the top into position and draw a line along the inside of top members E, K and P; remove, screw two more angle brackets to the line. Replace top, put your head through the hole in the frame and screw the two angle brackets to front member E.

Finally, fit a ¾in. frame to go inside the 15½in. hole to take a sub-baffle to fit the size of your loudspeaker. Bolt your loudspeaker to the baffle and screw to the ¾in. frame.

Other ways of fixing the loudspeaker cabinet together will suggest themselves to many readers, but an excellent way of finishing the job off is to make a simple ½in. wooden frame to the size of the cabinet, cover this with the same material as your curtains and press this frame under the overlapping top and above a skirting board or plinth board you can put around the bottom of the cabinet.

Another way is to cover the front in veneered hardboard, or simply in veneer if your concrete is smooth enough. A more refined way, perhaps, would be to make the main frame, before concreting, in walnut or sapele hardwood, and fit hardboard *inside* the frame.

When concreted this would leave a ¼in. recess which could be filled with walnut or sapele-faced veneered hardboard, thus simulating hardwood throughout. No lagging is needed in the cabinet.

You can live with this loudspeaker. No boom, no panel resonance, no coloration—you will never get tired of the superb bass. If you want more top—the modern craze—fit a tweeter to a thin frame the same shape as the cabinet.

Now forget your loudspeaker troubles and without fear compare your results with any outfit costing £100 or more. For those who must have stereo use a wooden or concrete column of any good design and mount this on castors as you are sure to find that your ears will not respond as they should, and you can wheel this cabinet about while you search for the best place to sit. ■

by G.M. and E.C.D.

semiconductors

TALKING POINTS ON CIRCUIT PRACTICE

No. 5—R.F. Operation of Transistors

Continued from page 62 of the May issue

THE consideration of transistors in r.f. applications, which includes their use as radio receiver "front-ends", brings us up against some factors we have not met before as well as some new effects of factors we have already dealt with.

A general discussion of some of the problems we are likely to meet, might be as well, before we start considering them in detail.

We shall want to use our transistors as a means of amplifying signals from an aerial, at reasonably high frequency, and then demodulating them to serve as the input to an audio amplifier.

The probability will be that our aerial will be of the Ferroxcube type, sensitive enough but highly critical and—compared with a normal outdoor type of aerial of course—unlikely to provide signals of any very great amplitude for us to start with, unless we are right underneath a transmitter.

It might also be as well then, if we start at the end, as it were, and deal with the demodulator, or rectifier as it is more usually termed, first.

First of all, as a transistor is not the best means of obtaining demodulation, our "rectifier" will doubtless be a diode. This fact in itself will impose some restrictions. Let us consider then the semiconductor diode.

CRYSTAL DIODES

Semiconductors, or crystal diodes are very heat-sensitive and should *never* be soldered without the use of a heat shunt of one sort or another. Nor are they perfect rectifiers since they do pass a small value of *reverse* current. But the fact which will concern us most here is their *resistance*.

Diodes of the crystal-type possess the peculiarity that they offer a considerable resistance in the *forward* direction, though of course very much less than their resistance in the reverse direction. This forward resistance reduces rapidly to an almost negligible value once current commences to flow—but initially it is definitely there and has to be taken into account, in fact there is a voltage drop across a diode even in the forward direction.

This is due to a certain phenomenon termed "hole-storage" but we need not concern ourselves with that, except to appreciate that it exists and that it lasts for a definite, if microscopic period of time from the moment current begins to flow to the moment the resistance reduces to its lowest value . . . known as the "recovery period". There is also an effect when current *ceases* to flow, which maintains an apparent current when the real current has stopped, again for a certain period of time. These periods of time are microscopic . . . but so are the time periods involved in the rectification of h.f. pulses or signals.

This initial high resistance of the semiconductor diode in the forward direction plus the time taken to overcome it does in effect mean that the diode is not a perfect rectifier of small currents, or currents which last only a microscopic period of time.

STANDING BIASING CURRENT

Conventionally the means adopted to get over this little trouble is to give the diode a *standing* current of a sufficient value to take it over its resistance "hill" into the area of low resistance the other side and maintain it there regardless of signal currents; when it becomes an efficient rectifier passing current easily in the one direction compared to an almost complete (though not quite) barrier in the opposite direction. Biased in this way it will pass either the negative side of an a.c. wave, or the positive side, according to which way it is connected of course, without any initial delay necessitated by breaking down its initial high resistance.

Failing such a standing biasing current—which is not always easy to achieve in the circuitry, the diode requires a certain strength of signal applied to it, then, if it is to be a good demodulator. Which infers several stages of r.f. amplification in front of it, because the signal obtained from the aerial in a normal transistor set will not be of very massive amplitude in the first case.

Now we come across quite a variety of what may be termed "trick" circuits, which attempt to get useful results out of a single transistor and a diode . . . and we have already seen that a semiconductor diode requires a robust signal.

CLASSICAL T.R.F. CIRCUITS

Most of these "economy" circuits stem from old-time "single-valve" circuits which rendered yeoman service in the old days. To mention but a few, we had the Armstrong super-regenerative circuit—in which a single valve was made to operate *over* the threshold of oscillation so offering no damping whatever to the aerial circuits, and by suitable selection of grid-leak and other component values the internal heterodyne, if any, was kept above audible limits so not interfering with reception. This type of circuit is known now as a "Quench" circuit.

Then there was the "Scott-Taggart 100"; we believe the first successfully to use a single valve first as an amplifier at radio frequencies, and then by feeding the rectified audio signal back through it, again as an amplifier at audio frequencies. This we now know as the "Reflex" circuit.

REACTION CIRCUIT

And, of course, the daddy of them all; the single-valve "Reaction" circuit whereby the stage is kept just short of the oscillation point by means of a variable positive feed-back . . . a circuit capable of amazing results since the damping on the aerial system was almost zero. All these circuits have come into fashion again, with the birth of transistors. Let us examine why they do not give anything like the same results as they did with valves. There is more than one reason.

The old regenerative receivers were fashionable in the days of *air-cored,* solenoid coils; they went out of fashion when dust-cores came in. Those of our readers who understand the principles of inductance, especially self-inductance, will know that changes in the secondary are reflected *back* into the primary, and will have no difficulty in appreciating that in a practical sense the coupling between the aerial inductance and the "reaction" coils in these receivers was quite a tricky problem. There was an optimum coupling; if coupling was too tight you defeated you own ends, and if it was made even tighter, then the "reaction" capacitor tuned the aerial; also the entire set-up depended to a great extent upon the actual anode voltage used . . . the lower the better, in fact, if you wanted "smooth" control.

This in fact follows from the theory of inductance!

With solenoid air-cored coils regeneration was a practicable procedure.

DIFFICULTIES OF APPLYING REACTION

With the coming of iron-cores usable at radio frequencies the situation altered drastically; the greatly increased number of lines of linkage made it extremely difficult to apply reaction to a dust-cored coil—which was probably pile-wound tightly on a secondary, anyhow—and retain any sort of control over it over a wide range of frequencies, though it was not impossible if only a single channel reception was concerned.

Pulling of the aerial circuit by the reflex circuit became difficult to avoid, the optimum coupling almost impossible to achieve in practice: and the whole set-up was more likely to "damp" the aerial system than undamp it.

It is equally difficult to adapt "reaction" to the modern Ferroxcube aerial, with its tightly wound primary and secondary aerial coils.

A further consideration lies in the fact that the early reflex receivers made use of what was then known as "leaky-grid" detection . . . a method difficult to describe in simple terms but which gave very great magnification on the grid of the valve itself by causing the incoming signal to charge a capacitor in the grid circuit so that the potential of the capacitor—accumulating with successive trains of incoming waves—moved the grid cumulatively so as to cause almost a cut-off in anode current before the charge was able to leak away (via the grid-leak). A time-constant of C and R is involved in this procedure, which was possible with a valve, whose input impedance was of the order of many thousands of ohms, but which has not yet been achieved successfully with the transistor whose input impedance is somewhere only about 50 ohms. A moment's consideration will show that whatever value of resistor one put in as a "grid-leak" (or baseleak), it would reduce it to 50Ω, due to the base-emitter path in parallel with it. This additional amplification . . . and it was "many times", is therefore not very practicable with transistors up to now.

There is furthermore the consideration that reflex or no reflex we just have not got a high enough impedance in the input of a transistor to enable us to develop any real work across it—these old-time circuits depended upon *voltage* variations, whereas what we have to feed a transistor with is *current* changes.

The potentials in our aerial, being waveform potentials, will be voltages; with the transistor we have to convert them to current changes . . . without a high impedance across which to achieve that conversion.

REFLEX CIRCUIT

The third form of circuit, the reflex, whereby the audio signal is brought back and fed through the first stage with the r.f. signal, so that the first stage operates at both radio and audio frequency, *is* more successful. It kills two birds with one stone in that it not only provides us with a stage of audio-amplification without using another transistor to do it, but by feeding the rectified audio signal—which is frequency modulated *d.c.*—back to the input and passing it, amplified now, through the diode again it provides the diode with a steady d.c. bias of a considerable amplitude and thus holds it well over in its region of low resistance so that the r.f. signals which it receives at the same time are dealt with under the best conditions. It is usually combined with a form of regenerative circuit as well . . . but still suffers from the regenerative difficulties already mentioned.

Regeneration, therefore, is a tricky problem with transistors; though it *can* be done: preferably by obtaining the feedback in such a way that it does not influence the input directly—cathode (emitter) injection, for instance. But we are still left with the problem of insufficient impedance in the device itself to do any real work over.

Recognising the limitations imposed upon us by the low values of impedance associated with transistors; recognising also the limitations imposed upon regenerative procedures by the same factor and also by the problems associated with modern dust-cored coils with their high values of inductance, let us now consider some further factors associated with transistors in r.f. applications.

We know that transistors can now be bought which will operate up to far higher frequencies than we are likely to want . . . the OC170 for instance; so that presents no problem. We know also that their alpha dash, or gain, varies according to frequency. *But* the transistor has a peculiarity which is not found in valves. Owing to the fact that it is a crystal, conduction is through a solid. There is in fact a resistance path between the input and output circuits of a transistor, and there is also a capacitative path . . . which must of necessity mean that changes in the input will effect the output, *and* changes in the output will be fed back to the input side. Also, since there is capacity associated with this internal feedback path, the value of the feedback will vary with frequency.

As anything on the collector of a transistor is out of phase with anything on the base the internal feedback must be negative and must take the form of unwanted signals appearing on the input side by reflection from the output side.

NEUTRALISATION

It is normal to cancel out this unwanted feedback by providing a deliberate external feedback of the same magnitude but opposite phase — the procedure being known as neutralisation or unilateralisation. Which is much the same in fact as "reaction" or "regeneration" which is the same thing. It involves, since collector and base are out of phase, reversing the phase of the feedback, since we want a positive feedback to cancel the internal negative feedback.

We have seen that the internal feedback values depend on frequency. These values can be calculated fairly easily for a single frequency—we will go into this in a moment. To calculate them for all frequencies, i.e. all the frequencies in the broadcast band to which a receiver may be tunable, is a different matter, since they would be varying all the time.

If we are going to use a reflext circuit, with several stages of t.r.f., and a regenerative circuit, we would at once be up against the necessity for calculating what the value of internal feedback in the transistor would be at all the frequencies we might be likely to tune it to. And then to calculate the necessary values of external feedback at all these frequencies in order to cancel it.

THE SUPERHET

Which brings us to the "preferred" r.f. circuit, and also to the reasons why it is the preferred circuit.

We have considered the difficulties. Now let us consider how they look to a superheterodyne circuit . . . which is the preferred circuit.

To begin with, we postulated a highly undamped aerial circuit; an oscillator for the first stage achieves this. Next, we postulated a degree of regeneration which shall not "pull" the input tuning; an oscillator looped back to its emitter will give us this. Next, we called for several stages of amplification before the diode, this we can obtain by a couple of stages of i.f. which being periodic tuned we will not need to tune and can therefore neutralise for one frequency only. Finally, we want a robust signal to drive the diode over the hill into its low resistance area . . . the output from the local oscillator added to the signal achieves this. And finally since the i.f.'s will be transformer coupled we can reverse the phase of our neutralising feedback simply by taking it from the secondary of the transformer instead of the collector.

Thus the superheterodyne circuit solves most of our problems without any trouble to ourselves.

And since it involves inter-stage transformer coupling it solves another problem also, that of stepping down the output of one stage to drive the base of the following stage . . . all that is necessary it to make the coupling transformers of the correct step-down ratio—probably somewhere round 6:1.

