

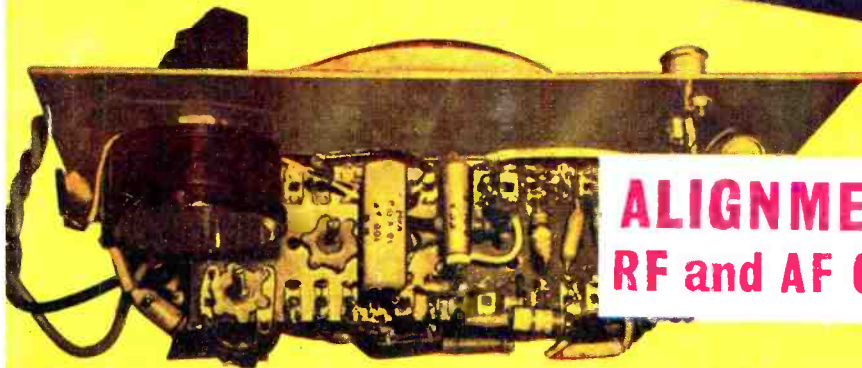
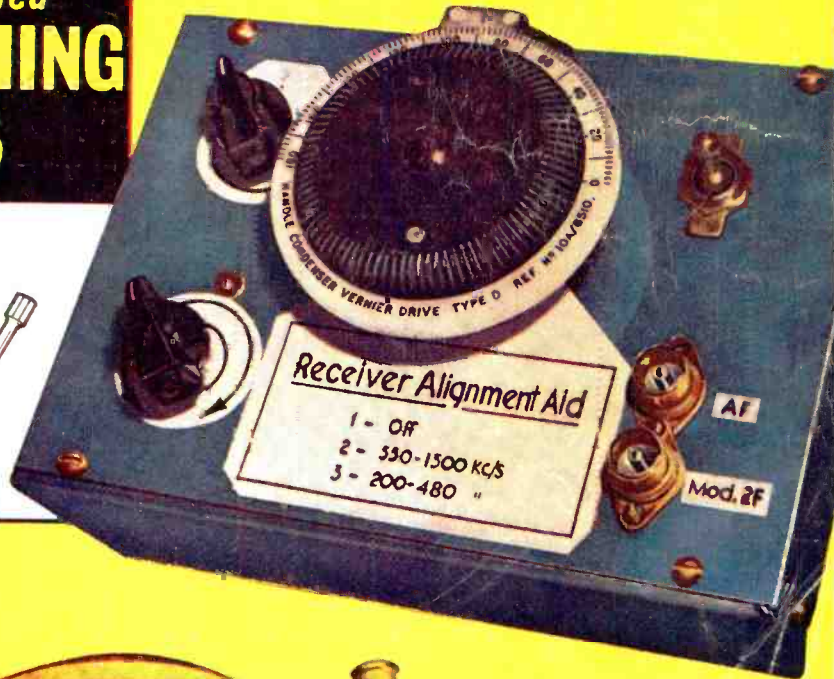
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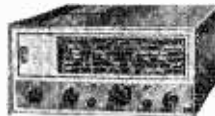
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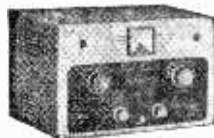
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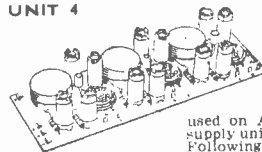
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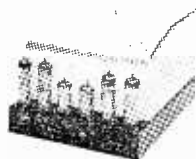
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**THE TUDOR STEREO HI-FI SYSTEM**, comprising a Self Powered AM/FM Tuner, Stereo Pre-amplifier, 12 watt per channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal cabinets for shelf mounting, with silver metal dials and matching knobs. Specifications: Tuner—



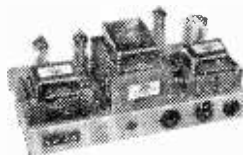
—Outstanding quality providing full V.H.F. FM long and medium waveband coverage, frequency range FM 87.5-106.5 Mc/s, AM/MW 522-1630 Kc/s. LW 145-270 Kc/s. 100mV output mains supply 105/240 A.C. Valve line-up: ECC85, ECH91, 6BF6, 6B91, EM84, ECC83. Multiplex outlet provided. Pre-amplifier—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pickups, direct play from Tape-Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion 0.1%, tape outputs 100mV from 90K, ohm source inputs—Microphone 5 mV, Tape 5.3 mV, R.I.A.A. 4.3 mV flat 250 mV, Tuner 100 mV. Valve line-up: 2—EF86, 4—ECC83. Power Amplifier—14 watts per Channel, sensitivity 1 volt rms. for 14 watts output, frequency response  $\pm 0.3dB$  20 c/s. —20 Kc/s. Speaker impedance 4, 8 or 15 ohms, surplus power available for Tape Pre-Amp, mains supply 105/240 v. A.C. Valve line-up, 2—ECC83, 4—EL84, 1—GZ34.

**DOUBLE FEATURE PRE-AMPLIFIER AND JLI0 POWER AMPLIFIER**

A new conception in the field of audio engineering by Stern-Clyne development engineers. The most up-to-date circuitry is used in the Double Feature Pre-amplifier, it has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay.

This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck. Offers superb reproduction from all sources at low cost. Available shortly. Brief Specifications:

★ **J.LI0 POWER AMPLIFIER**



Incorporates the latest triode-pentode ECL86 valves in push-pull, PARTRIDGE ultra linear output transformer, PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner. Output impedance 3—7.5—15 ohms.

KIT OF PARTS **11 Gns.** C. & I. 7/6.  
READY BUILT **14 Gns.**

★ **DOUBLE FEATURE PRE-AMPLIFIER**



enclosed in a silver hammer finish steel case, and an attractive perspex front panel completes the presentation.

KIT OF PARTS **£17.00** READY BUILT **£21.00** C. & I. 5/-  
PRICES: If both above units purchased together:  
KIT OF PARTS **£27.10.0** READY BUILT **32 Gns.** C. & I. 10/-



**MODEL CR3 S TAPE RECORDER**

MODEL CR3/S incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1 in., 3 in., and 7 in. speeds. Complete with microphone and 1,200ft. tape.

KIT OF PARTS **£33.8.0**  
ASSEMBLED **£43.0.0**  
AND TESTED (Carr. & Ins. 15/- extra).

**STEREO TAPE PRE-AMPLIFIER**

MODEL STP-1. For use with current TRUVOX, BRENNELL or COLLARO "STUDIO" 1 and 4 track Stereo Decks. Incorporates Ferroxcube Oscillator, 4-speed Equalisation Signal Level Meter and separate Gain Control. Includes separate Power Unit. KIT OF PARTS **£22.0.0** (Carr. & ASSEMBLED **£28.0.0** Ins. 8/6)



Instruction book and detailed price list (free with kit) available separately at 5/- Post Free.

**TAPE PRE-AMPLIFIER MULLARD Type "C"**

Suitable for most 1 track. Mono Tape Decks. Incorporates Ferroxcube Push-Pull Oscillator, Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit. KIT OF PARTS **£14.0.0** (Carr. & PARTS **£19.0.0** Ins. 7/6).



Instruction book and detailed price list (free with kit) available separately at 3/- Post Free.

**MULLARD TAPE AMPLIFIER**

MODEL HF/TR3/MK.II Based on Mullard's Type "A" design and suitable for most 1 track Mono Tape Decks. Incorporates Ferroxcube Treble Inductor, Gilson Output Transformer, and 3-speed Equalisation. Includes separate Power Unit, using PARTRIDGE Mains Transformer. KIT OF PARTS **£13.13.0** (Carr. & PARTS **£19.0.0** Ins. 7/6).



Instruction book and detailed price list (free with kit) available separately at 3/- Post Free.

**COMBINATION TAPE UNITS**

All our Tape Units can be supplied specially matched to any Tape Deck such as Collaro, Brenell Mk.5 Series II, also the Wearite. Specimen prices as below.

	Kit	Assembled.
STP-1 Pre-amp with Collaro Studio Tape Deck.....	£35. 0. 0	£42. 0. 0
Assembled with track switch fitted, £44.2.0		
STP-1 with Brenell Mk.5 Series II with Track Switch fitted.....	£68. 4. 0	
STP-1 with Brenell Mk.5 Series II, 4 Track Deck.....		£74.15.0
Type "C" Pre-amp with Collaro Studio Tape Deck.....	£24.10.0	£30. 0. 0
Assembled with deck wired and matched, £32.2.0		
Type "C" Pre-amp with Brenell Mk.5 Series II Deck.....	£46.11.0	£53. 1. 0
Assembled with deck wired and matched, £55.3.0		
HF/TR3 with Collaro Studio Tape Deck.....	£24. 3. 0	£29.10.0
Assembled with deck wired and matched, £31.12.0		
HF/TR3 with Brenell Mk.5 Series II Deck.....	£46. 4. 0	£51.11.0
Assembled with deck wired and matched, £55.13.0		

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Table with multiple columns listing electronic components such as resistors, capacitors, and diodes, including their values and part numbers.

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF VALVES - LOOSE OR BOXED, BUT MUST BE NEW METAL RECTIFIERS, 6X4, 6X5, 6X6, 6X7, 6X8, 6X9, 6X10, 6X11, 6X12, 6X13, 6X14, 6X15, 6X16, 6X17, 6X18, 6X19, 6X20, 6X21, 6X22, 6X23, 6X24, 6X25, 6X26, 6X27, 6X28, 6X29, 6X30, 6X31, 6X32, 6X33, 6X34, 6X35, 6X36, 6X37, 6X38, 6X39, 6X40, 6X41, 6X42, 6X43, 6X44, 6X45, 6X46, 6X47, 6X48, 6X49, 6X50, 6X51, 6X52, 6X53, 6X54, 6X55, 6X56, 6X57, 6X58, 6X59, 6X60, 6X61, 6X62, 6X63, 6X64, 6X65, 6X66, 6X67, 6X68, 6X69, 6X70, 6X71, 6X72, 6X73, 6X74, 6X75, 6X76, 6X77, 6X78, 6X79, 6X80, 6X81, 6X82, 6X83, 6X84, 6X85, 6X86, 6X87, 6X88, 6X89, 6X90, 6X91, 6X92, 6X93, 6X94, 6X95, 6X96, 6X97, 6X98, 6X99, 6X100, 6X101, 6X102, 6X103, 6X104, 6X105, 6X106, 6X107, 6X108, 6X109, 6X110, 6X111, 6X112, 6X113, 6X114, 6X115, 6X116, 6X117, 6X118, 6X119, 6X120, 6X121, 6X122, 6X123, 6X124, 6X125, 6X126, 6X127, 6X128, 6X129, 6X130, 6X131, 6X132, 6X133, 6X134, 6X135, 6X136, 6X137, 6X138, 6X139, 6X140, 6X141, 6X142, 6X143, 6X144, 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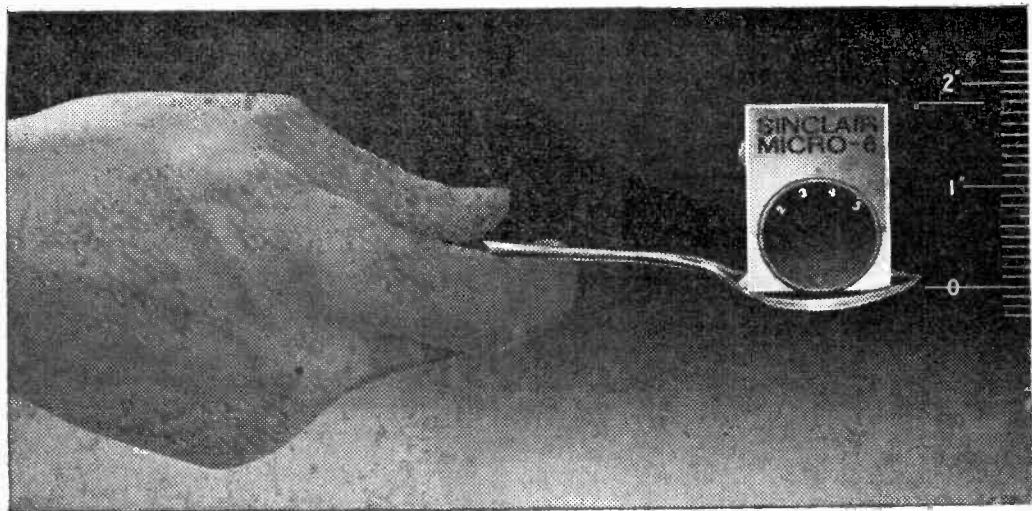
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# THE SMALLEST



## *A fantastic development in micro-miniaturisation*

The Sinclair Micro-6 is the smallest radio set in the world. Its six-stage circuit gives it the power and sensitivity that make reception possible under the severest listening conditions so that you can have radio at your command no matter where you are, in car or bus, at home or at work. Just look at the remarkable specification of this latest Sinclair micro-electronic design—and then look at its size. It is by the use of micro-components originally developed for use in space and computer electronics that a set with these tested and proven standards can be contained within a case considerably smaller than a matchbox.