With transistors, the apparently difficult is in fact the easiest. A five or six stage superhet is likely to be easier to build than either a "One-stager", "Reflex-regenerative", t.r.f.—or any other what-have-you! In addition to which, it will probably work—which is more than one can say about the others. For the reasons we have shown, we hope!

SERIES CONTINUED NEXT MONTH

"TEST GEAR TECHNIQUES"

We are sorry that Part 5 of this series has been held over until the July issue, due to the indisposition of the author.

Morse Practice OSCILLATOR

By GRAHAME MEACHEN

RECENTLY the writer was asked to build an audio oscillator for Morse practice that had sufficient volume to be heard by several people in a busy clubroom. Needless to say, it also had to be cheap and portable.

AN EXPERIMENTAL CIRCUIT

An experimental oscillator, using the circuit of Fig. 1 and a standard moving-iron earpiece, proved to be suitable only for a fairly quiet room, and something with more power was needed. However, a search of the available components produced nothing more than surplus " red-spot " audio transistors, and it was decided to see how much output could be squeezed out of these, before trying more expensive ideas.

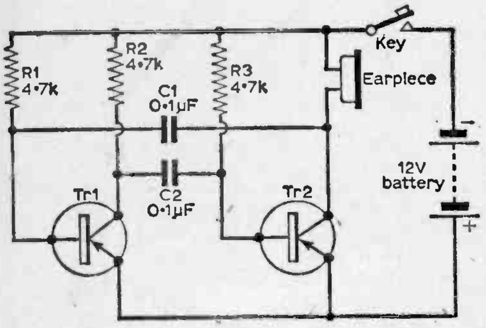

Fig. 1: The experimental circuit first used by the author.

HIGH OUTPUT CIRCUIT

The circuit of Fig. 2 was eventually determined by trial and error and the surprisingly high output turned out to be too loud for use at home, though ideal for the club; a simple switched volume control, as shown, was therefore added. This also had the effect of altering the frequency of the oscillator, but for Morse practice this was not undesirable.

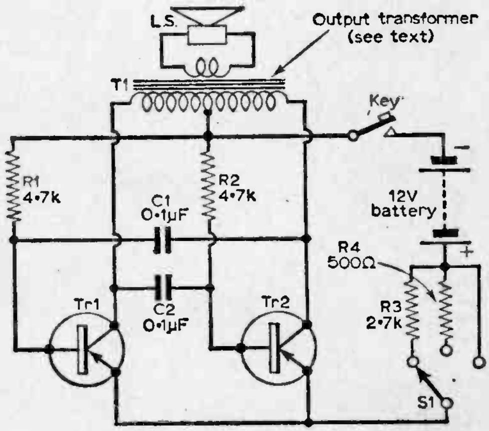

Fig. 2: A higher output oscillator.

The transformer can be any multi-ratio audio output transformer, with taps in the primary. The one actually used came out of a set nearly as old as the writer! The taps selected depend on the frequency required, and can only be found by experiment, as even transformers from the same source can give different results.

The loudspeaker used was a standard 3Ω 5in. p.m. moving coil, but any standard loudspeaker would suit. The actual circuit was built on 1½in. of 1½in. wide tagboard, which was taped to the output transformer. The batteries were two 6V PP1's, which had been taken out of a transistor superhet; they proved to have ample life remaining for this application.

In the writer's case, all the components, batteries and loudspeaker were built into a cabinet 8in. x 3in. x 5in. which was covered with rexine, but this depends entirely upon the builder's requirements. ■

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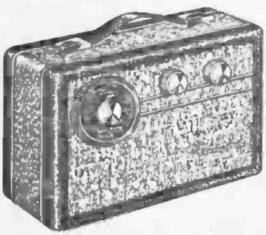

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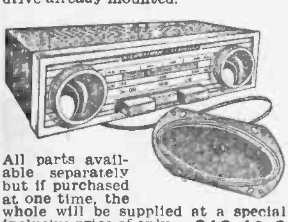

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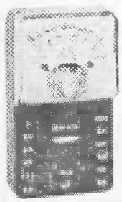

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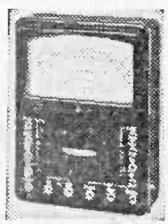

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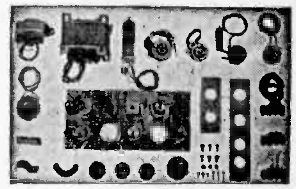

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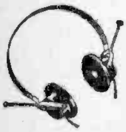

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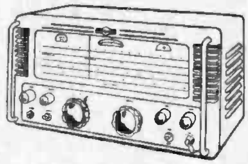

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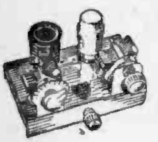

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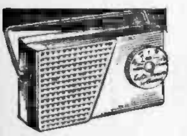

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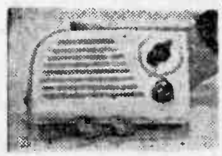

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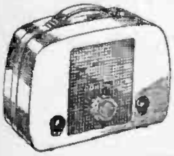

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ALL-BAND transmitting AND receiving AERIALS

BY R. F. GRAHAM

IN many circumstances it is convenient to have a single aerial which can be used on any of the amateur bands from 3.5—28Mc/s. The aerials described here are of this type, and though primarily intended for use with a transmitter, can give very good results when receiving, so will be of interest to short-wave listeners who are anxious to obtain long distance reception.

Some of the aerials are particularly intended for the 3·5, 7, 14, 21 and 28Mc/s amateur bands, though they will generally do very well for 19, 25, 31m, and other broadcast bands.

Using aerials of the type described here, the author established two-way communication with very distant stations, including amateurs in Australia and New Zealand. For these tests, a 120W transmitter was used, with 60W modulator (e.g., the usual type of a.m. speech rig). If c.w. were employed, or single-sideband, long distance communication ability would be increased.

Similar materials may be used for the construction of any of the aerials. Enamelled, hard drawn 14s.w.g. or similar single strand copper wire is suitable. Wire of several strands, such as 7/26, has also been employed, as has hard drawn copper wire. Enamelled wire is probably best, to avoid surface oxidisation.

For suspension, thin cord may be used. Very tough plastic line is also available, and does well. One or two insulators should be provided at each end of the aerial, and 4in. or similar ribbed glass or Pyrex insulators are especially suitable.

End-Fed Aerials

This simple type of aerial is shown in Fig. 1. Top and down-lead can usually be a single, uncut length of wire. The total length (top plus down-lead) can be chosen so that the aerial is approximately a half-wave, or multiple of half-waves, on each band. The feed point is then high impedance.

For this type of operation, 138ft may be used. This is approximately a half-wave on 3·5Mc/s, two half-waves on 7Mc/s, four half-waves on 14Mc/s, six half-waves on 21Mc/s, and eight half-waves on 28Mc/s.

If 1·8Mc/s operation is required, the length is near a quarter-wave and thus low impedance. The aerial is then used as a "Marconi", tuned against ground.

If 138ft cannot be erected, half this length will provide a half-wave on 7Mc/s, two half-waves on 14Mc/s etc. The feed point is high impedance on these bands, but low impedance on 3·5Mc/s. In other words, it is a Marconi on that band where it is near a quarter-wave, but a high-impedance aerial ("Hertz") on bands where it is a half-wave, or multiple of half-waves.

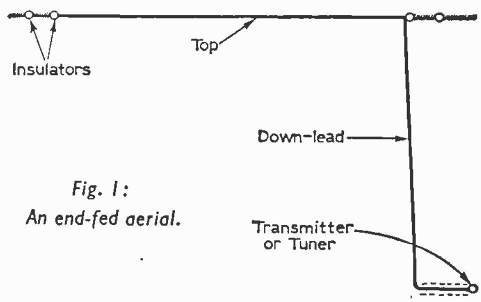


Fig. 1: An end-fed aerial.

When the feed point impedance of the aerial falls within the range of impedances available by adjustment of the transmitter, it is possible to operate directly into the aerial. Otherwise, an aerial tuner is required. In general, the tuner is preferable, as it provides harmonic suppression.

For receiving, the aerial may be taken directly to a high impedance aerial terminal. Or a tuner may be used, with feeder to the receiver, especially if the latter has a low impedance input. Such a tuner is exactly the same as described for transmitting, except that a wide-spaced tuning capacitor is not required. For best possible reception, the tuner is almost essential.

Zepp

This type of aerial is shown in Fig. 2. Feeder A is joined to the top (aerial). Feeder B terminates at the insulator, level with feeder A. A tuner is required. The top is approximately a half-wave, or multiple of half-waves, on the required bands. For 3·5—28Mc/s, 137ft is suitable.

The feeder can be made from 14s.w.g. wire, or 7/26 or similar stranded wire, which is easier to pull straight. Ceramic spacers hold the feeder

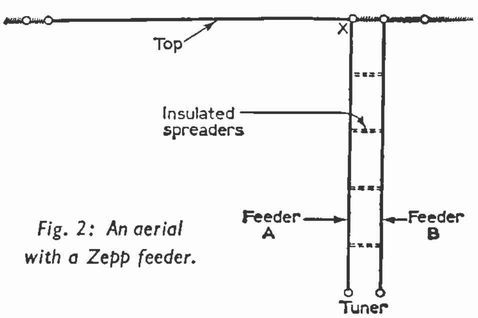


Fig. 2: An aerial with a Zepp feeder.

wires about 4-6in. apart. The spacers may be purchased or may be cut from insulating material, such as Perspex. Sufficient spacers are used to obtain reasonably uniform spacing between the wires—that is, at least one spacer for each 3ft.

The point X is high impedance on all bands. Therefore the impendance at the tuner end of the feeder will be high impedance when the feeder length is a half-wave, or multiple of half-waves. When the feeder length is near a quarter-wave, or *odd* number of quarter-waves, the end impedance will be low. For example, a 68ft feeder will present a high impedance on 7, 14 and 28Mc/s, but low impedance on 3·5Mc/s. Intermediate lengths of feeder will present a range of impedances, but it is generally possible to match to these, with an aerial tuner.

There is some radiation from the Zepp feeder, which is not balanced, but radiation here is less than with the down-lead of the end-fed aerial. This point may be important, if interference is being caused to TV broadcast receivers nearby.

And end-fed or Zepp aerial can frequently be erected with the near suspension cord attached to a high point on the house, so that only one other support is required. Builders' merchants can usually supply flagpoles and ladder-poles, which may be attached to a 4in. x 4in. or other stout vertical post, using $\frac{5}{16}$in. bolts.

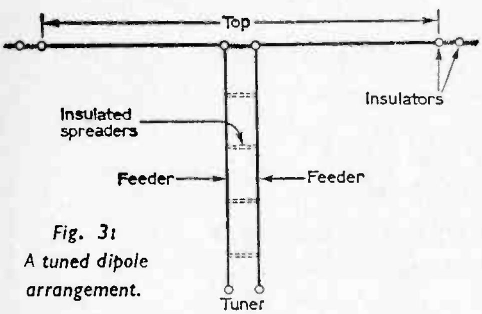


Fig. 3: A tuned dipole arrangement.

Tuned Dipole

This useful type of aerial is shown in Fig. 3. The feeder is made as for the Zepp, and the top length is generally a half-wave at the lowest operating frequency. A typical length for 3·5 to 28Mc/s is 136ft. For 7-28Mc/s 65ft can be used.

The aerial tuner is essential, and the impedance encountered at the tuner end of the feeder depends on the top length, feeder length, and operating frequency. If the top is a half-wave, its centre is low impedance. If the feeder is a quarter-wave long at this frequency, the tuner end will be high impedance. If the feeder length is a half-wave, or multiple of half-waves, the tuner end impedance will be similar to that of the centre of the aerial. A 136ft top with 68ft feeder will thus give high impedance at the tuner.

A dipole of this type can be tuned to resonance on many frequencies, if a suitably tapped coil is employed in the tuner, and can work well on many bands. For the same reason, lengths other than those found by calculation will perform well on the amateur bands. Considerable modification to

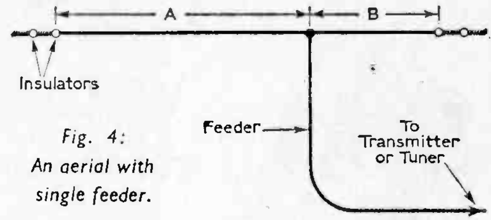


Fig. 4: An aerial with single feeder.

the top length is thus possible, to suit available space or supports.

Single Feeder Aerial

This type of aerial is shown in Fig. 4, and the down-lead is so attached as to provide a reasonable impedance feed on the required bands. There is also considerable radiation from the feeder, since this cannot be arranged to act as a flat or non-radiating line.

For 3·5-28Mc/s, the aerial may be 134ft long, with the feeder so arranged that A is 89ft and B 45ft. The feeder is $66\frac{1}{2}$ft long. For 7-28Mc/s, the aerial may be $66\frac{1}{2}$ft with a A 44ft and B $22\frac{1}{2}$ft, the feeder wire being 33ft long.

It will usually be necessary to use a tuner, as for the end-fed aerial. The tuner is in any case preferable, to help suppress harmonics.

Aerial Tuners

For transmitting purposes, the aerial tuner can perform several functions. It may be required to transform the aerial impedance to an impedance suitable for the transmitter, to reduce harmonic output, or to allow the transmitter to be adjusted for a low impedance output which will in itself reduce harmonics. With Zepp or tuned doublet feeders, it is also used to change the single output of a π circuit to the double or balanced circuit needed for the two feeders.

A tuner which may be used for end-fed aerials or single feeders, or for parallel tuning of Zepp and dipole feeders, is shown in Fig. 5. Most popular transmitters have a π output able to work into 75Ω or similar low impedance, and a short piece of 75Ω or similar coaxial cable is taken from here to the tuner.

A variable capacitor of about 150pF is satisfactory, and wide spacing is required except for low power. The capacitor can resemble the transmitter p.a. tuning capacitor, and it should be operated by means of an insulated extension spindle. It is equally satisfactory to use a two-gang capacitor, taking one set of fixed plates to A and the other set of fixed plates to B. The rotor plates are earthed, and the centre tap of the coil is then omitted.

The tuner coil is for the required bands. A tapped coil will allow coverage of all bands from 3·5-28Mc/s. For up to 150W, 26 turns of 18s.w.g. wire, occupying about 4in. on a $2\frac{1}{4}$in. diameter former, will be satisfactory. The Eddystone 1090 former is suitable.

An end-fed aerial, or single feeder, is taken to terminal A. If the impedance is not particularly great, the aerial or feeder can be tapped down the coil, as at C.

For use on higher frequencies, the capacitor is tapped across a suitable portion of the coil, as by connecting it to C and D. Once tappings have been located, tags may be soldered on, or a switch wired for band selection.

The coupling loop to which the transmitter is connected may consist of three turns of adequately insulated wire, close wound over the centre of the coil. If the tuner is used with a receiver, correct tuning will be shown by an increased reading on the signal strength meter of the receiver.

Low impedance feeders may be fed by taking them to turns near the centre of the coil. By this means, the tuner in Fig. 5 can be used successfully with almost any impedance feeder.

For low impedance feeders, however, series tuning is generally employed, and is more readily adjusted. A circuit for this is shown in Fig. 6. Satisfactory results are obtainable if one capacitor is omitted, though two are preferable. Points A and B are taken to the Zepp or tuned dipole feeders.

If the top length and feeder length of the Zepp or dipole are known, the need for parallel or series tuning can be anticipated, parallel tuning being used for high impedance, and series for low impedance. If the impedance is unknown, the circuit in Fig. 5 can be tried, the feeders being tapped in (C and D) if necessary. If results are still unsatisfactory, series tuning can be tried (Fig. 6) and will probably be suitable. A few odd aerial and feeder lengths are difficult to tune, and if this happens, the feeder length is best changed.

Flexible leads, with clips, will allow series or parallel tuning to be arranged in a few moments, and also allow the capacitors to be tapped in towards the centre of the coil, for higher frequencies. When best positions have been located, they should be noted for future use.

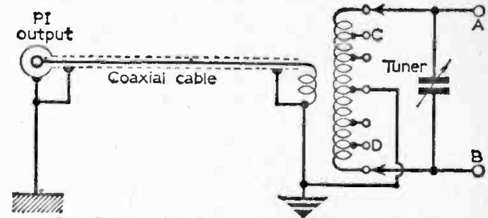
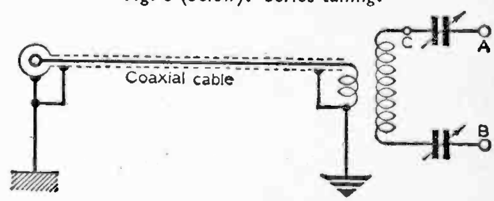


Fig. 5 (above): A tuner for high impedance.
Fig. 6 (below): Series tuning.



A Marconi aerial (e.g., end-fed wire near quarter-wave long) can be fed by taking it to C, Fig. 6, and taking B to the best earth available. The unused capacitor is not required.

If a harmonic trap is employed, it can be placed in the coaxial cable, as the trap is generally for a low impedance circuit, and must be operating at the correct impedance.

An r.f. meter may be included in series with the aerial feeder, to show that the transmitter is giving its usual output. The reading will depend on impedance and output ($I^2 \times Z = W$). A meter reading up to 350mA is suitable for small power with low impedance, or moderate power with high impedance. For larger power, a 1A or 2A meter will be more suitable, or the 350mA meter may be shunted. ■

THE P.W. SPINETTE

—continued from page 122

aperture. A piece of loudspeaker gauze about $4\frac{1}{2}$in. x 7in. is glued over the aperture underneath, being drawn taut. The loudspeaker is held in place by means of four $\frac{3}{8}$in screws, with washers. The turntable unit is positioned in its cut-out, and held with three $\frac{1}{2}$in. round-headed screws, with washers.

The volume control is fitted near the battery opening, and equipped with a knob. Leads between amplifier, loudspeaker, volume control, etc., are soldered on as previously described.

Installing the Units

After testing the equipment, the amplifier can be secured to the false bottom by means of two $\frac{1}{2}$in. screws. The motorboard is then finally placed in the case, and held by means of five $\frac{1}{2}$in. round-headed screws, with washers.

The battery cover is finished to match the motorboard, using surplus material. A small groove in the case, inside at the back, receives the cover, which is a push fit, and rests on the slightly projecting rim of the loudspeaker.

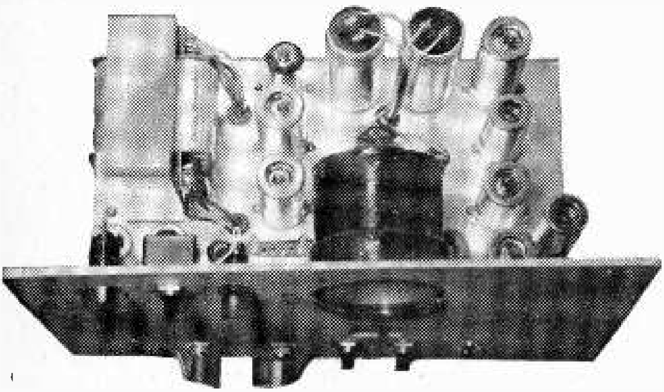
The turntable unit is adjusted for $33\frac{1}{3}$ or 45r.p.m. as required, by moving the projecting arm opposite the appropriate speed. An upright crank on the unit engages with springs in the pick-up arm, to hold the arm when the record player is carried. This crank is disengaged by moving it backwards, clear of the arm.

The motor is started by raising the pick-up and moving it fully outwards. It is then brought in, and placed on the record. Switching off is automatic, when the arm has moved inwards. The pick-up should not be allowed to drop on to the record or turntable. ■

PARALLEL TRACKING UNIT

It has been brought to our notice that the Parallel Tracking Unit described in the March 1963 issue of PRACTICAL WIRELESS *is covered by British Patent No. 917752 which is held by Mr. John A. Mackie. This device must not, therefore, be manufactured for resale except by arrangement with the Patent holder.*

Geiger Counter Digital Register



incorporating Scaler and Power Pack

• • •

by
E. Dexter

• • •

THIS ARTICLE DESCRIBES A DIGITAL REGISTER FOR OPERATING THE ADVANCED GEIGER HEAD DESCRIBED IN THE DECEMBER 1962 AND JANUARY 1963 ISSUES.

Continued from page 70 of the May issue

IF one is using, or intending to build, merely the simple digital counter published in P.W., February to April 1962, then the counting rate should definitely be kept down, so that errors in direct counting do not become intolerable, as can happen at fast rates of counting. Furthermore, one should make sure of obtaining a digital relay in really good condition.

The author has been making comparative measurements of several samples of these relays, and found great differences in the switching times, according to the condition. Thus cheaper samples, taken from the junk boxes on display in some surplus stores, showed switching times up to a fifth of a second, which led to over 30% error at counting rates of 100/minute.

On the other hand, really good specimens selected from the stock of a reputable firm had switching times as short as a twentyfifth of a second, leading to only about 7% error for direct counting at 100/minute. Whilst this point may not be all that important (as 20% is the common amateur tolerance for less exact work anyway, and on account of the inevitable errors in preparing specimens), for those constructors going no further than constructing the already published simple digital counter, it nevertheless receives full importance for the present high-quality counter described in this article. It is definitely necessary to make sure of obtaining a really sound digital relay; if possible, a brand-new item.

The further important observation was made during careful experiments with the prototype, that the effective switching time is dependent on the setting of the bias control in the digital counter circuit (VR2). This is because the bias setting influences the magnitude of the current pulse sent through the relay on each count.

This point was already mentioned in the text for the simple digital counter in P.W. Feb., 1962, where it was stated that the bias setting should be as high as *possible without* counting stopping altogether. The effective switching time then has its shortest possible value for the particular specimen of digital relay in use. When the bias setting is reduced to the point where permanent current almost commences, the current surges are so large on each count and after-effects consequently take so long to die away, that the "effective" switching time has then been observed to be anything up to double the better value at higher bias settings. The greater the pulse output amplitude from the Geiger head, the higher can the bias be set before counting ceases, and thus it is for this reason, among others, necessary to assure adequate signal amplitude from the Geiger head.

However, for the more careful work justified by the high quality of the present unit a further point observed during experiments with the prototype requires discussion. When using high-voltage Argon tubes with organic extinguisher anything up to 10% of the total pulses can be of considerably lower amplitude than the rest, so that these are missed when the bias is set critically for the full-amplitude pulses in the interests of short switching time. The demand is here contradictory to the first, so that some intermediate bias setting is more suitable. And, in fact, experience has shown that for this type of Geiger tube a bias setting midway between permanent current and no-counting gives the smallest direct counting error.

When using halogen quenched tubes such as the Mullard MX124/01 head, specified as ideal for the apparatus here described, the bias should be set as high as possible again, as such tubes give far fewer low-amplitude spurious pulses.

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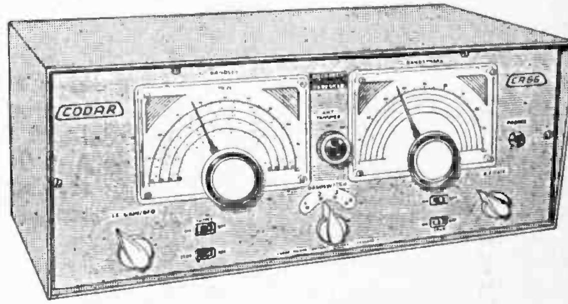

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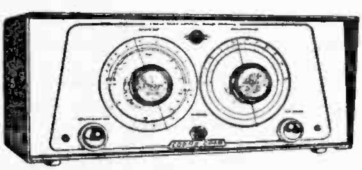

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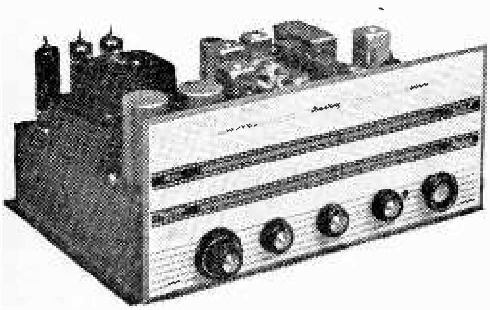

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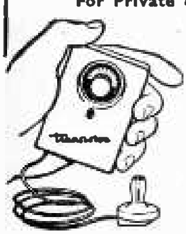

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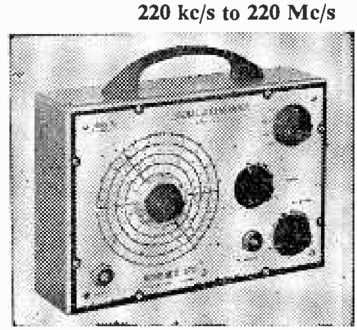

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Improvements with Scaler

The response time of the divide-by-two scaler V7 is very much shorter than that of the digital relay and is, in fact, shorter than a thousandth of a second in the here-published circuit. We may thus neglect its blockage time errors in comparison to blockage errors introduced by the much slower digital relay in the subsequent counter circuit.