Brilliantly designed by the Sinclair research and development team, the Micro-6 is years ahead of anything the Americans, Japanese or Germans have yet produced. For within its minute dimensions, just  $1\frac{4}{5}$  in. x  $1\frac{3}{10}$  in. x  $\frac{1}{2}$  in., it incorporates the features of a de-luxe receiver. The professionally styled case and dial give this set outstanding appearance and make it a delight to use. Building the Micro-6 will be the most fascinating experience you have ever had in electronics. Send for yours today and you will have for your pride and lasting pleasure the smallest and most efficient receiver of its kind on earth.

**A WORLD-BEATING BRITISH DESIGN**

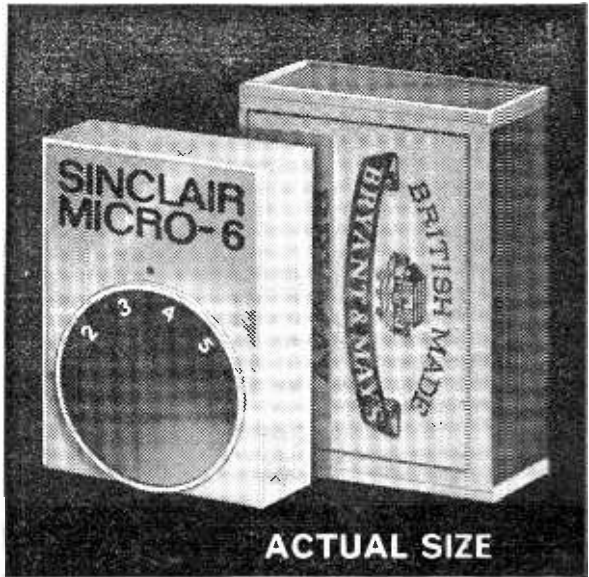
# SINCLAIR MICRO-6

One of a series of specialised micro-electronic transistor designs by

**SINCLAIR RADIONICS LTD. 69, HISTON ROAD, CAMBRIDGE**

# SET IN THE WORLD

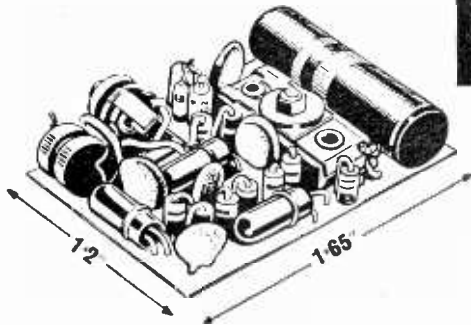
- ★ Six stage sensitivity.
- ★ Unique circuitry gives immense power and quality.
- ★ Plays in car, train, bus or plane.
- ★ Self-contained ferrite rod aerial and batteries.
- ★ Excellently detailed building instructions.



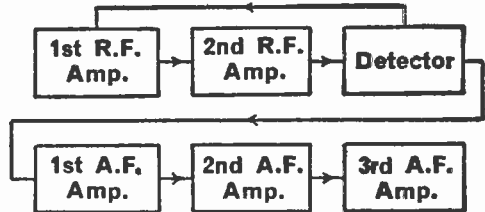
ONLY 1 1/5" x 1 3/10" x 1/4"

A.G.C.

## CHASSIS VIEW ACTUAL SIZE



This life-size illustration of the Micro-6 shows the ingenious printed circuit board layout which makes it such a delight to build. By following the well presented instructions handbook, building could not be simpler.



BLOCK DIAGRAM OF CIRCUIT

## TECHNICAL DESCRIPTION

The Micro-6 uses Micro-Alloy Transistors (MATs) in a completely new circuit comprising six stages. Two stages of R.F. amplification are followed by an efficient double-diode detector which drives a high gain three stage A.F. amplifier. Powerful A.G.C. is applied to the first R.F. stage to ensure fade-free reception of the most distant station, and tuning covers the entire medium waveband. This is widened out at the high frequency end to provide improved separation of Continental stations. The tiny ferrite rod aerial and earpiece socket were both specially designed for this set. This socket incorporates a switch which operates automatically on inserting the earpiece plug, and switches off when the plug is withdrawn. Listening is by means of the high-impedance lightweight earpiece provided. Quality of reproduction is outstandingly good. Instructions for building the Micro-6 set a new standard of clarity and simplicity. The diagrams are a masterpiece of technical illustration and the text contains all the information you require. Parts for building the Micro-6 together with instructions come to only **59/6**

Mallory Mercury Cell, Type ZM.312—1111d. each.

**MORE SINCLAIR DESIGNS ON NEXT PAGE**

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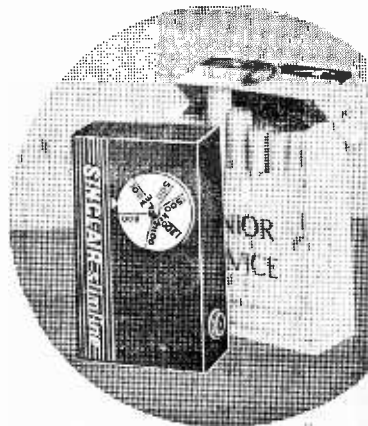
PW4

# THE MOST AMAZING TRIBUTE EVER PAID TO A CONSTRUCTOR'S SET

The success of the Sinclair 'Slimline' has been demonstrated again and again in the letters we have published from among the many hundreds sent to us by enthusiastic builders of this famous receiver. Of these, none surpasses the one we publish below. It typifies better than anything the ease with which the 'Slimline' can be built and also the excellence of the performance it offers. Newcomers to micro-transistor set building cannot do better than start right away with the 'Slimline' now.

## SINCLAIR "Slimline"

**Simplicity itself to build**



**It gives you Europe in the palm of your hand**

The Sinclair 'Slimline' is a micro-miniature receiver with self-contained ferrite rod aerial and accommodation for a standard PP.5 battery. Using Sinclair MAT Transistors and special circuitry, it provides great power and quality, tuning over the whole medium waveband and will play in car, bus or train. With all components, gold-trimmed blue case (size 2 1/4 in. x 1 1/4 in. x 3/4 in.) and lightweight earpiece, to build this set costs

**49/6**

**MORE SINCLAIR DESIGNS FOR YOU TO BUILD**

**SINCLAIR MICRO-PROBE**

Injects a test signal at any frequency from 1 Kc/s to 30 Mc/s into radio or amplifier for rapid location of faults. Smallest and most efficient of all. Only 1 1/8" x 1 3/16" x 1/4". Probe—5/16". Parts come to

**27/6**

*Built and tested—32/6*

**SINCLAIR MICRO-AMPLIFIER**

Smaller than a 3d. piece! From 30 to 50,000 c/s ± 1dB; 60dB power gain. Good R.F. broad band amp. or will even drive a loudspeaker. Parts come to

**28/6**

**SINCLAIR TR.5 AMPLIFIER**

With integrated tone control circuit and 1 watt output (transformerless) into 16 ohms. Sensitivity 0.5mV. Supplied ready built, with instructions.

**59/6**

**BOOKS FOR CONSTRUCTORS**

22 Circuits using MATs — 5/6. ● Tested Shortwave Receivers using MATs — 5/6 ● Tested Superhet Circuits for Shortwave and Communication Receivers using MATs — 6/6. ● All three together — 18/6.

60A Bromley Road,  
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London, S.E.6.  
3-12-63.

Dear Sirs,

Though you have received many tributes to this fine little set, I should still like to add mine, for I am a complete duffer of over 50 who till now had never attempted anything through sheer ignorance. I am still ignorant of the first principles of radio, but, within two hours of sitting apprehensively at the table to study the instructions, I was listening to my first programme and the quality of reproduction surpasses that of sets many times the price.

Yours faithfully,  
(signed) Harold F. B. Carter.

*A facsimile copy of the original of this letter has been shown to the Editor of this and other technical magazines.*

**GUARANTEE**

*All items sold are covered by our money back guarantee. Full service facilities available to Sinclair customers.*

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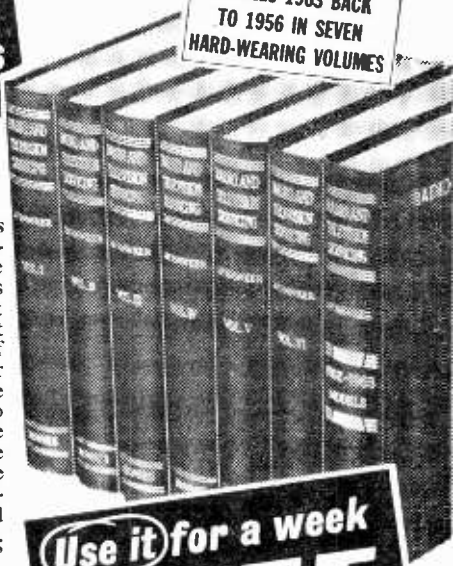
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An invaluable companion to your set for on-the-spot repairs. 272 pages of reference data on installing, fault-tracing and repairing, servicing equipment, etc.



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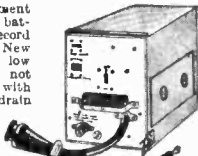
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MAKE A RADIO RECEIVER OUT OF YOUR AMPLIFIER. Full medium wave coverage. Ideal for all tape recorders, amplifiers, etc. No batteries required—just plug in! **29/-**

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- Charge Rate Adjuster.
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B.S.E. UA14 with latest turn-over head **£6.0.0** BARGAIN OFFER. If purchased with Bona Minihette Amplifier, £8.10.0 for both. P. & P. 5/-.

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New in Paxolin cabinet with circuit and instructions on rear panel. Calibrates transmitters and receivers. 3 choices of calibration points: 10, 100, 1,000 kc/s apart, harmonics up to 20 mc/s. Operates from 2 v. accumulator and 120 v. dry battery. **£2.19.6** P. & P. 3/6.

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Electronic construction sets made by General Electric Co.

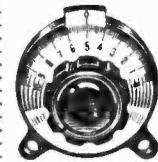
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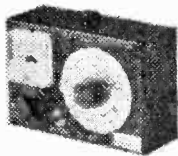
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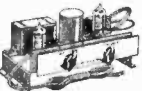
Designed for checking the radiation from a transmitting antenna. The sensitivity can be controlled by adjustment of panel control, the antenna length, or by increasing distance from the radiator. Frequency range 1-35 mc/s. 200mA D.C. Complete with instruction book. Post free.



69/6

**SONA MINNETTE GRAMOPHONE AMPLIFIER**

The "Minnette" is a compact two stage amplifier designed primarily for use in small portable self-contained Record Player Units. The circuit consists of a single triode-pentode valve, Mullard ECL82. The sensitivity of the valve is such that a relatively small input at the grid of the triode section will produce maximum power from the pentode section. Thus the output derived from most crystal pick-ups is ample to produce maximum output from the valve. The power supply is conventional and utilizes a Mullard E280 valve rectifier with adequate capacitive resistive filtering. Dimensions—Amplifier 6 inches by 3 inches by 4 1/2 inches. Front panel 5 1/2 inches by 1 1/2 inches. For operation on A.C. mains 230/250 volts.



£4.15 0/5/- P. & P.

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Morse key assembly. Key with base, cover and terminals. Complete with lead.



6/11 P. & P. 2/-

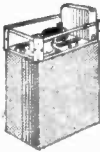
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11.5 input, 490 v. output at 65mA, from 6 v. input, approx. 250 v. output at 75mA. Price 9/11 P. & P. 3/6.



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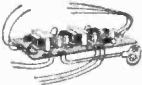


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**4 TRANSISTOR PUSH-PULL RADIO AMPLIFIER 45/-**

Complete with 3 ohm output transformer working from a standard 9 volt battery. Output in excess of 200 MW.



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Trans. & Receiver covers 2-8 Mc/s. (150-37 metres in two bands.) Has an intercom. amplifier. Designed for 12 and 24 volts operation. Uses a

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Transistor Holder, 3-pin, (P. & P. 3d.) 11d. each.

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Above MAT's postage paid.  
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Input 0.200-250 v. secondary tapped as follows:  
3v, 4v, 5v, 6v, 8v, 9v, 10v, 12v, 15v, 18v, 20v, 24v, 30v, at 4amps. BRAND NEW not Government Surplus. 36/-. P. & P. 3/6.  
**FILAMENT TRANSFORMERS** 200-250 v. input. 50 c/s. Output. 6.3 v. at 2amps. 6/11. P. & P. 1/3.

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12 v. input. Output frequency 30 to 41 mc/s with optional modulation at 760, 1150 or 1700 c/s. Crystals not fitted, but unit in excellent condition, probably unused. Valves CV18—DE119, CV51—Y65 (tuning indicator), 6J5G0—(two). Condensers: 28 including 6 large block type. Resistors: 21. Indicators: 5. Tubes: 1. Transformers 2. Switches: 4, including an S position crystal selector and 4 position tone switch. The unit is housed in a strong metal case and this in turn is mounted on shock absorbers in a wooden travelling box with carrying handles.

£5.10.0 P. & P. 2/-

**SIX TRANSISTOR RADIO**

Just arrived! Superb pocket radio. Give terrific reception station after station: home and abroad. Attractive finish. Perfect tone speaker. £3.15.0. P. & P. 2/6.