The scaler itself will thus be able to count individually both members of a fast pair of pulses provided that these are at least about a thousandth of a second apart. Furthermore, as only alternate pulses are passed on from the scaler to the counter only one member of each such fast pair requires a response from the digital relay and that is now a far less stringent requirement. Only if a third pulse arrives in addition, all within the relay switching time, do we now have a blockage. Such blockages are much rarer because they now require fast triplets instead of mere fast pairs, and the former are statistically far less likely than the latter. It is very easy to understand the relative likelihood of these two events.

Triplet of Pulses

A fast triplet of pulses means that two fast pairs, in immediate succession, must take place within the switching time of the relay—i.e., each must take half the switching time on the average.

Taking our typical poor relay, to give the worst possible conditions, which had a switching time of a tenth of a second, we thus require two fast pairs of a twentieth of a second in succession if a a count is to be missed during "scaling". Taking again our typical counting rate of 120 per minute (to give round figures of one count every half-second) there is "a tenth of a count every twentieth of a second" by direct proportion, which, putting it into plain words, means that the chances are *ten to one* against getting a single fast pair within a twentieth of a second.

The chances are, therefore, ten times ten to one against getting the "required" two such fast pairs in direct succession—i.e., when scaling, the digital relay will now miss only one in a hundred of the counts it is supposed to register. In other words, the counting error at 120 counts per minute, even with the assumed very poor relay, is now only 1%, whereas we had calculated it to be almost 20% under the same conditions by direct counting.

It is thus clear that *very great* benefit has been achieved by means of incorporating the scaler, much greater than the mere factor of two represented by the average frequency division. Errors at the average intended rates of counting are reduced by a factor of *not two* but about 20!

Superior Performance

Furthermore, on account of the preamplification given by V6 there is now excellent response even to pulses of slightly lower amplitude than the main pulses, so that all in all improvements in accuracy when the binary scaler is switched into circuit are very considerable indeed. Thus, at any rate for the specified tube and head circuit, a very superior performance is to be expected.

Reasons for Direct-counting Facilities

Certainly one should normally operate with the binary scaler in circuit when using this unit with the prescribed Geiger head. The reasons should be abundantly clear from the previous paragraph. One may thus ask why a direct-counting function without the scaler has been retained also. There are several good reasons for this, all connected with universality of the unit.

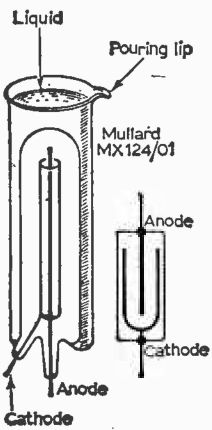
Firstly it may be desired to use the unit with other heads than Geiger heads. For example, a photoelectric head to count movements on machinery by interrupting a beam of light can be fed with power from P1 equally well and send its pulses to P2. The same head can count people passing, cars passing on a road, articles passing on a conveyor belt, etc. All such uses deliver pulse sequences where fast pairs beyond the direct resolving capabilities of the relay are highly unlikely at all and thus the convenience of a continuous direct display of the total number counted are great. A suitable microphone and audio-preamplifier (which can again receive power from P1) attached to a typewriter in a suitable way can count the number of strokes per minute made, which can be useful for teaching purposes, etc. Various possible adaptations for time and motion studies will occur to those interested in that field.

Secondly, it may be desired to use the unit in conjunction with some high-voltage Geiger tubes (fed from a separate e.h.t. supply) which manifest low-voltage flimmerings between true pulses, and thus the more sensitive scaler may register a lot of unwanted spurious counts. In such cases the direct counting is the more accurate, the few flimmerings which get through also on direct counting tending to compensate the resolving limit losses. However, a type of head as discussed below in connection with Fig. 5(e) is the better solution for flimmering high-voltage tubes, the scaler then being usable again. High-voltage tubes have no great advantage over the specified low-voltage tube Mullard MX124/01 as far as the amateur is concerned, the increase of general sensitivity being in no way in proportion to the extra trouble involved with the higher voltage. The author operates also a 1·5kV tube which is barely twice as sensitive as the Mullard tube here specified. The Mullard MX124/01 is observed to give very clean definite pulses and is particularly free of small-amplitude spurious pulses.

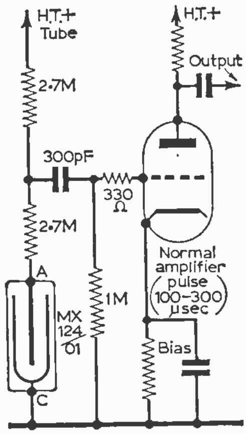
Thirdly, the way is intended to be left open for subsequent possible use of a decimal scaler using the cathode-ray divider tube E1T from Philips. This allows only every tenth pulse to reach the counter and displays all intermediate states on a fluorescent screen and has a resolving time up to hundreds of kilocycles per second—i.e., faster than the Geiger tube itself!

It is possible to use any number of binary scaler units in cascade, to divide by any power of two

Fig. 5b-e: Possible circuit arrangements for Geiger heads (see text).



(a)



(c)

Fig. 5a (left): A section through a Geiger tube and its circuit symbol.

Fig. 5c (left).

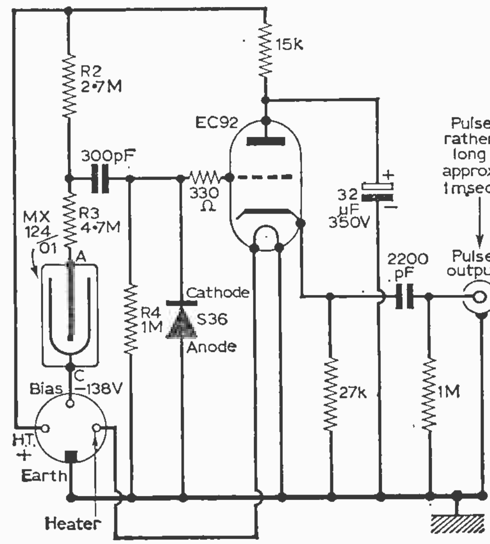
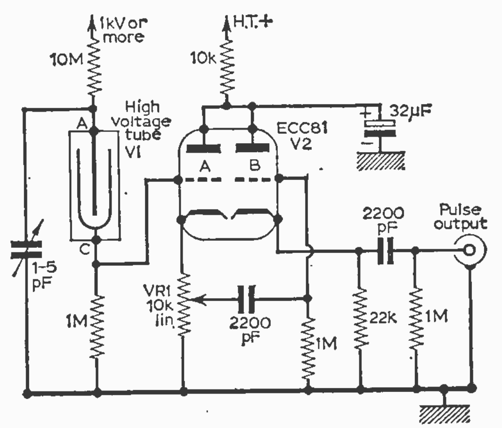


Fig. 5d (above).

Fig. 5e (below).



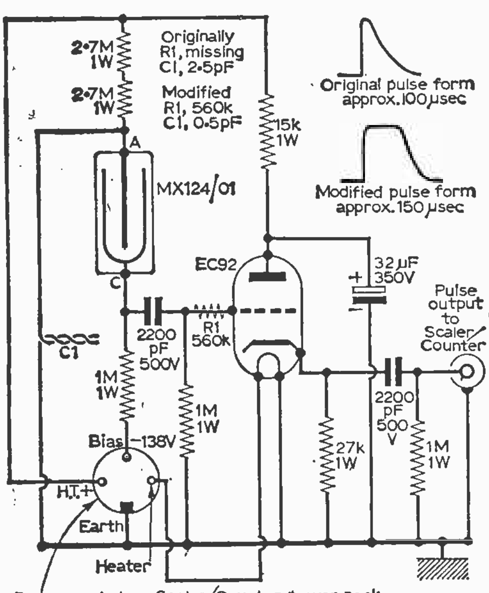


Fig. 5b: In the original form C1 (2·5pF) can formed of 7 half-twists of 0·7mm plastic insulated tinned copper wire. In the modified form 1½ half-twists will give the correct value.

desired. Such circuits would need a buffer amplifier and negative-pulse cathode follower between each binary stage and are perfectly straightforward. However, any readers intending to go ahead with building such units to operate ahead of the present unit should not feed them from P1 as any equipment with more than 0·3A heaters demand and a few milliamps h.t. will seriously overload P1.

Various Geiger Heads

Since writing the original article (December, 1962) describing a Geiger head using the Mullard

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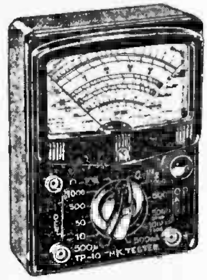

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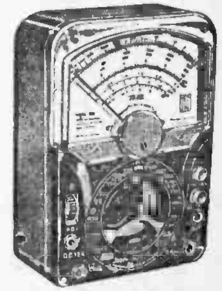

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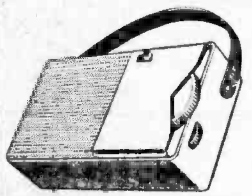

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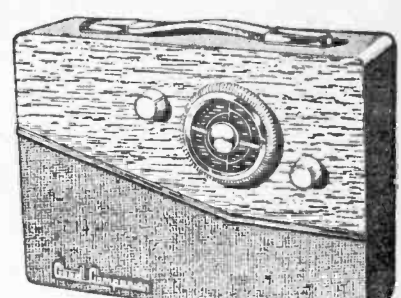

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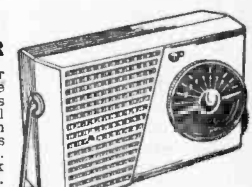

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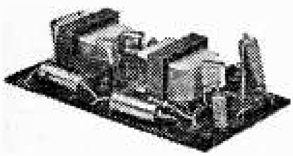

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CHP 2

MX124/01 tube, recommended for the present register unit, the author has received criticism from the manufacturers stating that his circuit (reproduced again in Fig. 5(b), the unmodified form without R1 and with C1 in unreduced form) probably imposes too high a capacitive loading on the tube, leading to its possible early destruction. Mullards recommended the use of their own circuit, shown in Fig. 5(c) and supplied quantitative charge-per-pulse data for this circuit, showing that it causes about a hundredth of a microcoulomb to pass per pulse.

Careful measurements on the author's prototype showed that in fact this amount is with certainty also not exceeded in his circuit. The total intentional and stray capacity across the tube in the original circuit, with unreduced C1, was measured as just under 7pF, and assuming that the maximum tube voltage of 470 volts is used, and that the tube capacity is fully discharged on each pulse, only about a third of the charge per pulse stated by the manufacturers results from this source. A further source of pulse charge is by direct arrival through the two 2·7MΩ tube anode resistors, and assuming (worst conceivable conditions) that the tube represents a dead short during its ionisation time (about 100 micro-seconds), about two-thirds to one hundredth of a microcoulomb can arrive, at the very most, on this way per pulse. The total is thus at the most just about the same as for the other circuit from Mullards.

The only other factor possible is excessive initial surge current through the tube when this ionises if the capacity across it is too high. However, Mullards also speak of using a circuit where the 300pF coupling capacitor to the amplifier grid is connected straight to the tube anode, which results in a measured total tube capacity of anything up to 10pF, at any rate higher than in the author's original circuit.

Thus there seems to be no valid reason against using the author's circuit with its particular advantages for the amateur, and this has proved itself during long usage.

The inclusion of R1 and reduction of C1 to the smallest value still giving a satisfactory signal output in the circuit of Fig. 5(b) brought negligible improvement of the capacitive loading of the tube, the total measured tube capacity falling thereby from about 7pF to about 5·5pF. However, the change in pulseform is useful. It is of no interest for the present unit with its binary scaler but the modified pulseform is ideal for operating the cathode-ray decimal scaler and might possibly save the need for interposing a shaper.

The fact that the author's circuit of Fig. 5(b) uses nothing whatsoever connected to the tube anode circuit leads to unusually low anode loading and thus the outwardly disturbing feature is the need to augment this loading very slightly to get a proper signal at the cathode, as explained in the original article. The actual final loading does not appear to differ greatly from the Mullard circuit and from the point of view of tube life it would seem to be immaterial which circuit is used.

The Mullard Circuit of Fig. 5(c)

Those constructors wishing to use the Mullard circuit of Fig. 5(c) must employ the minor modifications of detail then necessary to enable operation from the power supplies as available at P1 of the unit described in this article and to reverse the polarity. The Mullard circuit as it stands gives negative pulses, whereas we require positive ones.