**TEST SET TYPE 253**

Range 20-88 mc/s in 4 bands. Vernier tuning. Optional pulsed output with fine tuning 50 c/s mains operation. Noise generator. Strongly made, with metal carrying case. Contains many valuable components: 9 valves, full wave rectifier unit, 4 crystals, meter, mains transformer, numerous switches, chokes, condensers, etc.



52/6 P. & P. 5/-

**PLANET CRYSTAL MICROPHONE**



List Price one 35/-. Beautifully made in strong plastic case with approx. 5ft. of cable and jack plug. Response 50—13,000 c/s.

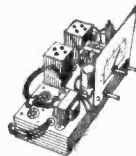
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Type 312-0015 or 0029 uses one AF 106 and one AF 125 Super Gain Transistor plus 2 diodes in ultra high RF plus additive mixer circuit. Tuning range 87-108.5 Mc/s. Amplification greater than 43dB. Built in A. F. and A. V. C. Size 4 x 1 1/2 x 1 1/2in. £8.5.0, including Purchase Tax. Post Free.

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These well made chassis were made for the Government for Forces entertainment with 6K8, 6K7, 6Q7, 6V6. Choke smoothing slow-motion tuning, printed scale, 200-550 metres. BRAND NEW. Cabinet with 8in. speaker to fit. Complete in maker's cartons.



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The Radio with the STAR features

- ★ 7-transistor superhet. Output 350mV.
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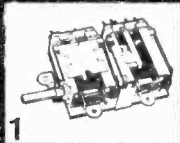
Please send, without obligation, details of the  
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Name \_\_\_\_\_

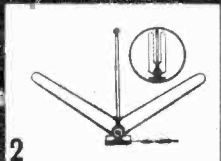
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1



2



3

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2. **625 INDOOR AERIAL.** 625 line indoor aerial complete with stand, fully extendable can also be used for 405, ITV, BBC and FM. 19/6, plus 1/- P. & P.

3. **A.C./D.C. POCKET MULTI-METER KIT.** 2in. moving coil meter scale, calibrated in A.C./D.C. volts, ohms and milliamperes. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milliams 0-10, 0-100. Ohms ranges 0-10,000, 0-100,000, 10/6. P. & P. 2/-. Wiring diagram 1/- free with parts.

4. **SIGNAL GENERATORS:** Cash £7.5.0 P. & P. 0/6. Coverage 100 Kc/s to 100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics. Case 10 x 6½ x 5½ in. Three miniature valves and Metal Rectifier. A.C. mains 200/250v., internal modulation of 400 c.p.s. to a depth of 30 per cent. Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output. Magic eye as output indicator. Accuracy 2 per cent.

5. **SIGNAL GENERATORS:** Cash £5.5.0 P. & P. 0/8. Coverage 120 Kc/s to 84 Mc/s. Case 10 x 8½ x 4½ in. Size of case 6½ x 5½ in. 2 valves and rectifier. A.C. mains 230-250v. Internal modulation of 400 c.p.s. to a depth of 30 per cent, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch variable A.F. output and moving coil output meter. Accuracy ± 2 per cent.

6. **A.C. MAINS MOTOR.** Silent running by famous manufacturer. A.C. Mains 230-250, shaded pull start. 1440 r.p.m., size 2½ x 2½ x 1½ in. approx. 7/6, plus 1/- P. & P.

7. **50 MICRO-AMP METER** movement by world famous manufacturer. Size 3 x 2½ in., 50/- Post Free

8. **THE MOTORISTS' REV. COUNTER.** Kit of parts comprising 270 degree 3in. moving coil movement. Manufacturer's present price of this movement would be at least 47. Complete with full instructions and circuit diagram. Measle calibrated up to 8000 r.p.m. Can be used with any 4 or 6 cylinder car. 20/6 Plus 3/6 P. & P. Meter movement only 22/- post paid.

9. **CHANNEL TUNER I.F.** 16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—POP80 and POC84 (in series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker. 10/- P. & P. 3/-.

10. **B.S.R. MONARCH UA14 WITH FULL-FI HEAD.** 4-speed, plays 10 records. 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Interlocks 7in., 10in. and 12in. records of the same speed. Has manual play position: colour brown. Dimensions: 12½ x 10½ in. Space required above baseboard 4½ in., below baseboard 2½ in. Fitted with Full-FI turnover crystal head, £5.10.6. P. & P. 6/8.

11. **POCKET MULTI-METER.** Size 3½ x 2½ x 1½ in. Meter dial 24 x 1½ in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts, 0-15, 0-150, 0-1,000. D.C. current 0-150 mA. Resistance 0-100K Ω. Complete with test prods, battery and full instructions. 35/- P. & P. 1/6.

12. **8-watt PUSH-PULL 4 VALVE AMPLIFIER plus METAL RECTIFIER.** A.C. mains 200-250 v. Size 10½ x 6½ x 2½ in. 4 valves. For use with all makes and types of pick-up and mike. Negative feed back Two input, mike and gram, and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 Kc/s. Noise level 40 dB down all hum. Output transformer tapped for 8 and 16 ohms speech coils. For use with std. or L.P. records, musical instruments such as guitars, etc. Suitable for small halls. £3.19.6. P. & P. 7/6. Crystal mike to suit, 15/- P. & P. 2/-, 8" x 5" P.M. Speaker to suit, 12/6. P. & P. 2/-.

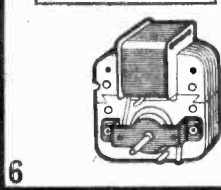
13. **FLOURESCENT LIGHT KIT.** 40 watt fluorescent lighting kit comprising Siemens Choke, 2 Lampholders, starter boiler and starter. 11/6, plus 3/- P. & P.



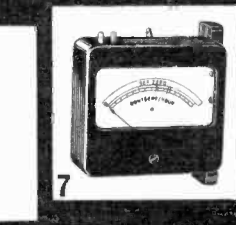
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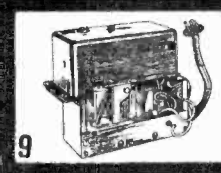
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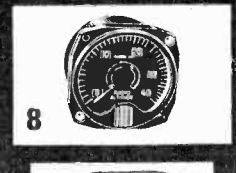
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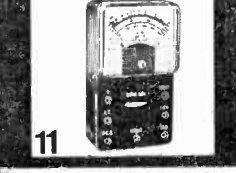
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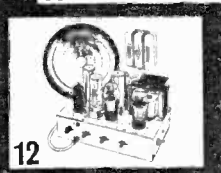
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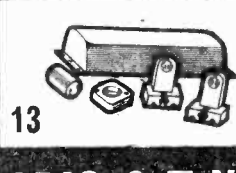
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13

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**21b HIGH STREET ACTON, LONDON, W.3.**

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WEDNESDAY

# HERE'S A LOW COST WAY TO GET INTO T.V. SERVICING FAST!

If you are a man who wants to get ahead in television, you will probably be interested in this new revolutionary type television training programme now being introduced for the first time.

Knowing that early success will usually spur a man on to greater achievement you learn how to make the easiest T.V. repairs first. Since the easiest T.V. repairs are the ones most often found on service calls, you are ready to make money right after the first lesson. Then as you progress you will discover how to handle every kind of trouble found in all makes of T.V. set!

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1. Simple adjustments to correct poor pictures.
2. Circuit faults indicated by a poor pattern.
3. Finding bad valves by observing picture faults.
4. Antenna principles and practices.
5. Facts about the T.V. signal to help you in repair work.
6. All about Cathode Ray tubes.
7. How to tell what is at fault.
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9. U.H.F. converters and tuners.
10. Television test equipment and alignment.
11. Advanced trouble shooting by picture analysis.

This is a real home study course that has been bound into one giant 8 x 11 in., 192 page manual to reduce cost.

Compares favourably with some courses costing very much more! By creating a mass market through large volume sales and eliminating individual letter writing we are able to pass on these savings directly to you!

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Please send your Television Course for a full seven days' free trial. If not delighted I may return the course post-paid without further obligation on my part. Otherwise I will pay cash price of 37/6 or 5/- weekly until 37/6 plus 2/6 service charge, total 40/- is paid.

Tick here if enclosing full price of 37/6. (Same 7-day money back guarantee). NOTE: Customers who send cash with order get in addition a 71-page book on TELEVISION FAULTS. Overseas customers please send full amount (including Ireland).

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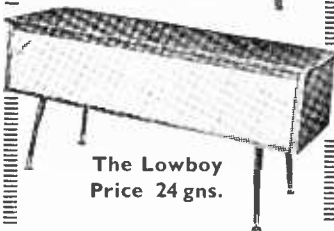
We can supply any cabinet to your own specification

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**THE LARGEST RANGE OF CABINETS IN THE COUNTRY**

Equipment is also our speciality.



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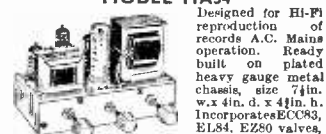
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### SPECIAL OFFER!

#### MARCONI QUARTZ CRYSTALS TYPES ZHB

Glass encapsulated, 2 wire lead out. Size 1 1/2 in. high x 1/2 in. dia. Following frequencies (Kc/s)  
13521, 13583, 13646, 13708, 13771, 13833  
13995, 13958, 14021, 14083, 14146, 14208  
14271, 14333, 14396, 14459  
6/- each. P. & P. 1/- per crystal. 3 or more Post Free.

#### 3-VALVE AUDIO AMPLIFIER. MODEL HA34



Designed for Hi-Fi reproduction of records A.C. mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2 in. w. x 4 in. d. x 4 1/2 in. h. Incorporates ECC83, EL84, E280 valves, heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Base, Treble and volume controls. Negative feedback line. Output 41 watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs valves, etc. P. & P. etc., wired and tested for only **£4.5.0** 4-TWO VALVE AMPLIFIER similar to above but using ECL82 and E280 with tone and volume controls. Output 3 watts. PRICE 75/-, P. & P. 4/-.

#### 4-SPEED PLAYER UNIT BARGAINS

All Brand New in Makers' Original Packing SINGLE PLAYERS  
B.S.R. TU/12..... £3.10.0 Carr. 3/6  
B.S.R. GU7 with unit mounted pick-up arm, £4.18.8 Carr. 4/-

#### AUTO CHANGERS

B.S.R. UA14..... £6.2.6  
Latest B.S.R. UA16..... £7.2.6  
LATEST GARRARD AUTO-SLIM With heavy-duty 4-pole motor. FEW ONLY £7.7.0. (Standard Auto-Slim £6.17.0). Carr. 5/- on each.

#### NEW CARTRIDGE BARGAINS!

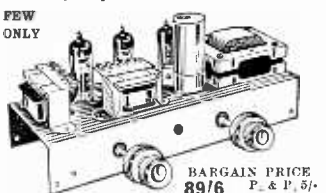
RONETTE STEREO 105 CARTRIDGE. Stereo/LP/78. Complete with two sapphires. Original list price 67/6. OUR PRICE 24/-, P. & P. 1/-  
COLLARO HI-FI STEREO 7/0 CARTRIDGE. Type 'C'. Complete with universal bracket and stylus for Stereo, LP and 78. Original list price 59/8. OUR PRICE 25/-, P. & P. 1/-  
ACOS GP65/1 T/O MONO CRYSTAL CARTRIDGE. Comp. with sapphire stylus and mounting bracket. Limited number only 12/6. P. & P. 1/-.

#### SPECIAL TRANSISTOR BARGAINS

ALL BRAND NEW  
GET 15 (Matched Pair) 15/-  
OC71 5/- OC72 6/- OC76 6/-  
PXA101 6/6 XA103 6/8 V15/10p 12/6  
Set of Mullard 6 transistors, OC44, 2—OC45  
OC81D matched pair OC81, 25/-  
EDISWAN MAZDA  
R.P.1 Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp.; (Equiv. OC44 and OC45)..... 10/6  
R.P. 2 Pack: 3—PXA102 I.F.;—PXA102 Osc.; 1—PXA102 Mixer..... 12/6  
L.P.6 Pack: Consisting of PXB113 Driver. Matched pair PXC171, mounted complete with heat sinks (Equiv. OC81D and OC81)..... 12/6  
ALL TRANSISTORS POST FREE

#### STEREO AMPLIFIER

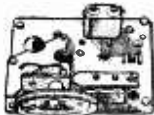
Incorporating 2 ECL82s and 1 E280, heavy duty double-wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



FEW ONLY  
BARGAIN PRICE 89/6 P. & P. 5/-  
Also available complete with two 8 x 5 in. Speakers for only £5.10.8. P. & P. 6/6.

**SPECIAL PURCHASE!**  
**TURRET TUNERS**  
by famous maker  
Brand new and unused.  
Complete with PUC94 and  
PC280 valves. 34-38 Mc/s  
I.F. Bicucials for Channels  
1 to 5 and 8 and 9. Circuit  
diagram supplied.  
ONLY 25/- each. P.P. 2/8.

**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 8/8 extra. Drum and spindle 3/6 extra.

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

**E.M.I. 4-speed Player and P.U. PATHER HUGG**  
PURCHASE either of us to offer these 67/6 4/6.



Heavy 8 1/2 in. metal turntable. Low flutter performance 200/250 v. shaded motor with tap at 45v. for amplifier valve filament if required. Turnover LP/78 head.