There are basically two ways of making these adaptations. The amplifier and tube h.t. feeds may be commoned and the tube cathode taken to the negative bias The pulse at the amplier anode is inverted and thus positive, therefore may be used to operate the cathode follower, which can be the second section of a double triode.

Fig. 5(d) shows another arrangement worth considering which makes do with only one triode. This receives a positive signal at its grid from the negative pulse from the tube, inverted by the overswing action of the fast silicon diode S36. The triode may thus be made the cathode follower directly. A disadvantage of this circuit is its great lengthening of the pulse.

Whatever type of head circuit is used the final stage *must* be a positive-pulse cathode follower. Any other stage with higher output impedance will not be satisfactory as the losses along the cable from the head to the register will be too high and the input circuit of V8 on direct counting would cause too high a loading, causing the signal to collapse.

It would thus seem that the original circuit of Fig. 5(b) is definitely the simplest and most recommendable for amateur usage with the register unit described in this article, whereas the Mullard circuit has possible scientific laboratory advantages where highest resolution is essential.

Gain Control

A final word about the use of high-voltage tubes. To avoid disturbance from spurious extra counts from the low-voltage flimmerings sometimes found in such tubes a gain control on the head is desirable. Fig. 5(e) shows the best way of introducing such a control, situated between two cathode followers in cascade. This is the only possible method of preserving the necessary constant low output impedance at all settings of the gain control. In using such a head the gain control VR1 should be set such that flimmer-amplitudes do not operate the binary scaler, yet all proper pulses are registered. Initial setting with a new tube is easily possible by observation on an oscilloscope.

It is definitely not permissible to use a potentiometer gain control in the grid circuit of a cathode follower here as this imposes excessive capacitive loading.

Operational Stability of the Scaler

One must very carefully make certain that the scaler really does pass on *every second* pulse and not every pulse or a few of the forbidden ones in addition. Critical conditions can result as the input amplitude is reduced to a level at which V7 ceases to give proper response. This will correspond to voltage levels from the Geiger head about a fifth as large as the "normal" pulses with the here-specified equipment. Particularly troublesome can be the high-voltage Argon tubes, which have quite a lot of spurious pulses of about this amplitude and can give rise to a number of curious effects in an improperly adjusted scaler.

As the input pulse amplitude is reduced there comes a point where the scaler V7 ceases to trip over and counting stops altogether. There is then the possibility of pulses reaching the digital counter input V8 direct through via V6, C13, C14, C15. The polarity is, of course, correct, and if the remaining amplitude getting through is sufficient the apparatus will start counting every pulse at this point *in spite of* being switched to scaling.

There are two parts to this question, firstly whether such direct through pulses can get through *at all*. They certainly *cannot* get through if the last proper pulse left V7 resting with the section on pins 1, 2, 3 conducting because the very low anode impedance of this heavily-conducting section then shorts the junction of C14 and C15 to chassis. However, if the last proper pulse left V7 resting the other way, with pins 6, 7, 8 conducting and 1, 2, 3 cut-off, there is nothing to stop pulses getting direct through to V8 from V6.

As long as the amplitude is sufficient for V7 to respond properly, the anode responses, by feedback over C16 and C18, fully neutralise any such direct-through pulses so that division is then certainly correct. When the amplitude of the input has been reduced to the point where V7 does not trip over any more its section on pins 6, 7, 8 still gives anode pulses, only these are now of insufficient amplitude to cut-on the other section. However, they are certainly still sufficient to neutralise the would-be straight-through pulses by compensating feedback over C16 and C18. Thus, even in this "dangerous" state, counting of every pulse does not take place immediately scaling ceases. There is a span of amplitudes for which no response at all results. The lower limit of this is when the amplitude is so low that positive kicks at V7 pin 6 cease also. Then, finally (but, as said, only if the resting state of V7 is with conduction at pin 6), pulses can go straight through to V8 from V6 and will cause every pulse to be counted if still of sufficient amplitude to operate the digital counter.

The simple remedy for this is to make certain that pulses of insufficient amplitude to operate V7 properly are then also with certainty of insufficient amplitude to operate V8 under any circumstances. This condition should be satisfied in Fig. 1 as published, in many cases, and is favoured by using as high-bias a setting of VR2 as possible during scaling.

However, as the direct-through amplitude is very greatly dependent on the pulse-shape from the Geiger head, trouble may be found and should be checked by using a variable-amplitude circuit such as in Fig. 5(e), checking whether at any setting of VR1 of that figure the "all-pulses counting" can be induced. If this is possible for suitable low input pulse amplitudes when the bias control VR2 is set at low bias then that should be ignored, but if it is possible at middle or high bias then a voltage-divider is necessary between C15 and R36.

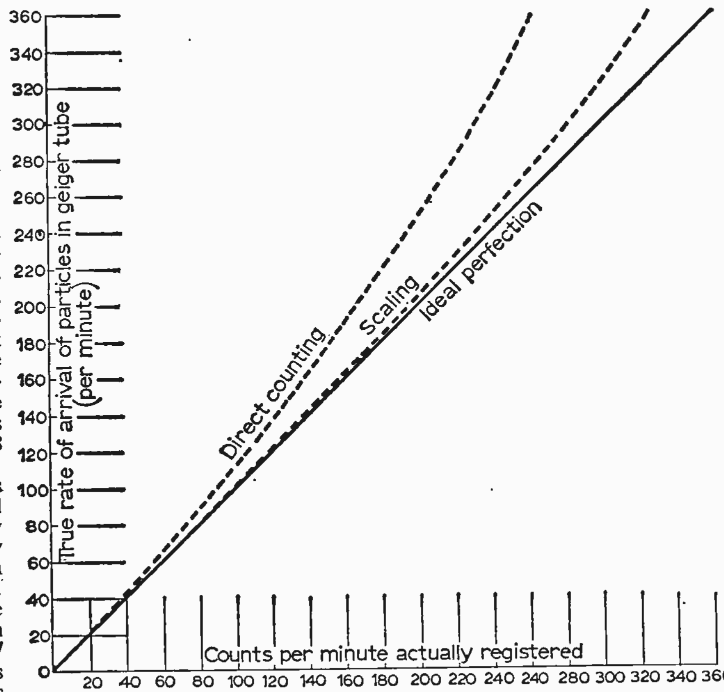

Fig. 6: Simple counting error due to switching time required by digital relay is shown in this graph, for various counting speeds. The increasing effect of this error in direct counting at high speeds is compared with the improvement upon scaling and the would-be state of perfection.

A suitable arrangement suggested for this is to reduce R36 to 68k 1 watt and wire a 470k 1 watt resistor in series from C15 to the junction of R35 and R36. It is probably of no disadvantage to incorporate this modification right from the start as experiment seems to indicate no interference whatsoever with normal performance thereby.

Arithmetical Correction for Errors

The counting deficiencies resulting from relay switching time and scaler switching time may be subsequently allowed for by using the typical graph of Fig. 6, compiled by calculation and fully confirmed by experiment, for the prototype. It is based on a switching time of 0·06 seconds as observed for the relay in the prototype. This may be taken as quite typical and even if not absolutely accurate for some other relays will certainly give improvements in the final results if used. ■

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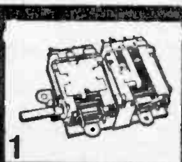

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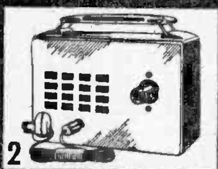

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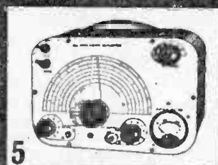

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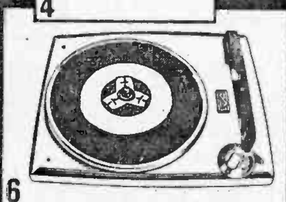

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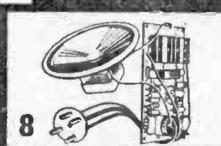

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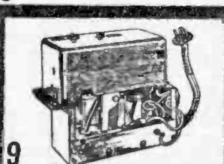

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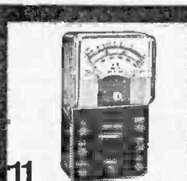

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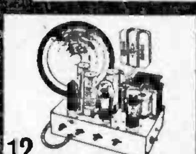

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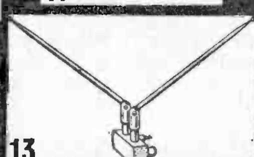

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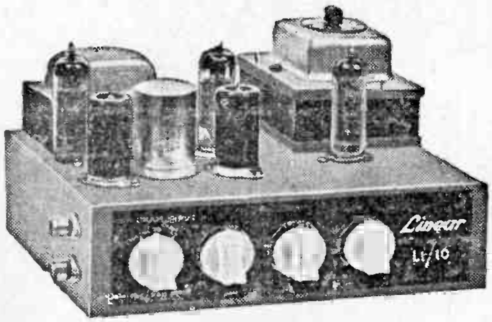

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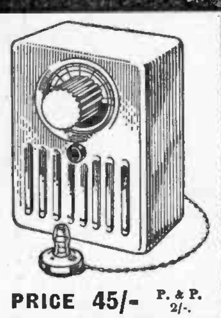

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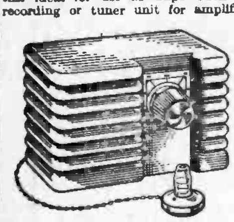

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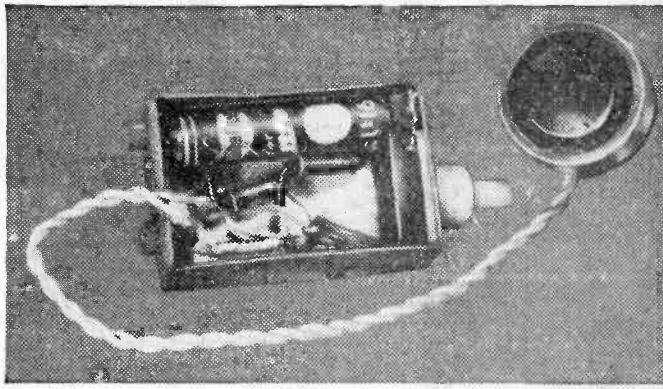
MINIATURE AMPLIFIERS

for beginners to construct

By C. Marshall



One of the author's amplifiers

THE basic circuit is shown in Fig. 1 and is a two-transistor, direct-coupled amplifier, using an absolute minimum of components.

R1 supplies the bias current for Tr1 and the collector-emitter current of Tr1 provides bias for Tr2. Any change in base current of Tr1 is amplified and applied to the base of Tr2, where it is again amplified. The two collector currents vary in phase and this causes a current change through the battery. This current gain is changed to voltage gain in the earphone connected across the output terminals. The current gain of the amplifier is the product of the current gains of the individual transistors.

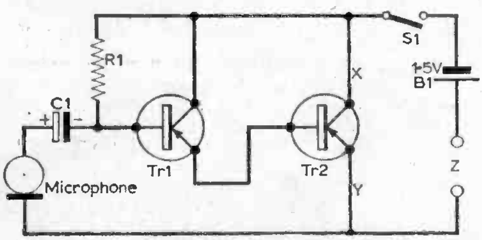


Fig. 1: A simple amplifier circuit.

The output may be taken from any of the points X, Y or Z. The output from X has the disadvantage that neither side is at earth potential, whilst the output at Y is at rather low volume and so the output at Z was chosen.

The capacitor C1 is needed when the microphone was a d.c. resistance of less than 25,000Ω. With crystal microphones C1 is not needed but otherwise the circuit remains the same.

With the pre-amplifier, as shown in Fig. 3, R2 replaces the earphone and the output is taken via the capacitor C2. The volume control is in the two-way intercom circuit only as space was available—it could quite well be excluded.

Transistors

These circuits will work well with almost any transistors, "surplus" types working perfectly well. All transistors have a maximum working

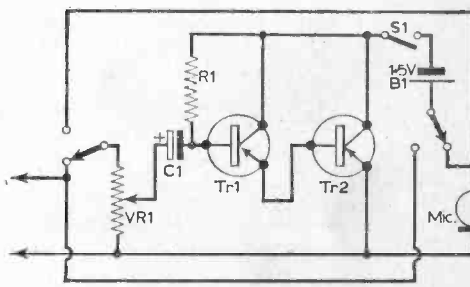


Fig. 2: An intercom amplifier circuit.

voltage which varies from type to type. Here they are tabulated for easy reference.