**RECORD PLAYER AMPLIFIER**

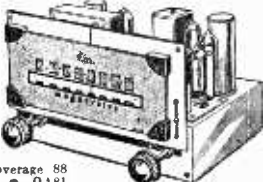
2 valve (EZ40, ECL82). A.C. mains, 3 watts output. Ready built, tested and complete with valves and output transformer. Size 7 1/2 w. x 2 1/2 d. x 3 1/2 h. 55/-. P. & P. 3/-. Suitable speakers: 4 1/2 in. 15/- P. & P. 1/8. 10 x 3 in. 28/-. P. & P. 1/6.

**SPEAKER & CABINET FABRICS**

Oatmeal, or Red and Gold Vynair for speaker and cabinet covering, also Red Resin for cabinet covering only. All 34 in. wide and usually sold at 35/- yard. **OUR PRICE 13/6** per yard plus P. & P. 1/9. (Minimum order 1 yard). Send S.A.E. for samples.

**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. ● OARI balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3 in. glass). ● Self powered, using a good quality mains transformer and valve rectifier.
- Valves used ECC85, two EF80's, and EZ80 (rectifier).
- Fully drilled chassis. ● Size of completed unit 8 x 6 x 5 1/2 in. ● All parts sold separately. Set of parts if purchased at one time 40.18.6, plus 8/6 P.P. and ins. Circuit diagram and instructions 1/8 post free. Mark II Version as above but complete with magic eye, front panel and brackets. 20.12.6. P. & P. 8/6.
- Mark III Version as Mark I but with output stage (ECL82) and tone control. 27.7.0. P. & P. 8/6.
- Handmade 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.



Mark III Version as Mark I but with output stage (ECL82) and tone control. 27.7.0. P. & P. 8/6. Handmade 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. ● Printed circuit panel (size 5 1/2 x 2 1/2 in.). ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerials. ● All first-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions. All parts sold separately. Set of parts if purchased at one time. **ONLY 24.5.0** P. & P. 2/8



**35 OHM SPEAKERS**

Suitable for use with above 2 in. Goodmans. Ideal replacement for most pocket portables 8/6. 2 1/2 in. 10/8; 3 1/2 in. 12/8; 5 in. 17/8; 7 x 4 in. 21/-. P. & P. 1/6 per speaker.

**Portable CABINET**

Size approx. 9 1/2 x 6 1/2 x 3 1/2 in. Suitable for above using 3 1/2 in. speaker, 25/-. P. & P. 2/8.

**COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET**

3 I.F. transformer, 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. Size 7 1/2 w. x 2 1/2 d. x 3 1/2 h. This amplifier (which is used in a 20 gn. record player) employs ECC83, EL84, EZ40 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. **PRICE 69/6 P. & P. 3/6**

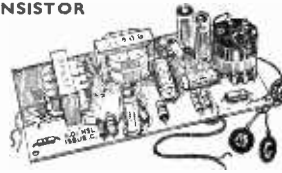
DI.T.O. Mounted on board with output transformer and 6 in. speaker. **Complete at 89/6 P. & P. 4/6.**

**QUALITY PORTABLE RECORD PLAYER CABINET**

Light motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8 1/2 in. **PRICE 23.9.6 Carr. 5/-**

**HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1**

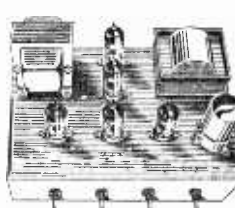
- Peak output in excess of 1 1/2 watts.
- All standard British components.
- Built on printed circuit panel size 6 x 3 in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET114 or st. Mullard OC511) and matched pair of OC81 o/p's.
- 9 volt operation.
- Everything supplied, wire battery clip, solder, etc.
- Comprehensive, easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.
- Also ready built and tested. 52/6. P. & P. 2/6. A pair of TA1's are ideal for stereo.



**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 EL24s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram. Also records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 ohm speaker and 3 independent volume controls and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL24s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.) All parts sold separately. **ONLY 26.19.6** P. & P. 6/6. Also available ready built and tested complete with input jack plugs. **28.15.0** P. & P. 6/6.



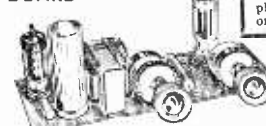
**BRAND NEW 3 OHM LOUDSPEAKERS**

2 1/2 in. 12/6; 3 in. 12/6; 6 1/2 in. 15/-; 8 in. 21/-; 10 in. 25/-; 12 in. 27/6. E.M.I. 2 1/2 in. tweeter ... 10/6. 10 in. x 6 in. ... 28/-. Also 13 ohm 12 inch, 30/-. Rola Celestion approx. 8 in. x 9 in. midrange speaker 10/6 P. & P. up to 6 in. 1/8; over 6 in. 2/6 per speaker.

**AMPLIFIER CAGES**

**BRAND NEW**  
Strongly made wooden construction, tough plyrite covered, complete with carrying handle. Overall size 13 1/2 in. wide x 8 in. deep x 8 in. high with sloping front panel. Weight only 4 1/2 lbs. Ideal for our 10/14 watt amplifier and many others. **BARGAIN PRICE 28/6** P. & P. 4/6.

**AMPLIFIER ON PRINTED CIRCUIT BOARD**



**Superior CABINET** To take 3 x 5 in. speaker, with motor board will accommodate BSR UA14 or UA16. 28.8.6. Carr. 5/6. Speaker 10/6 extra. P. & P. 1/6 extra.

**LARGE CABINET** Similar to above with 3 ohm speaker. 28.8.0 Carr. 5/6.

**TAPE DECKS**

**COLLARO STUDIO DECK** £10.10.0 plus 5/6 carr. and ins. **B.S.R. MONARDECK** (Single speed) 8 in. per sec, ample control, uses 54 in. spools, 28.18.0 plus 5/6 carr. and ins. (Tapes extra on both).

Two valve. HV85, UT84, 6 P.F. trans. use with 80 Volt tap of motor, 28/8. P.P. 2/6 on above. Dropper res. for filament if required, 2/6.

**★ BARGAIN CORNER ★**

**ACOS CRYSTAL MIKES.** High amp. 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.  
**GARRON MIKE INSERTS.** Brand new. 9 1/2 in. dia. 3/6 P. & P. 9d.  
**STANDARD COLVERN 50K W/P.** Present Price 2 for 4/- P. & P. 1/-.  
**STANDARD 1 1/2 in. FUSEHOLDERS.** Laminated. Twin. 12 for 1/8. P. & P. 9d. Laminated Single. 2 for 1/-. P. & P. 6d. Boiling-Lee Panel mounting, single 2/- each. P. & P. 6d.

**MAINS TRANSFORMER**

Drop thru type. Tapped primary 110v., 200v., 220v., 240v., 320-0-320v. at 80ma and 6.3v. at 3 amps. Generous core. Stack size 3 1/2 x 2 1/2 x 1 1/2 in. Weight 4 lbs. **ONLY 15/-.** P. & P. 5/6.  
**CONDENSERS.** 5000 m.Fd. 15 v. wkg. Size 3 x 1 1/2 in. dia. 8/- each. P. & P. 6d. each.

**SPECIAL SPEAKER BARGAINS!**

**FEW ONLY 6 x 4 in. 3 ohm Speakers.** Only 9/-. P. & P. 1/6 per speaker.  
**8 x 5 in. 3 ohm SPEAKERS BY WELL KNOWN MAKER** Unrepeatable at only 10/6 each. P. & P. 1/6 per speaker. A pair of these are ideal for Stereo.

**TRANSISTOR DRIVER 0/P TRANSFORMERS.** Tapped 3 ohm and 15 ohm output, plus 4 suitable Transistors giving approx. 1 watt output. 80/- P.P. 2/-.  
**Practical made 5000 m.Fd. 15 v. wkg. TUNGSTEN CONDENSERS.** Size 2 1/2 x 1 1/2 in. 4/- each. P. & P. 1/6.

**LOOK OPPOSITE FOR MORE BARGAINS**

**HARVERSON 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)  
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	Dep.	&	Mthly. pmts. of
Tape Amplifier for Studio Deck with ready wired printed circuit control and input panels, mains and output transformers, knobs, plans, screws, etc. EC85, EC83, EZ80, EM85 and 2 EL84. 3 watts output. Magic eye, radio and Mic. inputs. Ext. speaker socket. Tone and Monitor controls. Can be used as an amplifier. £11.11.0	24/-	12	18/-
Collaro Studio Deck. Very latest model, 3 speeds, 7in. spools. £10.19.6	22/-	8	27/3
Case for above, with 8 in. speaker, two tone grey £5.5.0	55/-	12	58/-
Complete Kit with Tape and Microphone. £29.0.0	20/-	9	21/-
B.S.R. Monardeck TD2, latest model 5 1/2in. spools £9.9.0	20/-	8	21/-
Tape Amplifier for B.S.R. Deck, printed circuit ready wired with EC83, ECL82, EM85 and EZ80. Complete with all plugs, sockets, panels, knobs, etc. Mounts under deck making a self-contained unit. £9.9.0	37/6	12	20/5

### For QUARTER TRACK

Collaro Studio Deck, Marriott "N" heads. £17.17.0	37/6	12	20/5
Tape Amplifier for Studio Deck, described above, but quarter track. £12.12.0	37/-	12	20/8
Case, with speaker, two tone grey. £5.5.0	70/-	12	58/2
Complete Kit with Tape and Microphone. £38.0.0			

B.S.R. TD2 Deck with Marriott "L" Series heads £11.11.0	24/-	12	19/-
Tape Amplifier for B.S.R. deck, as over, but quarter track. £9.9.0	20/-	9	21/-

### TAPE PRE-AMPLIFIER

For Studio Deck, with power supplies. EC83, ECL82, EZ80 and LM84. Mic. and Radio sockets, gives an equalised output of 400 mV/Volts. Hall Track £8.8.0	20/-	8	21/-
Quarter Track £9.9.0	20/-	9	21/-

TAPE HEADS			
MSS Quarter track. Record/Playback and Erase per set. £33.3.0	—	—	—
Bradmatic Half track Record/Playback head only £12.6	—	—	—
Bradmatic Half track Record/Playback and Erase on plate. £1.19.6	—	—	—
Collaro pressure pad for third head position. 4/-	—	—	—

### BRENELL

Mk. 5 Series 2 Deck, Hall Track 4 speed. £32.11.0	65/-	12	54/-
Mk. 5 Series 2 Tape Amplifier with power pack £26.0.0	52/-	12	43/2

## GRAMOPHONE UNITS, MOTORS, PICK-UPS

Decca Deram Arm and Plug-in Shell. £5.5.0	—	—	—
Decca Deram Transcription Cartridge. £4.14.8	—	—	—
Decca Deram Auto Cartridge. £3.13.6	—	—	—
Garrard SRP10 with GCS cartridge, Mono, single player. £5.9.11	—	—	—
B.S.R. VA14 with TCS cartridge, Mono, 4-speed changer. £6.19.6	20/-	6	23/3
Garrard Autosim, Mono GCS cartridge, 4 speed changer. £7.17.0	20/-	7	22/6
Garrard AT6 Autosim de Luxe, GCS Mono cartridge. £11.9.0	26/8	9	24/9
Garrard 4H/F with Mono GCS cartridge. £17.0.0	34/-	12	28/2
Garrard Lab Type "A" Transcription auto-changer, Mono with GCS cartridge. £19.14.9	39/6	12	32/9
Garrard 301. £20.12.2	43/2	12	34/-
Garrard 301 Sirobe. £22.0.0	44/-	12	36/8
Phillips AG1018, Stereo cartridge, will change 7in. records (adapter 10/- extra). £12.12.0	27/-	12	20/8
Golding GL58 with arm, less cartridge. £15.19.8	32/-	12	26/6
Golding GL70 with arm, no cartridge. £26.3.0	55/-	12	43/2
Golding GL55X, as GL58 but less pick-up arm. £13.1.7	27/7	12	21/6
Golding "88" Transcription, no arm. £17.14.0	39/-	12	29/-

## ARMSTRONG - NEW TUNER AMPLIFIERS

### MONO

AF208 A.M./F.M. Radio chassis, bass and treble controls, P.C. inputs, etc. £21.4.0	46/-	12	34/10
ST3 Mk. 2 A.M./F.M. Self-powered tuner. £25.12.0	33/-	12	42/9
227M A.M./F.M. Radio chassis 10 watts. £33.18.0	70/6	12	56/1

### STEREO

Stereo 55 A.M./F.M. Radio chassis, with Stereo gram inputs. £29.18.0	62/6	12	49/5
223 A.M./F.M. Self-powered (Tuner only). £28.15.0	57/8	12	47/9
224 P.M. only, Self-powered Tuner. £22.10.10	45/-	12	37/4
227 A.M./F.M. Radio chassis, Stereo gram, 10 watts each channel. £49.15.0	87/6	12	81/1
228 A.M./F.M. Radio chassis, Stereo gram, 10 watts each channel, P.H.T. etc. £56.0.0	112/-	12	93/2

### OTHER TUNERS

Tripletone F.M. Tuner, less power. £18.19.6	28/-	12	23/2
Tripletone F.M. Tuner, self-powered. £15.14.6	31/6	12	26/1

## STEREO AMPLIFIERS

Armstrong 222, integrated, 10W per channel. £27.10.0	55/-	12	45/8
Dulei GA505, integrated. £18.19.0	40/8	12	31/1
Rogers Cadet Mk. 2 with pre-amplifier, 4 300 valves. £26.15.6	53/6	12	44/5
Leak Stereo 20, Main amplifier. £39.9.0	64/6	12	50/3
Leak Varislope stereo pre-amplifier. £25.0.0	50/-	12	41/8
Quad 22 Stereo Control Unit. £28.0.0	50/-	12	41/8

For Quad Mains Amplifiers see Mono section.