Spot	Maximum Voltage	Voltage Used
Green	3	1½
Yellow	6	4½
Red	12	9
Branded	25 (app.)	18

With some transistors the bias resistor R1 may have to be changed, but this is discussed more fully later.

Capacitors

C1 is the base blocking capacitor. Its value is not in any way critical. In the prototype an 8μF electrolytic capacitor was used and values down to 1μF give good quality. A 0·1μF was tried, but understandably resulted in a reduction of quality.

The capacitor C2 is to give d.c. blocking to the amplifier. For feeding a valve amplifier it should be 0·01μF and rated at 500V with high insulation

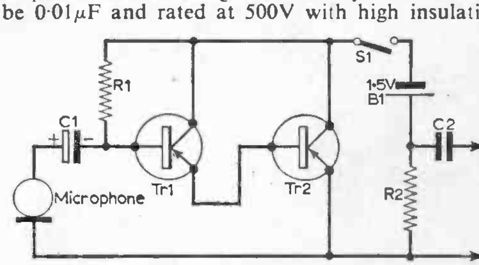


Fig. 3: A simple pre-amplifier.

for complete safety. When feeding a transistor amplifier C2 should be an 8μF of 15V working, but the exact value is not critical.

Resistors

R1 in Figs. 1 and 2 is about 220kΩ with a 1·5V battery. The collector current of Tr2 should be measured and, if necessary, altered by changing the bias resistor. The current required depends on the impedance of the earphone. Here is a table for different impedances of earphone:

Impedance	Current
100Ω	5mA
250Ω	2mA
500Ω	1mA
1,000Ω	0·75mA

The pre-amplifier current should be about 0·5mA. R2 has a value of 1kΩ, this value giving good volume yet leaving 1V across the transistor. The volume control is about 50kΩ.

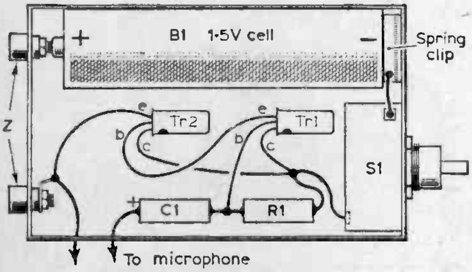
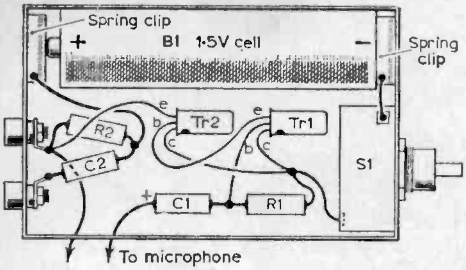


Fig. 4 (above): The wiring diagram of Fig. 1.

Fig. 5 (below): The pre-amplifier wiring diagram.



Earphone

The earphone used in the prototype was the normal single earpiece type with a d.c. resistance of 100Ω. Earphones with a d.c. resistance of more than 1,000Ω are not suitable for these circuits. Values of R1 are given for a 100Ω earpiece and must be changed for other resistances. Low impedance headphones may be used if they are more convenient. A single earphone may also be used as a microphone.

Construction

The circuits in Figs. 1 and 3 are constructed in a standard size matchbox and these will be dealt with first. The exact position of the components will depend on the individual components used, but the general layout is shown in Figs. 4 and 5. A U16 1·5V battery was used because it is of the

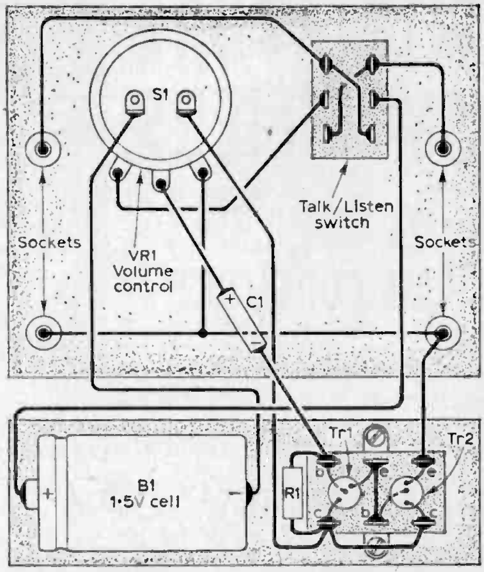


Fig. 6: The component layout of the intercom.

ideal size for fitting in the matchbox.

First the tray should be accurately marked where the holes are to be cut, two $\frac{3}{16}$in. holes for the sockets and one $\frac{1}{4}$in. hole for the switch. A piece of softwood should then be cut so that it just fits into the end of the tray. The holes may then be carefully drilled. Twist bits only should be used and the drill must only be turned slowly or the wood will split.

The battery contacts should now be prepared. For the one-way amplifier one of the sockets should have its tag bent at right-angles and tinned to make good contact.

For the pre-amplifier a piece of tin should be bent to form the positive contact. A similar piece of tin forms the negative contact in both cases. The two wires to the switch should be connected and the switch fastened into position.

The wiring of the small components should be followed from Figs. 4 and 5. The transistor leads should always be provided with a heat sink whilst soldering.

The two-way intercom amplifier is built on to a small panel, the switch, volume control and sockets being fastened to the front panel, the amplifier constructed on a three-way tag board fastened to the base. The U2 battery is held in place by a small rubber band. The wiring is shown in an expanded form in Fig. 6. The on/off switch is incorporated on the volume control.

When using the intercom the two earphones should be identical or too much current may flow one way and too little the other. In the author's prototype the front panel was 3¼in. by 4in. and the base 1½in. by 4in.

The U2 battery will have a very long life in this circuit and it is most convenient to solder the leads directly to the battery.

In conclusion, a word of warning, especially for beginners—take care to connect all the transistors, capacitors and batteries the correct way round. ■

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SINGLE RECORD PLAYERS				
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GARRARD SRP10 (Mono PU)	£5. 9.11	£1.12.11	3 of	£1.9.0
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GARRARD 4HF (GC8 PU)	£16.12.6	£3. 6.6	12 of	£1.4.5
PHILIPS AG1016 (S/M PU)	£12.12.0	£2.10.0	12 of	18/6

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WHITELEY: **HF106** 10in., £7.0.0.; **HF1012** 10in., £4.7.6; **HF816** 8in., £6.0.0; **T816** 8in., £5.13.6; **T10 Tweeter**, £4.8.3; **T359 Tweeter**, £1.10.6; **CX3000 Crossover unit**, £1.11.6; **CX1500 Crossover unit**, £2.0.0. H.P. Terms available on all speakers.

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"Baby Alarm"

BY L. K. MARSH

COMPONENTS LIST

Resistors:

R1	100Ω	R5	270kΩ
R2	390kΩ	R6	10MΩ
R3	100kΩ	R7	470Ω
R4	6·8kΩ	R8	150kΩ

(All resistors ½W)

Capacitors:

C1	100μF, 6V	C4	0·005μF
C2	0·05μF	C5	0·005μF
C3	100μF, 12V	C6, 7	32+32μF, 350V

Variable Resistor:

VR1 250kΩ with d.p. switch

Miscellaneous:

L1	Small l.f. choke (60mA)
F1	1A fuse
T1	Midget output transformer to suit speaker
T2	Mains transformer: secondaries—200V at 60mA; 6·3V at 0·3A
MR1	Metal rectifier (200V, 60mA)
V1	ECL80
Tr1	Any "surplus" a.f. type

THE basis of this unit is a high gain transistor preamplifier followed by a triode voltage amplifier and pentode output stage.

It was built on an old Band III add-on type of converter, which was chosen because it happened to be found in the spares box and because it had its own a.c. power pack and suitable valvebase already fitted on its chassis.

The valve in the converter was unsuitable and was replaced by the required triode-pentode, an ECL80, which is readily available cheaply. The valve requires 6·3V at 0·3A l.t. and draws around 20mA h.t.; the transistor draws negligible current, of course. This power requirement can be provided very simply.

The microphone used with the finished device is a low impedance moving coil type which matches directly to the transistor base input.

Construction

In the writer's case, using the add-on converter unit as a basis, all unwanted parts were removed, leaving the power pack, valveholder and coaxial sockets. Starting from scratch, however, should present no difficulties, for there are few components involved and these can be grouped logically round the major parts. Keep the input leads away from the power pack and ensure that the transistor is not placed near any excessive heat, e.g. near the ECL80 valve.

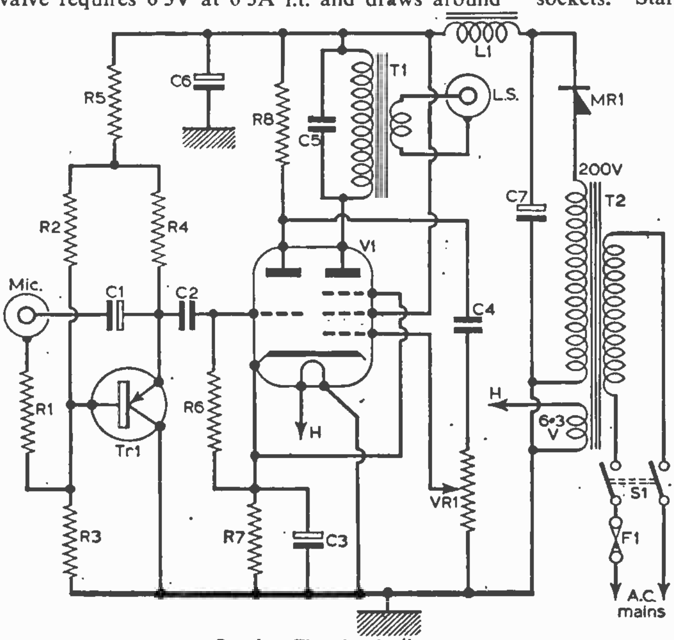

Fig. 1: The circuit diagram.

Testing

Connect a low impedance microphone to the input socket. Connect the extension loudspeaker to the output socket via a suitable length of flex. The writer has the unit placed near to the baby's cot with about 6in. of lead for the microphone; the loudspeaker is downstairs and is connected by plastic-covered flex.

Ample gain should be obtained with the volume control about threequarters advanced. Earthing was found essential to remove traces of hum and mains pick-up noise. If three-pin wiring is available this should, of course, be used.

BOOKS REVIEWED

RADIO ASTRONOMY FOR AMATEURS

By Frank W. Hyde; published by Lutterworth Press. 236 pages, 5½ x 8½ ins. Price 25s.

FOR those wanting to try something new, radio astronomy is both a challenge and an opportunity. This comparatively new science is rapidly gaining in importance and much useful work is within the scope of the amateur for a modest outlay.

The author, an acknowledged authority on the subject, has struck just the right balance and level in his treatment. Not too advanced to deter the newcomer; not too elementary to turn away the more experienced.

The book can be divided into three main sections. The first group of chapters deals with basic astronomy. The second group covers basic electronics. The third group describes practical equipment. such as receivers, aerials, etc. Much of the explanatory electronics will be "old hat" to readers of this magazine but it takes up very little of the bulk of the book.

What is left is fascinating. A newcomer to astronomy could hardly find a more lucid general introduction than is provided in this book. And the chapters on extra-terrestrial and solar radiations are of absorbing interest.

From the practical aspect, complete circuits are provided for receiving equipment and the matter of aerial construction is described in detail. There is a useful section on operating the equipment, and a handy bibliography is provided for further reading.

There are few serious amateur radio astronomers at the moment, but their ranks will undoubtedly grow. Here is an excellent introduction to this new field.—*W.N.S.*

WORKED RADIO CALCULATIONS

By Alfred T. Witts, A.M.I.E.E.; published by Sir Isaac Pitman & Sons Ltd.
184 pages, 4¾ x 7¼ ins. Price 15s.

HERE is a welcome third edition of what has become an established standard. For those not familiar with the book, it consists of graded practical examples of the various mathematical problems encountered by radio service engineers, wireless operators, students and experimenters.

Not a few amateurs find that many of the necessary mathematical calculations, that must be made, provide a stumbling block. This need not be so, and this book goes far to killing the bogy. In fact the presentation and treatment is such that many readers will wonder why they ever thought radio calculations were difficult!

The author assumes that the reader is conversant with the general theory, and so explanatory notes have been reduced to the barest minimum. This has enabled him to set out the relevant data in a clear uncluttered manner. The approach is to pose a brief problem and then to show how this is resolved. These are essentially *practical* calculations, of the kind constantly met with in any home constructional work.