## MONO AMPLIFIERS

Linear L45, 3 watt, 3 valve. £5.19.8	—	—	—
Linear Diontic, 12 watt, suitable Mic. or Guitar. £12.12.0	27/-	12	20/8
Linear Concord, 30 watt, ideal Guitar amp., with case. £18.0.0	36/-	12	29/10
Dulei DP45, integrated amp., 5 watt, ECL86 valve £13.2.8	28/6	12	21/6
Dulei DP413, 15 watt with 2 valve pre-amp. £25.4.0	50/8	12	41/11
Tripletone Hi-Fi Major with pre-amp. Suitable for Guitar or Mic. etc. £15.18.9	35/3	12	28/1
Leak TL/12, 10 watt Main amp. only. £18.18.0	40/6	12	31/1
Leak Varislope pre-amplifier. £15.15.0	31/6	12	28/1
Quad, 15 watt Main amplifier only. £22.10.0	45/-	12	37/4
Quad pre-amplifier, Mono. £19.10.0	39/-	12	32/4

## JASON F.M. AND TV SOUND TUNERS

FMT1, complete with 4 EF91 valves. £7.4.6	21/-	7	20/6
FMT2, less power, complete with 4 EF80 valves. £9.4.6	20/6	9	20/6
FMT2, with power, complete with 4 EF80 and 1 EZ90. £11.4.6	22/6	9	24/9
FMT3, Fringe, complete with valves, less power £10.19.0	22/-	8	27/3
FMT3, with power, complete with all valves. £12.19.0	26/-	12	21/6
JTV/2, switched F.M. and TV sound, self-powered, all valves. £15.12.6	33/6	12	25/8
Mercury II, as JTV/2 but less power, all valves £11.0.0	22/-	8	27/3
Instruction book included in all kits. Available separately, 2/6 and 3/6.			
JTV/2, ready built state channels. £22.5.0	44/6	12	36/11
Monitor, ready built (as Mercury II). £16.10.0	33/-	12	27/4

## LOUDSPEAKERS

Goodmans Azette 8. £5.5.7	—	—	—
Goodmans Axion 19. £6.5.11	—	—	—
Goodmans 6K/20/XL. £7.7.0	—	—	—
Goodmans XO 5000 cross-over. £2.0.11	—	—	—
Goodmans Axion 201 12in. Unit. £10.17.3	22/5	12	17/11
Goodmans Axion 301 12in. Unit. £15.4.4	30/6	12	25/3
Wharfedale Super 8/RS/DD. £6.14.2	—	—	—
W.B. HF1012 10in. £4.7.6	—	—	—
R.T.C. 12in. Unit, 15 watt. £5.5.0	—	—	—
R.T.C. Hi-Fi Master. £8.8.0	20/-	8	21/-
Wharfedale W12/EG 12in. 15 watt Lead Guitar speaker. £10.10.0	21/-	12	17/5
Wharfedale Super 10/RS/DD 10in. high quality unit. £17.10.0	35/-	12	29/-
Wharfedale W16/EG 16in. 15 watt Bass Gumar speaker. £17.10.0	23/8	12	17/11
Wharfedale RS/12/DD 12in. 15 watt. Hi-Fi. £11.10.0	27/8	9	24/9

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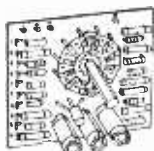
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# PARK RADIO LTD.

**YOUR MAIN SUPPLIERS  
FOR THE NEW MARTIN  
10W. AMPLIFIER KITS**

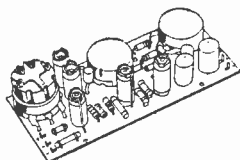
With these ingenious new MARTIN AUDIOKITS you can build an ALL-TRANSISTOR Hi-Fi Assembly to suit your personal requirements exactly. When built you will have a modern, powerful, high quality assembly with ALL the features of a de-luxe hi-fi assembly. Building is easy, and you will save pounds. Designed for simple panel mounting. Easily doubled up for stereo. Full instructions with every kit. Leaflets free on request.



## UNIT 1 FIVE STAGE SELECTOR

Enables up to 5 inputs to be connected and correctly matched to following pre-amp stage. With transistor, resistors and capacitors mounted on printed circuit board. Long spindle for adding stereo when required. With Mazda AC150 Transistor.

Size 3 1/2 x 3in. For Magnetic and crystal P.U.s, Radio Tuner, Microphone, and output from tape head. Requires 9-15 V. **47/6**

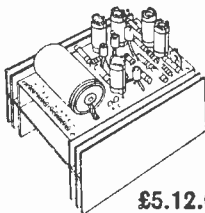


## UNIT 4 COMBINED PRE-AMPLIFIER AND TONE CONTROL UNIT

Three stages of audio control—bass control operating between -16 to +10 dB; treble control between -16 to +12 dB; volume control with on-off switch to serve power supply to complete installation. With transistors, resistors, etc. on printed circuit board. 6 1/2 x 2 1/2in. 9-15V. **62/6**

## UNIT 5 MAIN AMPLIFIER

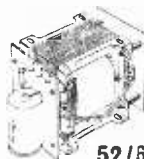
Complete with heat sink on which the six transistor printed circuit amplifier is built. Transformerless output gives maximum of 10 watts into 8-ohm speaker, operating from 24 volt supply. Pre-tested by makers. Transistor line-up: Mazda AC139, AC113, AC154, AC157, 2xNKT451, A4120.



Wharfedale 3:15 ohms **13/6**  
Matching Transformer. **£5.12.6**

## UNIT 6 POWER SUPPLY UNIT

Operates from 260-250 volts, A.C., giving D.C. output at 24 volts for main amplifier and tapping for power to other Martin Audiokit Units. Incorporates heavy duty transformer, full smoothing and latest type rectification. Elegant front Control Panel for **10/6**  
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## The SKYROVER

Controls: Waveband Selector, Volume Control, On/Off Switch, Tuning Control. In plastic cabinet, size 10 x 6 1/2 x 3 1/2 in. with metal trim and carrying handle.

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## The SKYROVER DE LUXE

Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11 1/2 x 6 1/2 x 3 1/2 in., covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

Can be built for

**£12.19.6**

P. & P. 5/- extra

Data for each receiver 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries, 2/8 extra. Four Leak-Proof batteries, 3/4 extra. All Components Available Separately.

# THE SKYROVER and SKYROVER DE LUXE

### GENERAL SPECIFICATION:

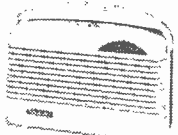
7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. The SKYROVER and SKYROVER DE LUXE covers the full Medium Waveband and Short Waveband 31-94 M. and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for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

### SPECIFICATION:

Superhet, 470 Kc/s. All Mullard Transistors and Diode. Uses 4 U2 batteries, 5in. Ceramic Magnet P.M. Speaker. Easy to read Dial Scale, Band Spread Tuning, 500 MW Output, Telescopic Aerial & Ferrite Rod Aerial. **WAVEBAND COVERAGE:** 180-576M: 31-94M and Band Spread on 13, 16, 19 and 25 metre Bands.

## The "REALISTIC" Seven

★ 7-transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5 1/2 x 5 1/2 in. in one complete assembly. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3 1/2 in. in Red/Grey, Blue/Grey or all Grey. ★ Easy to read dial. ★ External socket for car aerial.

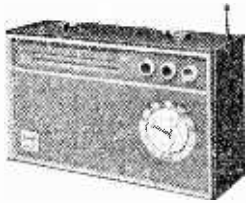


★ I.F. frequency 470 Kc/s. ★ Ferrite rod internal aerial. Operates from PP9 or similar battery. ★ Full comprehensive data supplied with each receiver. ★ All coils and I.F.'s etc. fully wound ready for immediate assembly. An Outstanding Receiver, LASKY'S PRICE for the complete parcel including Transistors, Cabinet, Speaker, etc. and Full Construction Data. Can be built for **£5.19.6** P. & P. 4/6.

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

## REALISTIC Seven DE LUXE

By popular request a De Luxe version of the well-proven Realistic "Seven" now available. With the same electrical specification as standard model—PLUS A SUPERIOR WOOD CABINET IN CONTEMPORARY STYLING, covered in attractive washable material, with super-chrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. ALL FOR ONLY **£1 EXTRA.** P. & P. as for Std. model



## THE "SPRITE"

Can be built for

**79/6**

P. & P. 3/6 extra.

★ Six-Transistor Superhet Miniature Personal Pocket Radio. ★ Long and Medium wavebands. ★ Ferrite Rod aerial. ★ I.F. Frequency 470 Kc/s. ★ 3in. Speaker. ★ Printed circuit 2 1/2 x 2 1/2 in. Slow Motion Drive. ★ In Plastic Case. Size 4 x 2 1/2 x 1 1/2 in. 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 mounted on the printed circuit. The SPRITE pre-assembled, plus cabinet, speaker and all components for final construction, **79/6** P. & P. 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.

## READY BUILT BOY'S TRANSISTOR RADIO

Ready built, 2 transistor pocket radio in attractive plastic case, size only 4 x 2 1/2 x 1 1/2 in. Fitted with 2in. loudspeaker. Socket for personal earpiece & telescopic aerial. Works from single PP3 type battery. Fully tunable over full medium waveband. Supplied complete with earpiece, telescopic aerial, carrying purse and 9 volt battery. Ideal Birthday Gift.

### LASKY'S PRICE

with all accessories Post Free.

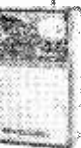
**42/-**

### ALSO AVAILABLE

6 transistor model, size etc. as above. Supplied complete with personal earpiece and leather case.

### LASKY'S PRICE

Post Free



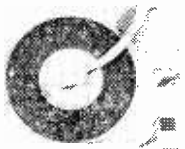
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### HEADPHONES

S. G. Brown Type F earphones, moving iron 2000 ohms, hand-held type but a headband could easily be fitted. P. & P. LASKY'S PRICE 14/6 per pair. 1/6.

## E.M.I. 4-SPEED RECORD PLAYER

New, unused and individually boxed fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13 1/2 x 12 1/2 x 4 1/2 in. A 9in. metal turntable is fitted. For use on 200/250 volt A.C. Mains, with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.s etc., but if desired a G.P. 67 LP/78 Mono cartridge will be supplied in lieu of the GP73 at no difference in cost.



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P. & P. 3/6 extra.

COLLARO 4TR 200 TRANSCRIPTION RECORD PLAYER UNIT. New and unused—listed at 17 gns. LASKY'S PRICE £9.19.6. Carr. & Pack. 5/-.

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Connoisseur Crafts, 0.0	Braun PC4L Stereo Transcription Unit ..... £12.95
Decca FFSS Stereo Pick-up ..... £18.10	2 x Sharon Loudspeaker systems ..... £19.19.0
<b>Total £50.46</b>	<b>Total £47.86</b>

"PRIVILEGE PARCEL" Price: £27.10.0	"PRIVILEGE PARCEL" Price: £45.0.0
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Collaro Studio Tape Deck, 1-track model ..... £10.13.0	Collaro Studio Tape Deck, 1-track model ..... £13.19.6
Lasky's Tape Amplifier ..... £8.19.6	Martin Tape Amplifier, 1-track model ..... £12.12.0
P/able Case ..... £3.15.0	7 x 4in. spkr. .... 15.6
<b>Total £24.00</b>	<b>Total £31.16.6</b>

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## LASKY'S NEW SCOOP The "Sixteen" Mullirange METER KIT

This outstanding meter was featured by *Practical Wireless* in the Jan. '64 issue. Lasky's are now able to offer the complete kit of parts as specified by the designer. The "Sixteen" Mullirange offers the home constructor and serviceman an instrument that will meet most of his requirements for voltage, current and resistance measurement. There are 16 switched ranges: 9 for voltage measurement, 4 current ranges and 3 resistance ranges. All British components are used throughout. The instrument case is supplied with the meter movement built-in. The two scales are clearly printed in black on white and are very easy to read.



**RANGE SPECIFICATION:** D.C. volts: 0-2.5-25-50-250-500 at 20,000Ω/V. A.C. volts: 0-25-50-250-500 at 1,000Ω/V. D.C. current: 0-50μA. 0-2.5-50-250 mA. Resistance: 0-2,000Ω. 0-200KΩ. 0-20MΩ. Basic movement: 40μA I.s.d. moving coil. With universal shunt full scale deflection current is 50μA. Size of finish: Black plastic case 3 1/2 x 5 1/2 in. Controls: 12 position range switch; separate slide switch for A.C. volts—D.C. ohms; ohms zero adjustment pot. meter zero. External connections: Two 4mm. sockets for test lead plugs. Power requirements: One 1.5V. and one 1.5V. batteries. Complete with all parts and full construction details.

This offer is exclusive to Lasky's Radio. **LASKY'S PRICE**

**£5.19.6** P. & P. 5/-

Pair of batteries 2/5 extra

Data and circuit available separately 2/6 returned if all parts bought.



**TAPE DECK MOTORS**  
Motors for the Collaro Studio Deck—new and unused. 200-250 v. A.C. Take-up, rewind and capstan. Listed at £2.50 each. **LASKY'S PRICE 14/11** each. P. & P. 2/6. Set of 3 35/- P. & P. 6/-.

### TAPE SPLICER SPECIAL OFFER!

By famous manufacturer. All metal nickel plated construction with separate razor blade—securely clamps tape while splicing. Listed at 18/6. **LASKY'S PRICE 14/6** POST FREE



**MAKERS SURPLUS FM TUNER CHASSIS**  
A factory built FM Tuner using the Gorrler front end unit and I.F.S. Freq. range: 88-108 Mc/s. Valve line-up: 6AL5, 3 x 6AU6, ECC85. Fully assembled on printed circuit. Illuminated glass dial. Overall size 12 x 5 x 3 in. Unpowered—requires 6.3 v. L.T. and 200 v. at 40 mA H.T. Full circuit data included.

**LASKY'S PRICE £5.19.6** P. & P. 6/-

### 4-SPEED AUTO CHANGERS

B.S.R. Type UA14/UA20	£5 19 6
COLLAHO Studio C60 wired for stereo with monaural pickup	£8 19 6
MAGNAVOX-COLLARO latest model, 4-speed Stereo Autochanger. Fitted diamond stylus and record dust cleaning attachment	£7 19 6
GARRARD Stereo	£6 10 0
Auto-Slim Mono	£7 10 0
Auto-Slim Stereo	£7 10 0
Auto-Slim Mono Plug-in-head	£7 7 0
Auto-Slim De Luxe Stereo AT8	£11 9 0
Lab. Model "A" Mono	£19 14 0
Lab. Model "A" Stereo	£20 10 0

Postage on all above 5/-

**H.I.M. 45 R.P.M. AUTOMATIC RECORD PLAYER.** Designed to take only 45 r.p.m. 7in. discs. Will play up to 8 automatically. Fitted with lightweight pick-up and crystal cartridge, mounted on a plinth. For 200/250 v. A.C. mains. Size approx. 10 x 10 x 5 in. **LASKY'S PRICE 59/6** P. & P. 3/6 extra.

See opposite page for addresses

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1F1	7/6 8BR7	6/8 12BH7	10/6 DK95	7/6 EL84	7/- PYS2	7/6
1F2	4/- 8BW6	6/8 12CGT11	1/12 P192	5/6 EM85	10/- PYS3	7/6
1FD1	7/6 8BW7	7/- 12QGT7	7/6 DL91	6/- EY31	7/6 R19	6/6
1FD9	5/6 8D2	4/- 12SN7	6/8 D106	7/6 EY81	10/- 85A1	6/6
1P1	7/6 8F12	4/- 18A3	8/- EB91	4/- EZ40	5/6 U92	7/6
1P19	6/8 8HG4T	7/- 18A35	9/8 EB941	7/6 EZ80	6/- U76	7/6
1P11	6/- 8JG7	7/6 25L0G7	7/6 EBF50	6/8 EZ81	9/8 U78	5/6
1R5	6/8 8K76	5/8 30C1	7/6 EC851	4/- HVR2	9/8 U142	7/6
1R5	5/6 8K86	6/- 30L1	7/6 EC882	6/8 KTR3C	6/- UB41	8/6
1T4	4/- 8Q70	5/6 35L6GT	7/6 EC883	6/8 R266	13/6 UCH2	8/6
1L5	5/6 8SL7GT	6/- 35W4	8/8 EC884	8/8 N18	5/6 U141	8/6
3Q4	5/6 8SN7GT	7/6 35ZAGT	8/- EC885	7/6 N19	6/- UY41	7/6
3R1	6/8 8V9G	7/6 37B5	7/6 EC898	8/8 N19	6/- UY41	7/6
3V4	6/- 8X4	5/- 80	6/- EF192	7/6 N709	7/- W17	4/6
5Y3GT	5/- 8X5G	5/8 DAF91	5/6 ECH42	9/- PCV84	7/6 W76	4/6
5Z4G	7/6 7Y4	6/- DAP96	7/6 ECH81	10/- PCF80	7/6 W142	8/6
6A55	5/6 8D3	4/- DC990	12/6 ECL90	8/6 PCF82	6/6 X17	5/6
6A15	4/- 8D7	6/8 DP91	4/- ECL92	7/6 PCF82	9/8 X142	9/-
6AM6	4/- 12AD6	11/8 DP96	7/6 EF41	9/- PCL54	9/- X150	9/6
6AT6	5/- 12AH8	10/- DH76	7/6 EF90	8/- PL81	9/8 Z77	4/6
6BA6	5/- 12AT7	4/- DH77	5/- EF95	9/- PL82	7/- ZD17	5/6

### ASK FOR RESISTOR AND CAPACITOR COLOUR CODE FREE WITH EVERY PURCHASE

High Stability Resistors 1/2W 5% 50Ω to 1M, 9d. Midget Ceramics 500 v., 8d. Coax. Super Quality 1/2W, 6d. 1/2W, Plugger 8d. Sockets 9d. Silicon E.T.T. Res. 250 v., 300 mA 1in. x 1in. 9/6. Contact Coiled 250 v., 50 mA 6/8. 85 mA 5/6. **NEW TRANSISTORS BY MULLARD.** OC19, OC26, OC96, 25/-; OC44, OC45, 5/-; OC70, 8/-; OC71, 5/-; OC72, 6/-; OC72 Matched pair, 12/-; OC74, OC75, OC78, 7/6; OC81, 8/-; OC81 Matched pair, 12/-; OC170, OC171, 7/6.

**VALVES MATCHED IN PAIRS**  
EL34 27/6, EL84, 15/-, N709 15/-, 6V6G 15/-, 6RW6 14/- per pair. Push-Pull O.P. Transformer for above 3/15 14/6, P. & P. 1/6. 12in. P.M. Speaker 3Q 24/6. Baker's "Selhurst" 12in. 15Ω 15W Stalwart 80/-, 12in. Stereo Model 86.15.0.

**SETS OF VALVES**

DK91, DF91, DAF91, DL92 or DL94	19/6	ER42, EF41, EB41	19/6
DK96, DF96, DAF96, DL96	20/6	EL41, EZ40	37/6
6K8, 6K7, 6Q7, 6V6, 5Z4 or 8X50	19/6	EH42, EF41, EB41	41/6
1R5, 1T4, 1R5, 3R4 or 3V4	19/6	EL41, EY41	35/6

Postage and packing 6d. Over 41 post free. C.O.D. 4/-

## BARGAIN OFFER!

**AMPLIFIER.** 3 watts, 2 valves, 6X4, ECL82. AC Mains. Mounted on board with 8in. speaker, Pilot light and Tone Control. £3.10.0 complete. Post 4/6.

**CONNECTING WIRE.** Stranded or Single. Various colours our selection. 100ft., 4/-.

**ELECTROSTATIC Tweeter LSH75** with diagram, only 2/6 each  
**SPEAKER CABINET.** The HAYDON (17 x 15 x 8in.). Designed to take a 12in. heavy duty speaker. Made of 1/2in. wood. Ideal for bass guitar. Covered with Yvynide and Vynair in contrasting colours. With strong carrying handle, 60/-, post 7/6 extra.

**SPEAKER** suitable for above cabinet. R.T.C. 15 ohm 15 watts Heavy duty 12in., £5, post 4/6.  
**STEREO** Ronette S 106, 25/-.

**CARTRIDGES.** Monaural. Acos GP59-5 high output, 15/-. Acos GP65-1G medium output, 15/-, to fit most Garrard, Collaro or B.S.R. pick-ups.

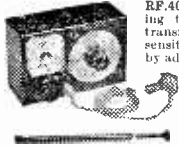
**EARPIECES** with cord and 3.5 mm. plug. Crystal, 4/-; 180 ohm: magnetic, 6/6; 80 ohm 2.5 plug, 4/-.

**HIGH RESISTANCE PHONES:** 4,000 ohms. Chinese, 11/6 pair  
**TRANSISTOR ELECTROLYTICS:** 1uF, 2uF, 4uF, 5uF, 8uF 16uF, 32uF, 50uF, 100uF, all 15 volt, 1/3 each.  
**BARGAINS IN TRANSISTORS.** The latest Mullard M Series. OC44M, two OC45M, OC81DM. Two OC81M matched pair. OA90 diode. Complete set, 22/6. OC44, 3/6; OC45, 3/6; OC71, 2/6; OC72, 3/-; OA81, 2/3; GEC S6 Good AF General Purposes, 2/-; GET873 RF, 2/3.

**MEMICHAEL TELESCOPIC TV AERIAL.** 23" extending to 45". Fitted with coaxial plug. Will suit any set. **ONLY 7/6**  
**MAKE** your own light-sensitive switch; for parking lights, burglar alarms, model railways, door bells, window lights, etc., etc. The Circuit, Mullard ORP12 Light Cell, two transistors and resistors, 25/- the Set.

**TERMS: C.W.O.**  
**BROADWAY ELECTRONICS**  
**92 MITCHAM ROAD, TOOTING, S.W.17**  
(four minutes from Tooting Broadway Underground Station)

**R.F. FIELD INDICATOR**



**RF40.** Designed for checking the radiation from a transforming antenna. The sensitivity can be controlled by adjustment of panel control. The antenna length or by increasing distance from the radiator. Freq. range 1-250 Mc/s. 200µA D.C. Complete with instructions.

Complete as illustrated with instructions.  
PRICE 69/6.

**DM.614. 50K DYNAMIC SUPER SENSITIVE DESK OR NECK MICROPHONE**  
Never before such high quality at such low price. Complete with tangle-free cord and desk stand. Light weight. PRICE 45/- Complete in presentation pack.



**4-TRANSISTOR PUSH-PULL AUDIO AMPLIFIER**

Model EG.2004



Not a kit—a ready-built miniature amplifier incorporating input and output transformers, 4 transistors 9 volt battery snap cord (for Power) speaker and volume control connection leads. The most useful amplifier ever produced. Complete with full instructions and circuit diagram. Ideal for making powerful transistor radios, tape recorders, baby alarms, record players, intercom etc. Must be heard to be appreciated.

ONLY 42/6

**SIGNAL INJECTION PROBE I.T.I.**



Push button operation. Ideal for making rapid checks on radios, TV, Amps, etc. PRICE 39/6

**HAWAIIAN PORTABLE RECORD PLAYER Model HN707**

Uses a unique pick-up unit turntable and special speaker to give amazing volume and reproduction without the use of valves or transistors. Battery operated, plays up to 12in. records at 33 1/2 or 45 r.p.m. Separate fine speed and volume control. 45 r.p.m. adaptor and stroboscope. Durable plastic cabinet fully waterproof with carrying handle and record storage compartment. Size 9in. dia. x 3 1/2in. deep. Weight 2 lb. 9 oz.



**SPECIAL OFFER NOW ONLY £4.19.6**

**AUTOMATIC SOLDERING IRON SF.1**



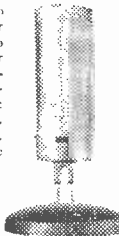
30 watt. First in the country that feeds solder automatically. Easy one hand action, lightweight and extremely robust, gives you a third hand. Tip and solder are replaced at the exact spot needed, any required amount of solder can be automatically fed to the tip by adjustable rod to Standard A.C. mains. Fully guaranteed.

**SPECIAL 1964 OFFER ONLY 39/6**

**FANTASTIC BUY!**

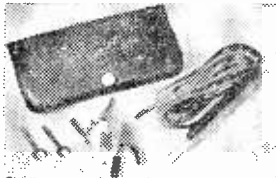
**STEREO DYNAMIC MICROPHONE MODEL SM.D100**

A truly revolutionary new stereo dynamic microphone, ideal for the tape recording and audio enthusiast who has an eye for quality and value. Brief specification—Frequency response 50-15,000 c/s. Output impedance: 50K ohms, Sensitivity: -60dB. Size: 8 1/2in. high. Mike 2 1/2in. dia. Base 4 1/2in. dia. Mike can be removed from table stand and used with floor stand if desired. Supplied complete with table stand and foot, of screened lead in display carton.



Price 9 Gns. S.A.E. to leaflet.

**AR.13 UNIVERSAL TEST LEAD KIT IN PLASTIC CASE**



Consists of 4 1/2in. long x 3/16in. dia. red and black plastic handle pin-prods with heavy duty 37in. rubber leads with 5,000 v. breakdown insulation terminating 2in. long x 1/16in. dia. plastic strip banana plugs. 3 sets of interchangeable terminals are included (spade lugs, phone tips, alligator clips), all slip directly on to banana plugs. PRICE 9/6.