There are ten sections, each dealing with a specific type of calculation, including a newly added, and valuable section dealing with transistor circuits. Whether a professional or an amateur, this book will be invaluable and a great time saver. Highly recommended.—*W.N.S.*

RADIO DATA REFERENCE BOOK

Compiled by G. R. Jessop, A.M.Brit.I.R.E.; published by Radio Society of Great Britain.
136 pages, 75 diagrams., 5½ x 8¾ ins. Price 12s. 6d.

THIS is a new RSGB publication bringing together in convenient form, essential reference data for the radio engineer, designer and amateur. In general, the data are presented in the form of curves, tables and charts, with only sufficient text to permit its effective use.

The material provided includes general formulæ, but is mainly directed towards the amateur transmitter since sections are provided for pi-network tank circuits, wide band couplers, voltage multiplier circuits, modulation transformer ratios, aerial design information and so forth. For those experimenting with transmitters, this book provides in a convenient form much material that would otherwise be found scattered in various reference books. —*D.C.*

THE PYE BOOK OF SCIENCE

Published by Vista Books and the Pye Group
158 pages, 8½ x 11 ins. Price 25s.

TODAY the challenge of space is a great stimulant for further scientific advancement and it seems fitting that the first article in this book should deal with space travel. However fanciful this glimpse into the future may seem, the other articles are very much down to earth and bear witness to the tremendous advance science has made in recent times.

This book has been very carefully written to inform the layman in the simplest and clearest manner of some of these achievements. Each chapter is admirably illustrated with photographs and diagrams.

Not surprisingly, many of the subjects included have a common bond—electronics. Representative of these are: industrial and other special applications of radio telephony and closed-circuit television equipment: radiotelescopes: computers; and that ubiquitous device which has made so much possible—the transistor.

Some of the many other aspects of scientific progress described are: the atom and how it is harnessed to provide power; plastics: the hovercraft; spare-part surgery; and modern aids to archaeology.—*F.E.B.*

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Trade News

Transistor Car Radio

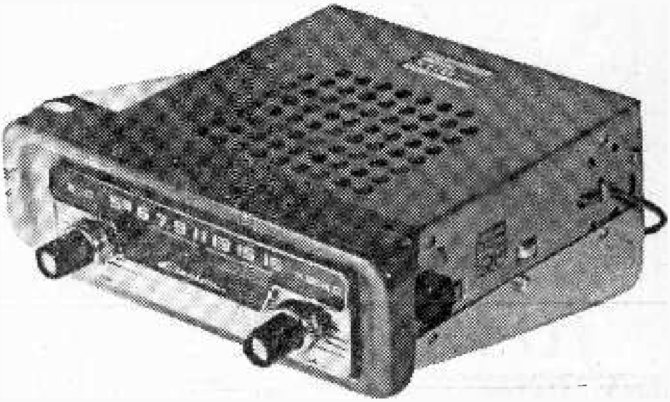
JUST recently the Clarion Trading Co. Ltd., of Tokyo, has started exporting its Clarion 85A car radio to Great Britain. The sole distributing agents of this product in this country are University Electrics Ltd.

The model 85A is a compact, all-transistor receiver which will be found small enough to fit into a car with even the most limited amount of space available for a radio. The radio forms a fixed installation in the car and operates from the 12V supply. It tunes over the whole medium waveband and has an output of over 1W.

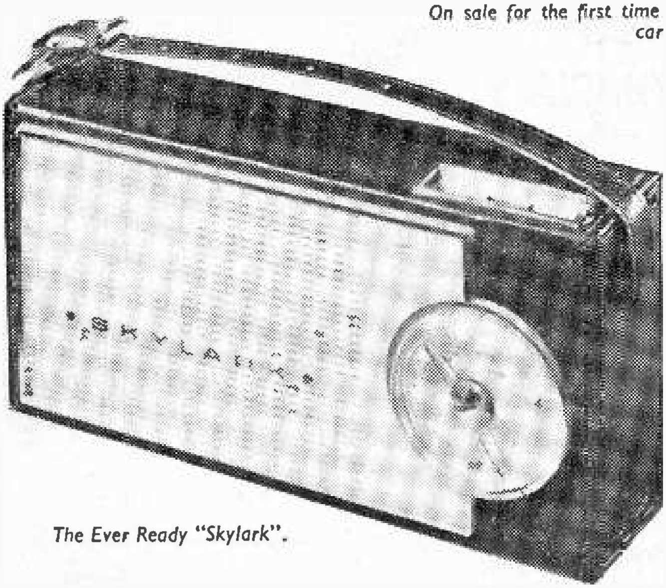
The 85A costs £13 15s. and comes complete with dashboard suspension plate, connecting leads, etc. The distributors are *University Electrics Ltd., 7 Hertford Street, London, W.1.*

Stereo Headphones

AT the Audio Festival and Fair held in London, Standard Telephones and Cables Ltd. exhibited prototype models of stereo headphones and two new microphones. These new headphones have been designed by STC for listening to stereo reproduction to provide high-fidelity listening. The manufacturers are *Standard Telephones and Cables Ltd., Connaught House, 63 Aldwych, London, W.C.2.*



On sale for the first time in the U.K., the Clarion 85A car radio.



The Ever Ready "Skylark".

Portable Receiver

THE latest portable receiver from the Ever Ready Co. (Great Britain) Ltd. is the "Skylark". This set provides loudspeaker or earpiece reception and for this incorporates a special earpiece compartment as well as a 3in. diameter loudspeaker.

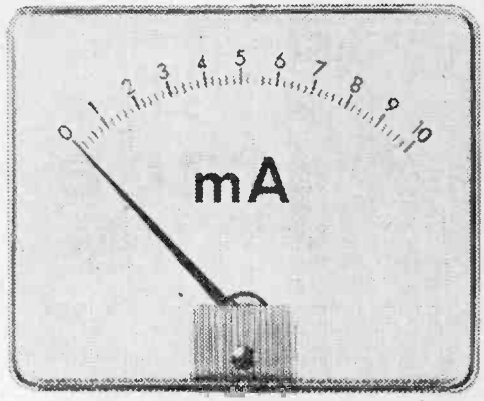
The "Skylark" measures on $7\frac{3}{4}$in. x $3\frac{7}{8}$in. x $2\frac{1}{4}$in. and is a six transistor superhet design using a printed circuit form of construction. The retail price of this receiver is $11\frac{1}{2}$ guineas and the manufacturers are the *Ever Ready Co. (Great Britain) Ltd., Hercules Place, London, N.7.*

Transparent Case Meters

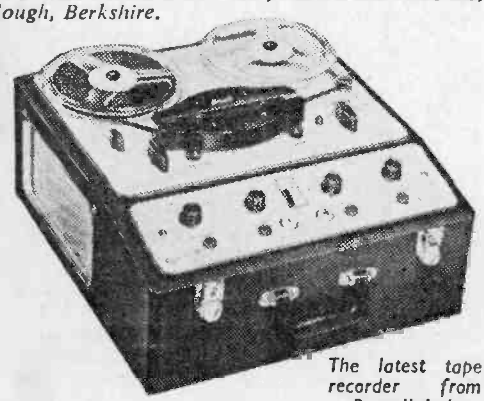
THE recently announced new range of moving-coil meters from Taylor Ltd. have been made available in modern transparent mouldings.

The new range is called the "Clarity" range and the meters come in three different sizes with scale length of 2½in., 3in. and 4in. Ranges commence from 10μA and the meters are also available as milliammeters, ammeters, voltmeters, etc.

The meter movement incorporated in the "Clarity" range can withstand overloads of up to 10,000% without damage to the coil or pointer. This new range of meters comes from *Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Berkshire.*



One of the new meters of the "Clarity" range, made by Taylor Ltd.



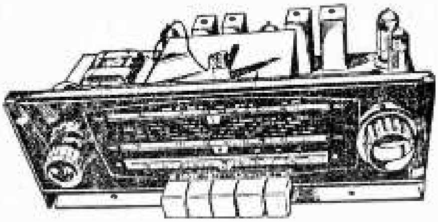
The latest tape recorder from Brenell Ltd.

Latest Tape Recorder

SEEN for the first time at the recent Audio Festival and Fair was a new model Brenell tape recorder. This is the Mk 5 series 2 and incorporates a four-speed, three-motor tape deck. This model is a successor to the Mk 5 machine and has a new amplifier in its design.

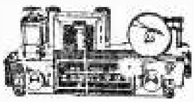
Two models of this recorder are available, one incorporating a magic eye indicator at 69 guineas and one with a recording level meter at an extra 5 guineas. The makers of this new recorder are *Brenell Engineering Co. Ltd., 1a Doughty Street, London, W.C.1.*

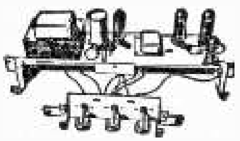
BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £12.12.0 (Carriage Paid)



A.C. ONLY. Chassis size 15 x 6¾ x 5¾in. high. New manufacture. Dial 14½ x 4in. in 2 colours, predominantly gold.
Pick-up Ext. Speaker. Ae. E., and Dipole Sockets. Five push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested. O.P. Transformer. Tone Control. 1000-1900 M.: 200-500 M.; 88-98 Mc/s. Valves EZ80 rect.; ECH81, EF89, EABC80, EL84, ECC85. Negative feed-back circuit.
Speaker and Cabinet to fit chassis (table model), 47/6 (post 5/-).
9 x 6in. ELLIPTICAL SPEAKER, 20/-, to purchasers of this chassis.
TERMS: (Chassis) £3.10.0 down and 5 monthly payments of £2.
Cheap Room Dipole for V.H.F., 12/6. Feeder 6d. yd. Circuit diagram 2/6.

SELF-POWERED VHF TUNER CHASSIS. Covering 88-95 Mc/s. Mullard permeability Tuner. Dims. 10½ x 4½ x 5in. high ECC85 and 3—EF91 and 2 diodes. Metal Rectifier. Mains transformer. Fully wired and tested. Only £7.7.0 (carr. paid). Room dipole 12/6 Feeder 6d. yd.





PUSH-PULL AMPLIFIER £5.5.0

(5/- Carr.)

Brand new 200-240 A.C. mains. Bass, treble and vol. controls. With valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 x 3½ x 3¼in. With o.p. trans. for 2-3 ohm speaker. Front panel (normally screwed to chassis) may be removed and used as "flyingpanel." Stereo version 2 x 4 w, same price. Fixed panel. Tone & Vol. Controls.

TAPE RECORDER AMPLIFIER

Type TR1. Fully built, high gain, low noise, printed circuit. Attractive grey and gold front panel 13 x 3in. Height 5¼in. overall. Front to back 5¼in. Vol. and on/off tone. Mike, radio and ext. speaker jacks. Valves ECC83, ECL82, EZ80. Mains trans. Ready to bolt to B.S.R. Deck. Complete with switch wafer wired. Our Price ONLY £5.15.0 (6/- Packing and Carr.). Also available for Collaro Deck at 5/- extra.

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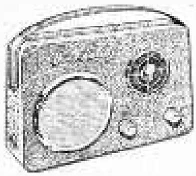
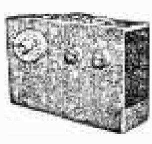
All brand new parts. Rexine and Vynair Cabinets. Different colours. All holes drilled in printed circuit boards. Full M.W. and L.W. coverage. Car aerial socket. Alignment service, 17/6, inc. return post. All parts supplied separately. Built in 2/3 hours. 500 mW. output. Booklet 2/6, refunded on purchase of kit.

THE "SCALA"



"Scala" Kit £4.19.6. (Post 3/-). Size 8½ x 2 x 5¼in. high and 3⅞in. speaker; or fully built £7.10.6.

THE "MILAN"



"Milan" Kit £5.17.6. (Post 3/6). Size 9 x 3¾ x 7in. and 8 x 2⅝in. speaker.

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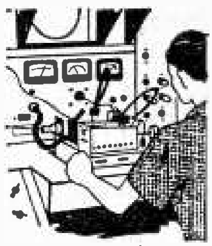

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INTERNATIONAL CORRESPONDENCE SCHOOLS

LETTERS TO THE EDITOR

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of the cover.

The Editor does not necessarily agree with the opinions expressed by his correspondents

ECHO CHAMBER SPRINGS

SIR,—Since publication of my article "Electro-mechanical Echo Unit" in your April issue, I have received some useful information from Messrs. Terry and Sons (the spring manufacturers) at Redditch, Worcestershire. This firm can supply a suitable tempered spring for use in the delay unit of this chamber. The specifications of this spring are: wire diameter 0·01in.; outside diameter $\frac{1}{8}$in.; body length at initial tension 8in. The price of this spring is 7s. 6d. nett.