**9V BATTERY CHARGER AND AC ELIMINATOR MODEL LA.6P**

A "MUST" for every transistor set owner! Save those batteries set direct from A.C. mains. Reactivate all your old PP3 batteries. Unit contains neon indicator and standard battery connections with nearly 2 yards of nickel leads and plug. Also snap cord for connection to set.

transistor set owner: running four transistor



NOW ONLY 19/6



**NOW ONLY 24/6** With the RA30 RADIO AMPLIFIER

Designed for use with transistor radios, valve radios, car radios, amplifiers, where quality reproduction of sound is required. Plugs into car-type output sockets of nearly all miniature sets. The cabinet is finished in beige leather, with contemporary gold bathes at each end. Complete with 12B extension cord fitted with miniature plugs, individually cartoned and guaranteed. Size: 9 1/2in. x 3 1/2in. diameter.

**SA.80 INTEGRATED STEREO AMPLIFIER**



**NEW MODEL! Incorporating double wound transformer**  
4 x 4 watt. The perfect choice for a low cost Hi-Fi stereo system. Dual pick-up and tuner inputs. Tone control. Independent volume controls. 15 ohm speaker output. Supplied complete for only **£9.10.0**

**SUBSTITUTION BOXES**

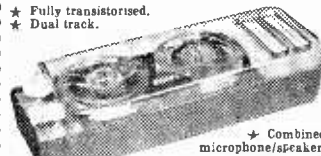
Fully calibrated complete with insulated leads. Kceal O.M.G. RESISTANCE BOX provides 21 standard values at 1 watt, 15 ohms to 10 meg. Price 37/6.



Model O.M.G. CAPACITANCE BOX provides 9 standard values from 0.001 to 0.22 mfd at 500 volt working. Price 29/6.

**MINIATURE PORTABLE TAPE RECORDER MODEL TC.601**

★ Fully transistorised.  
★ Dual track.



★ Combined microphone/speaker.

★ Size only 10 1/2" x 3 1/2" x 2 1/4"

Completely portable, self-contained, full function miniature tape recorder utilising advanced transistor circuitry with 4-transistor push-pull output stage to give you quality reproduction you would only expect from units three times the price. Simple control or rewind stop/playback/record, and variable volume control. Attractive tan and gold high impact poly-crystal case with transparent snap-on plexiglass top enabling unit to be operated with top in position. Complete with dual purpose microphone-speaker, 200 ft. of tape, batteries and instruction book.

PRICE **£8.19.6**

**THIS MONTH'S SNIP!!**

**OPERATORS UNIT.** Fantastic bargain. Outstanding value! As illustrated. 3/6. POST PAID.

JACK SOCKET

250 MFD ELECTROLYTIC CONDENSER

4 WAY TELEPHONE SOCKET

MIDGET METAL RETAIL RECTIFIER



MAIL ORDERS TO: (DEPT. P), 32a COPTIC STREET, LONDON W.C.1.

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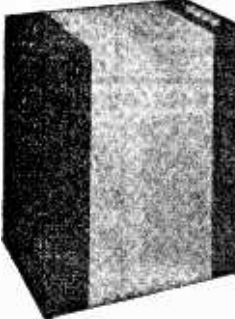
# THE R.S.C. BASS-MAJOR 30 WATT GUITAR AMPLIFIER

A MULTI-PURPOSE HIGH FIDELITY, HIGH OUTPUT UNIT FOR VOCAL AND INSTRUMENTALIST GROUPS  
 Eminently suitable for bass, lead or rhythm guitar and all other musical instruments

- \* Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in. diameter speech coil. 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 £43.0 and 12 monthly payments of £39.11. 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 complementary shades of Rexine/Vynair. 200-250 A.C. mains.  
**£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.**

## R.S.C. SENIOR 15 WATT LEAD or RHYTHM GUITAR AMPLIFIER

High-fidelity push-pull output. Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments of "mike" and pick-up can be used at the same time. Loudspeaker is a heavy duty high flux 12in. 20 watt model with cast chassis. Chassis is well made and finished as Junior Model. Size approx. 18 x 18 x 8in.

**Only 18 Gns.** Carr. 10/-

Send S.A.E. for leaflet. Or DEPOSIT 37/9 and twelve monthly payments of 31/6.



## R.S.C. B20 BASS GUITAR AMPLIFIER

A highly efficient unit incorporating a massive 15in. 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. Or Deposit £32.0 and 12 monthly payments of 51/8. Carr. 17/6.

# GLASGOW — LONDON — EDINBURGH

326 ARGYLE STREET 238 EDGWARE ROAD 133 LEITH STREET  
 Three new branches opening in March

**TRANSISTOR SALE.** Mullard OC71 3/9, OC45 4/11, OC4 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. 1a consisting of a partially drilled metal case, main transformers, 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 28/11.

### SELENIUM RECTIFIERS

F.W. BRIDGE	24 v. 2 amp.	14/9
6/12 v. 1 a.	3/11	24 v. 20 amp.
6/12 v. 2 a.	8/11	H.T. TYPES H.W.
6/12 v. 3 a.	9/9	150 v. 10 mA.
6/12 v. 4 a.	12/3	250 v. 50 mA.
6/12 v. 6 a.	15/3	250 v. 60 mA.
6/12 v. 10 a.	26/9	250 v. 80 mA.
6/12 v. 15 a.	35/0	250 v. 250 mA.

**CONTACT COILED.** 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.

### HIFI 10-WATT AMPLIFIERS.

Brand New Complete Units. **£7.19.9** Carr. 5/6.  
 Manufacturers' discontinued Model. Push-Pull output. Latest high efficiency valves. Dual separately controlled inputs for "Mike". Separate Bass and Treble Controls. High sensitivity. Output for 3 or 15 ohm speaker. Guaranteed tested and in perfect working order.

**HEAVY DUTY LOUDSPEAKERS IN SUBSTANTIAL REXINE COVERED CABINETS.** Type BG1. Suitable for Bass Guitar. Speaker Unit 15in. High Flux. 15 ohms 30 watts. Cabinet size approx. 24 x 21 x 13in. Only 19s. 6d. Or Deposit 43/- and 12 monthly payments of 34/-. Type BG3/2. Suitable Bass and Lead Guitar. Two 12in. high flux 15 ohm 25 watt speakers, one with aluminium speech coil and dual cone 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 29s. 6d. 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. Output for 15in. or 18in. speaker or for two 12in. 15 ohms. Or Deposit 25/9 and 9 monthly payments 25/9. Size 30 x 30 x 16in. cut for 15in. or 18in. speaker 13gns. or Deposit 30/4 and 9 monthly payments 30/4. Suitable speakers available.

**PANE EXTRA HEAVY DUTY LOUDSPEAKER 15in. TYPE 153.** 40 watts. Total flux 375,000 lines. Extremely high sensitivity 15 ohm voice coil. Only 18 gns. or Deposit 37/9 and 12 monthly payments 31/6.

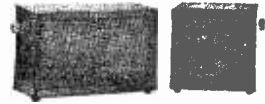
**PANE EXTRA HEAVY 1-SPEAKER 183.** 18in. 15 ohms. 60 watts 3in. diam. Speech Coil. Total Flux 375,000 lines. High sensitivity. ONLY 24 gns. or Deposit 51/- and 12 monthly payments of 42/9. Send S.A.E. for leaflet on 153 and 183.

**EX. GOVT. SMOOTHING CHOKES.** 200 mA. 3-5 H. 50 ohms. Parmeko 8/9; 150 mA. 10 H. 50 ohms 9/9; 90 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. Output 250 v. 60 mA. 6.3 v. 2 a.

**R.S.C. POWER PACK. 39/9.** Louvred metal case only 8 x 5 1/2 x 2 1/2in. Stove enamelled. For 200-250 v. A.C. mains. Output at 4 pin plug and socket 250 v. 60 mA. fully smoothed and 6.3 v. 2 a. Suitable for power requirements of almost any Pre-amp. or Radio Tuner.

**R.S.C. BABY ALARM or INTER-COMM. 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 intercom. of this class would normally cost £20-£30. Only 89/6. Carr. 5/- or assembled ready for use 6 gns.



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

## DERBY

Now open at 26 Osbaston Road The Spot

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 32 High St. 6 Gt. Western  
 Arcade, Opp. Snow Hill Station  
 Half-day Thursday No half-day

**SHEFFIELD HULL**  
 13 Exchange St. 51 Saville  
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**LIVERPOOL BRADFORD**  
 73 Dale St. 56 Morley St.  
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**MANCHESTER LEEDS**  
 8-10 Brown St. 5-7 County  
 (Market Street) (Mecca) Arcade  
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MAIL ORDERS to 54 Wellington Street, 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.

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MAIL ORDERS to 54 Wellington St, 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.

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**HULL** 51 Savile St., Hull  
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**BRADFORD** 56 Morley St. (Above Alhambra Theatre)  
 Bradford  
**MANCHESTER** 8-10 Brown St. (Market Street)  
 Manchester 2  
 No Half-day  
**LEEDS** 5-7 County (Mecca) Arcade  
 Briggate, Leeds  
 No Half-day

**DERBY 26 Osmaston Road THE SPOT**

**FANE HEAVY DUTY HI-FI SPEAKERS**

12in. 15 ohms. Cast chassis. Exceptionally robust 2in. diam. Voice Coil Assemblies. 122/10 20watt, 5 gns. 122/10A 20watt, 8 gns. 122/12 20watt, 7 gns. 122/12A 20watt, 8 gns. 122/14 22watt, 9 gns. 122/14A 22watt, 10 gns. 122/17 25watt, 21.17. 4 122/17A 25watt, 17 gns. 15in. 15 ohms. Cast chassis. Exceptionally robust 2in. diam. Voice Coil Assemblies. 152/12 20watt, 12 gns. 152/12A 20watt, 13 gns. 152/14 27watt, 14 gns. 152/14A 27watt, 15 gns. 152/17 35watt, 16 gns. 152/17A 35watt, 17 gns. \*Indicates cone type. 30-17,000 c.p.s. Send S.A.E. for leaflets. Terms available.

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

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 dB down. Frequency response ±3 dB 30-30,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 307 output valves. All components are chosen for reliability. Six valves are used EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE. The unit is designed for CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS, etc. For use with Electronic ORGAN, GUITAR, STRING BASS, etc. For standard or long-playing records. OUTPUT SOCKET PROVIDES L.T. and H.T. for RADIO FEEDER UNIT. An extra input with associated vol. control is provided so that two separate inputs such as Gram and "Mike" can be mixed. Amplifier operates on 200-250 v. 50 c/s. A.C. Mains and has output for 3 and 15 ohm speakers. Complete Kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required Carr. 10/- perforated cover with carrying handles can be supplied for 19/9. The amplifier can be supplied, factory built with EL34 output valves and 12 months' guarantee, for 14 gns. Send S.A.E. for leaflet. TERMS: DEPOSIT 33/9 and 9 monthly payments of 33/9. Suitable microphones and speakers available at competitive prices.

**ARMSTRONG, DULCI, LINEAR, ROGERS, LEAK and JASON EQUIPMENT, GOODMAN'S, W.B. and FANE SPEAKERS, GARRARD and GOLDRING T/TABLES CASH or H.P.**

**SUPERHET FEEDER UNIT.** Design of a high quality Radio Tuner (specially suitable for use with our Amplifiers). Delayed A.V.C. Controls are Tuning, W.C.H. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size approx. 8 x 7in. high. Simple alignment procedure. Point-to-Point wiring diagrams, instructions and priced parts list with illustrations, 2/6. Total building cost £4.15.0. S.A.E. for leaflet.

**R.S.C. BATTERY TO MAINS CONVERSION UNITS**  
 Type BM1. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 in. approx. Completely replaces battery supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. Suitable for all battery portable receivers requiring 1.4 and 90 v. This includes low consumption types. Complete kit with diagrams, 39/9, or ready to use. 46/6.



Type BM2. Size 8 x 5 1/2 x 2 1/2 in. Supplies 120 v. 90 v. and 60 v. 40 mA and 2 v. 0.4 a. to 1 amp. fully smoothed. Thereby completely replacing both H.T. batteries and 1.4-2 v. accumulators when connected to A.C. mains supply 200/500 v. 50 c/s. SUITABLE FOR ALL BATTERY RE-CHARGERS normally using 2 v. accumulators. Complete kit of parts with diagrams and instructions, 49/9, or ready to use. 58/6.

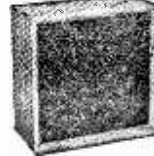
**P.M. SPEAKERS.** 10in. W.B. "Stentorian" 3 or 15 ohms type HF 1012 10 watts, hi-fidelity type. Recommended for use with our All Amplifier. £4.7.8. 12in. R.A. 3 ohms 10 watts (12,000 lines). 59/9.

**TWEETERS.** R.A. 3 ohm. 25/9; 15 ohm. 25/9  
 R.A. 12in. DUAL CONE 3 ohm 8 Watt Speakers. Ideal for Stereo. Only 39/9 ea.

**Jason FMTI V.H.F./F.M. Radio Tuner design.** Total cost of parts including valves. Tuning dial. Escutcheon, etc.. £6.19.6.