This spring gives excellent results and is far superior to the "fire element" used in the prototype unit.—B. L. PHILLIPS (Preston, Lancashire).

PLUG-IN TRANSISTORS

SIR,—As a keen radio constructor, I feel that there is a very worthwhile market for an enterprising manufacturer to produce plug-in transistors. I know that there are transistor holders already on the market, but I am thinking of a pin and socket arrangement. This would not only enable the transistors to be used many more times, but would, of course, eliminate heat dangers (heat shunts seem to have a habit of not performing their duty successfully!). Also, if suitably made, they would prevent transistor leads being connected incorrectly.

Naturally the price of a plug-in component would be a little more, but I think the advantages of such a system would outweigh the extra cost.—W. A. BEAUMONT (Hatfield, Hertfordshire).

MINUETTE PRAISE

SIR,—I have now completed three receivers using the design given in your January 1962 issue—the P.W. Minuette. I have constructed them both as the original circuit and also as the reflexed version which was described later, and both designs deserve much praise.

I have only had to use a 4in. length of ferrite rod and cheap transistors, including some surplus types and I have always achieved satisfactory results.—A. J. SIMMONDS (Welling, Kent).

NOVICE LICENCES

SIR,—I would like to know why the Post Office in this country should be so much against a "novice licence" such as our friends in the USA enjoy. This would surely have several advantages, one being a probable increase in radio club memberships, which at the moment always seem low due to lack of interest.

Secondly, it would, almost overnight, remove the large number of "pirates", so saving the GPO much time and expense.

Also, an enthusiast having first obtained his novice licence (which would, of course, allow for only modest transmissions) would be encouraged to work for a full licence.—E. R. WILES (Wilden, Bedfordshire).

[We make no apology for once again publishing correspondence on this subject, as so many people appear to feel so strongly for and against it. Also, Mr. Wiles has put forward one or two interesting points in favour of these licences.—Ed.]

LANGUAGE BARRIER

SIR,—Your correspondent Mr. A. Jameson (March issue) rightly stresses the great advantages which a knowledge of Esperanto would offer all radio amateurs. Being by far the easiest language to learn, genuine conversation on all subjects with foreign amateurs could then replace the present stereotyped QSO's to which so many non-English speaking amateurs are so often limited, due to difficulties they experience with our language.

Esperanto is already widely used by operators in some parts of Europe, South America and elsewhere, and the British Esperanto Association in London, would I am sure, be glad to help.—R. E. WOOD (Cambridge).

CORRIGENDUM

General Purpose Communications Receiver

There is a small wiring error in the circuit diagram of Fig. 2 on page 799 (January issue). The left-hand contact on S2C should be linked to the rotor of this switch. The circuit will then function as described in the text, i.e. position 1—"marker on, limiter off"; position 2—"limiter on"; position 3—"limiter off".

Musical Alarm

IMPORTANT NOTE

It must be emphasised that this device (page 1116, April issue) is intended for use only with portable *battery powered* receivers, particularly transistor types which operate from low voltage batteries. The alarm must *not* be employed to switch the supply input to a mains operated receiver.

CLUB NEWS

AMATEUR RADIO MOBILE SOCIETY
Hon. Sec.: G3FPK, 79 Murchison Road, London, E.10.

The Society was well represented at Trentham Gardens for this year's North Midlands Mobile Rally, which was staged on April 21st.

A magnet for mobile amateurs from all over Europe, the U.B.A. Mobile Rally, at Verviers, Belgium, attracted a large contingent of A.R.M.S. members. It was held on 28th April.

Future Event:
May 11th—First London Single Sideband Dinner.

COVENTRY AMATEUR RADIO SOCIETY
Hon. Sec.: A. J. Wilkes, G3PQQ, 141 Overslade Crescent, Coundon, Coventry, Warwickshire.

The "open night" meeting of 1st April was followed later in the month by a film show held on the 22nd.

"Two metre contests" was the subject under discussion at the meeting on the 29th.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.

On April 17th a number of members assembled at the appointed place for the start of the first d.f. practice run of the season.

On May 1st a sale of surplus items of equipment was held.

Future Event:
May 8th—Safety in the shack and home.

FLINTSHIRE RADIO SOCIETY
Hon. Sec.: A. Antley, "Fairholme", Fairfield Avenue, Rhyl, Flintshire.

After the slow morse practice at 7.30 p.m., L. W. Barnes (GW3PCZ/T) continued his series of lectures—"Simple Hints and Kinks"—at the meeting for April, held on the 29th.

ISLE OF WIGHT RADIO SOCIETY
Hon. Sec.: Capt. E. C. Dolling, "Sweet Briars", New Road, Wootton Bridge, I.W.

The committee recently decided to intensify its recruiting campaign and therefore anyone interested in joining the society should visit the Social Club, Lower St. James Street, Newport, where meetings are held every other Friday evening.

The secretary also invites radio clubs wishing to hold field days in the Isle of Wight to contact him for assistance in planning the events.

LINCOLN SHORT WAVE CLUB
Hon. Sec.: A. D. Taylor, G3OSB, 34 St. Peter's Avenue, Lincoln.

Any local short wave enthusiasts are invited to the meetings of this club, which are held on the first Wednesday of each month in the Lincoln Technical College.

LOTHIANS RADIO SOCIETY
Hon. Sec.: W. T. Sutherland, GM3JWS, 47 Great King Street, Edinburgh 3.

"Ancient Radio at Sea" was the title of the lecture given by T. Spiers at the first meeting in April. Later in the month on the 25th, Sandy Laurie gave a talk on "Monkey Glands for the H.R.O." and also gave a demonstration of T.V.I. proofing.

MANSFIELD AMATEUR RADIO SOCIETY
Hon. Sec.: M. Dawson, 35 Elkesley Road, Welbeck Colliery Village, Mansfield, Nottinghamshire.

This new society has been formed to serve the needs of local amateur enthusiasts and information about the club can be obtained from the secretary. The weekly meetings are held at the Hope and Anchor Inn, Union Street, Mansfield.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden Halifax, Yorkshire.

The most important Society event for April was the Annual General Meeting, which was held on the 10th. On 17th April the "Amateur Sound Licence" was the subject of a discussion.

READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook Road, Reading, Berkshire.

This club reports good attendance at all meetings. On April 27th, the meeting was devoted to a spares sale.

Future Event:
May 25th—Receivers.

STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: R. A. G. MacIntosh, 50 Field Lane, Oldswinford, Stourbridge, Worcestershire.

At the recent Annual General Meeting, G3CLG was elected President, G3HGI vice-president, G2OG treasurer and BRS20894 secretary.

WESSEN AMATEUR RADIO GROUP
Hon. Sec.: G. J. Fowle, 138 Surrey Road, Branksome, Poole, Dorset.

The film show and lecture given by G. J. Fowle was held on April 1st. On the 8th, the Group took part in an inter-group quiz with the Southampton R.S.G.B. Group.

On April 20th members visited the Worcester P.O. radio station.

WORCESTER AND DISTRICT AMATEUR RADIO CLUB
Y.M.C.A., Henwick Road, Worcester.

At the Hobbies Exhibition held in Worcester on 18th, 19th and 20th April, the Club operated a station on 160, 20 and 2 metres under the call sign GB3WOR.

An Audio Absorption Wattmeter

With regard to the article that commenced on page 718 of the December 1962 issue, the voltage figures given in Tables 1, 2 and 3 in the text should be reduced by a factor of 1·11. This is necessary because no account was taken of the Form Factor for an alternating current. The amended Table 1 is reproduced below. Tables 2 and 3 should be amended in a similar manner.

Table 1

Impedance							
3Ω				15Ω			
Voltage	Power	Voltage	Power	Voltage	Power	Voltage	Power
3·48	5	7·79	20	7·79	5	15·59	20
3·11	4	6·97	16	6·97	4	13·95	16
2·70	3	6·03	12	6·03	3	12·08	12
2·20	2	4·93	8	4·93	2	9·86	8
1·56	1	3·48	4	3·48	1	6·97	4
1·10	0·5	2·47	2	2·47	0·5	4·93	2

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SUPER CAR-PORTABLE RADIO OFFER

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A fully transistorised Go-Anywhere portable that automatically becomes a real car radio simply by sliding into the car-holder tray. Full Medium and Long waveband coverage—Press button wavechange—Transistors used: 1—OC44; 2—OC45's; 1—OC82D; 2—OC82's and one diode. Internal ferrite rod aerial—Internal loudspeaker provides ample volume as a portable. Separate 8 x 5in. speaker is used in the car (supplied complete with 8 x 6in. baffle for easy fixing). Battery drain is exceptionally low, the life of the set's self-contained battery is approx. 200 hrs. Attractive finish in two-tone red and grey Vyanide washable material. Carrying handle folds away when not in use. Tuning scale is illuminated when set is operating in the car-tray. Size 9½ x 7¾ x 3in. Bracket for padlock provides an effective thief deterrent. Compares with sets costing at least double. Properly installed this set will give you years of pleasure and service—both in and out of your car. **Note: as a car radio this receiver operates ONLY from a 12-volt electrical system (positive or negative earth). As a portable it is powered by its own internal battery.** All connections to car battery, speaker and aerial are automatically made simply by sliding into car-tray.

WIRECOMP'S PRICE £10.19.6

COMPLETE WITH METAL TRAY, ALL CAR FITTINGS, 8 x 5in. CAR SPEAKER & FULL EASY-TO-FOLLOW FIXING INSTRUCTIONS. PP9 Battery 3/9 extra. P. & P. 7/6 extra

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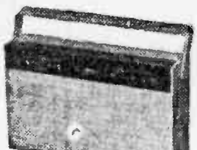

This superhet receiver uses the very latest circuitry, 6 transistors and two diodes and is fully tunable over both medium and long wavebands. First stage uses three Mullard AF.117 alloy diffused transistors with OA79 and OA91 diodes. output—OC81D and two OC81's in push-pull. I.F. frequency 470 Kc/s. Large internal ferrite rod aerial gives excellent reception over all ranges. 3 inch high flux speaker has a maximum output of 330mW. Operates on four 1.5 v. pen torch batteries. All components are mounted on a single printed circuit board. Attractive plastic case with carrying handle—fitted sockets for personal earpieces, tape recorder and car aerial. Size 6¾ x 4 x 1½in.

MAY BE BUILT FOR £5.7.6 All parts sold separately.

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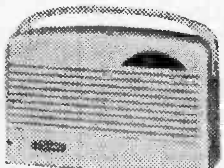
THE 'REALISTIC 7'



A fully transistorised Portable Receiver made to the highest professional standards—is now available to the homeconstructor. Comprises 7 Mullard Trans. OC44, 2 OC45's, OC71, OC81D, and 2 OC81's plus OA70 Crystal Diode. Delivers 350 milliwatt output to 4in. high flux speaker—I.F. frequency 470 Kc/s.—fully tunable over medium and long wavebands. All components mounted on single printed circuit board, size 5¼ x 5¼in. Attractive two-tone plastic cabinet with carrying handle—size 7 x 10 x 3½in. with easy to read dial and socket for car aerial, choice of Red/Grey, Blue/Grey or all Grey. Complete with full instructions. **All parts sold separately.**

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Fully tunable over Long and Medium wavebands. Uses printed circuit and High sensitivity internal ferrite rod aerial. I.F. frequency 470 Kc/s. Transistors: 3 Philco 2067's, 2 Mullard OC81M's, OC81DM and OA90 diode. 3 inch speaker. Works on single PP3 battery. Supplied with the complete R.F. and I.F. stages. Driver and Output stages, ready built and mounted on the printed circuit; for final assembly you only have to fit the wave-change switch, tuning condenser and drive, volume control, earphone socket and aerial rod. In very attractive plastic case, size 4 x 2½ x 1in. **All parts sold separately.**

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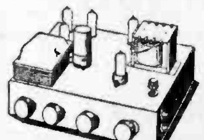

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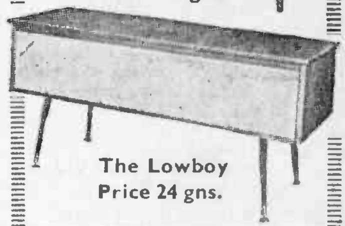

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PRACTICAL WIRELESS, JUNE, 1963

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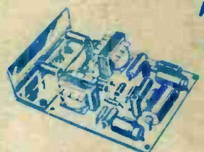

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