**LINEAR L45 MINIATURE 45 WATT QUALITY AMPLIFIER.** Suitable for any record playing unit and most microphones. Negative feedback 12 dB. Separate Bass and Treble Controls. For mains 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Mullard valves E280, ECC83, EL84. Size only 7x5x5 1/2 in. high. Guaranteed 12 months. Only £5.19.6. Send S.A.E. for leaflet. Terms: Deposit 22/6 and 5 monthly payments of 22/6.

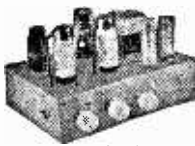
**12in. 10 WATT HIGH QUALITY LOUDSPEAKER**



In walnut veneered cabinet. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4.19.6 Carr. 5/-. Terms: Deposit 11/3 and 9 monthly payments of 11/3. 12in. 20 WATT HI-FI LOUD-SPEAKERS IN CABINETS. Size 19 x 18 x 10in. Finish as above. Terms: Deposit 17/9 and 9 monthly payments of 17/9. Only £7.19.6. Carr. 8/9. For larger types see preceding page.

**LINEAR L634 GRAM AMPLIFIER.** High quality. Separate Bass and Treble controls. Handsome appearance. Completely enclosed. Black/Gold Frontplate 5 gns.

**R.S.C. 4-4 WATT A5 HIGH-GAIN AMPLIFIER**



A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads, in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 dB down, 15 dB of Negative feedback is used. H.T. of 300 v. 25 mA and L.T. of 6.3 v. 1.5 a. is supplied for the supply of a Radio Feeder Unit, or Tape-Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue Hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4.15.0. Kit assembled ready for use 25/- extra. Plus 3/6 carr., or deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

**GLASGOW — LONDON — EDINBURGH**

326 ARGYLE STREET Three new branches opening in March 238 EDGWARE ROAD 133 LEITH STREET

**THE SKYFOUR T.R.F. RECEIVER.** A design for a 3 valve long and medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion detector. Valve line-up 6K7, SP61, 6V6G. Selectivity and quality excellent. Simple to construct. Point-to-point wiring diagrams, instructions and parts list 1/9. maximum building costs £4.19.6. Inc. attractive walnut veneered wood cabinet 12 x 6 1/2 x 5 1/2 in.

**R.S.C. BASS REFLEX CABINETS, JUNIOR MODEL.** Specially designed for W.B. HF1012 Speaker, but suitable for any good quality 10in. speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18 x 12 x 10in. Handsome appearance. Ensure superb reproduction for only £3.19.6.

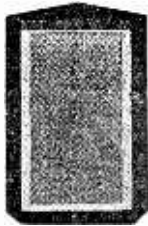
**STANDARD MODEL.** As above but for 12in speakers. Size 20 x 15 x 13in. For vertical or horizontal use. £5.19.6. Set of legs with brass ferrules. 19/6.

**R.S.C. JUNIOR HI-FI REPRODUCER.** The very latest Goodman Axiette 8 High Fidelity loudspeaker (retailing at approx. 5 gns.) fitted in a specially designed Bass Reflex cabinet size 12 x 13 x 10in. Acoustically lined and ported and finished in polished walnut veneer. Matching impedance 15 ohms. Frequency range 40-15,000 c.p.s. Power handling 8 watts nominal. **8 Gns.** Ideal for Stereo. Carr. 4/6.

**MULTI-METER, CABY MI.** Sensitivity 2,000 ohms per volt. A.C. and D.C. 54/- A.10. Basic Meter sensitivity 155 microamps A.C. and D.C. ranges £4.17.8. B.30. Sensitivity up to 10,000 ohms per volt A.C. and D.C. £6.10.0. 30,000 ohms per volt, with overload buzzer. £8.19.6.

**R.S.C. CORNER CONSOLE CABINETS**

Polished walnut veneer finish. Pleasing design. **JUNIOR MODEL.** Size 20 x 11 x 8in. for 8 x 5in. or 10 x 6in. speakers. £2.9.8. **STANDARD MODEL.** Size 27 x 18 x 12in. for 8 or 10in. speakers. £4.11.9. **SENIOR MODEL.** Size 30 x 20 x 15in. for 12in. Speaker. Suitable Speaker systems below. Only 7 gns.



**AUDIOTRINE HI-FI SPEAKER SYSTEMS.** Consisting of matched 12in. 12,000 line. 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. The smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating £4.19.9. Carr. 5/-. Or Senior 15 watt. £6.19.9. Carr. 7/6.

**AUDIOTRINE EQUIPMENT CABINETS**

Size 36 x 15 x 18in. Beautiful walnut veneered finish. Elegant contemporary design. Robust construction. Uncol. removable baseboard. Death above baseboard 5". Terms: Dep. 29/9, and 9 mthly. pymts. 29/9



# AUDIOTRINE HI-FI TAPE RECORDER KIT 25<sup>1</sup>/<sub>2</sub>

G.N.N. Carr. 17/8.

**REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR**  
Incorporating the latest Collaro Studio Tape Transcriber. 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 14 x 15 x 8 1/2 in. 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.



## HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

**ONLY 5 PAIRS OF SOLDERED JOINTS PLUS MAINS**

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



Two input sockets with associated controls allow mixing of "line" and gram as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, E281. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small compact of current manufacture. **INDIVIDUAL CONTROLS FOR BASS AND TREBLE** "Lift" and "Cut". Frequency response  $\pm 3$  dB 30-30,000 c/s. Six negative feedback loops. Hum level 60 dB 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, LEAD OR RHYTHM GUITARS, etc.**  
**OUTPUT SOCKET** with plug provided for **RADIO FIDELITY UNIT**. Size approx. 12 x 9 x 7 in. 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.** (Or factory built 51/- extra.)  
If required louvered metal cover with 2 carrying handles can be supplied for 13/9. **TERMS ON ASSEMBLED KIT'S. DEPOSIT 2/6** and 9 monthly payments of 2/9/. Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Microphones, etc., with cash and credit terms.

**R.S.C. GRAM AMPLIFIER KIT.** 3 watts/output. Negative feedback. Controls Vol., Tone and Switch. Mains operation 200-250 v. A.C. Fully isolated chassis. Circuit, etc., supplied. **Only 39/9, Carr. 3/9.**  
**HI-FI CRYSTAL PICK-UP HEADS.** (Cartridges) Acos Standard replacement for Garrard, B.S.R. and Collaro. 16/9. Acos Stereo-Monaural. 29/9. Ronette Stereo-Monaural 39/9. B.S.R. Stereo 39/9.  
**BRADMATIC RECORDING HEADS.** High Impedance Record/Playback 22/- Low Impedance Erase, 12/6.  
**MARRIOTT RECORDING HEADS.** High Impedance. Record/Playback 15/- Low Impedance. Erase, 10/-.  
**PICK-UP ARMS.** Complete and with latest Acos/hi-fi Turnover Cartridge 29/11. **CRYSTAL MICROPHONES.** Hand type NP10 14/9; R.T.C. 19/9. Acos Mic 40 25/9. Acos M. U41 4-speed. Stick type Acos 39-39/9. BM3 with neck band and heavy table stand 59/9. Lapel type 29/9.  
**COLLARO JUNIOR** 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. **Only £3.19.6.**  
**R.S.C. U41 4-speed AUTO-CHANGERS** with hi-fi turnover head. £8.19.6. Carr. 4/8.  
**GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER** with high fidelity pick-up. Latest model. For 200-250 v. A.C. mains. £27.17.8. Carr. 4/6.  
**GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTO-CHANGERS.** Turnover GC8 head, for 200-250 v. A.C. mains. £11.9.0.  
**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 1 1/2 x 2 1/4 in. Controls: Vol. and Tone with Switch. **Only 59/6.**

**LINEAR TAPE PRE-AMPLIFIER.** Type LP1. Switched Negative feedback equalisation. Positions for Record lin., 3lin., 7in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriber and a high fidelity amplifier, but suitable for almost any Tape Deck. **Only 9 gns. S.A.E. for leaflet.**

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



A complete set of parts for the construction of a stereo-phonetic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. 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, E281. 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/- and ready to use for 59/6 extra.

Kit can be supplied assembled and ready to use for 59/6 extra.

## SENSATIONAL STEREO OFFER

A complete set of parts to construct a **4 Gns.** quality Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. Stereo Pick-up Head 19/9 extra with above only.  
**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 Panel; Fuses. Fuseholder and circuit. 59/9. Carr. 4/6.

## R.S.C. BATTERY CHARGING EQUIPMENT

Guaranteed 12 months.



charging. Louvered steel case with stoved eye hammer finish. Fused and ready for use with mains and output 59/9 leads and battery clips. Carr. 4/6.  
**Terms:** Deposit 12/- and 5 monthly payments of 12/-.

All for A.C. Mains 200-250v., 50 c/s.  
**ASSEMBLED 4 amps. 6/12 v.** Flitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. Fused, ready for use with mains and output leads. Carr. 12 v. 3/9. 6/12 v. 1 amp. 27/9 Less meter.

**BATTERY CHARGER KITS** Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders. Grommets, panels, Heavy Duty Clip, circuit. Carr. 3/6 extra. 12 v. or 12 v. 1 amp. .... 22/9 As above, with Ammeter. 28/9 6 v. 2 amps. .... 19/9 6 v. or 12 v. 2 amps. .... 25/9 6 v. or 12 v. 2 amps. including set of Ammeter. .... 35/9 6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector. .... 52/9

**CHARGER KIT, 12 v. 14 AMP or 24 v. 7 AMP** Consisting of mains trans. 200-230-250 v. F.W. (Bridge) selenium Rectifier, Ammeter, Fuses, Variable Resistor, Heavy Steel Stove enamelled case and Circuit. **Only £9.19.6.** Carr. 15/-. Please state if 12 v. or 24 v. kit required.

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

Interleaved and Impregnated. Primary 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. 0-5-6.3v. 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  
200-0-200v. 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  
300-0-300v. 150mA. 6.3v. 4a. 0-5-6.3v. 3a. 29/9  
**FULLY SHROUDED UPRIGHT** 250-0-250v. 60mA. 6.3v. 2a. 0-5-6.3v. 2a. Midway type 2 x 3 x 3in. 17/11  
250-0-230v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 27/9  
300-0-300v. 130mA. 6.3v. 4a. 5v. 3a. 27/11  
300-0-300v. 150mA. 6.3v. 4a. C.T. 6.3v. 1a. for Mullard Amplifier. 33/9  
350-0-350v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a. 27/11  
350-0-350v. 150mA. 6.3v. 4a. 0-5-6.3v. 3a. 35/9

**MIDGET MAINS Primaries** 200-250 v. 50 c/s. 250v. 60mA. 6.3v. 2a. 11/9  
250-0-250v. 80mA. 6.3v. 2a. 12/11  
Both above size 2 1/2 x 2 1/2 in.  
**FILAMENT TRANSFORMERS** All with 200-250v. 50 c/s primaries 6.3v. 1.5a. 5/9; 6.3v. 2a. 7/9; 0-4-6.3v. 2a. 7/9; 12v. 1a. 7/11; 6.3v. 3a. 9/11; 6.3v. 3a. 17/8; 12v. 1.5a. twice. 17/8.  
**SMOOTHING CHOKES** 150mA. 10-10 H, 250 ohms. 11/9  
100mA. 10H, 200 ohms. 8/9  
80mA. 10H, 35 ohms. 5/9  
60mA. 10H, 400 ohms. 4/11  
**CHARGER TRANSFORMERS** All with 200-230-250v. 50 c/s Primaries; 0-9-15v. 1a. 12/9; 0-9-15v. 2a. 14/9; 0-9-15v. 3a. 18/9; 0-9-15v. 5a. 19/9; 0-9-15v. 6a. 23/9; 0-9-15v. 8a. 29/9.  
**AUTO (Step up/Step down) TRANS.** 0-10-120-230/250v. 50-80 watts. 13/9; 250 watts. 39/9; 150 watts 27/9.  
**MICROPHONE TRANSFORMERS** 120: 1 high grade, clamped. 8/9.

ARMSTRONG AF200AM/FM RADIOGRAM CHASSIS



\$21-4-0 (carriage free)

- FULL BAND (87-108 Mc/s.) and MEDIUM BAND 187-470 Mc.
• 8 WATT OUTPUT, 7 VALVES.
• 16 dB NEGATIVE FEEDBACK.
• WIDE-RANGE BASS and TREBLE CONTROL.
• 3 COMPENSATED PICK-UP INPUTS.
• FREQUENCY RESPONSE 20-20,000 c.p.s. +/- 2 dB.
• TAPE RECORD and PLATYTRACK FACILITIES.
• CONTINENTAL RECEPTION OF GOOD PROGRAMME VALUE.
FOR 8, 7 and 18 ohm SPEAKERS. Write for free literature.

New Boxed VALVES 30-day Guarantee

Table listing various vacuum tubes with their types and prices, such as 6X4, 6X5, 6X6, etc.

NEW ELECTROLYTIC CAPACITORS FAMOUS MAKES

Table listing electrolytic capacitors with their values and prices, such as 1/2 50/300V, 1/2 100/250V, etc.

TELESCOPIC GIBSON AERIALS 18in. extending to 43 in. 8/8 ea.

TRIFLEXERS Bands I, II, III, 18/8. COAX PLUG, 1/8. LEAD SOCKETS, 5/8. PANEL SOCKETS, 1/8. OUTLET BONES (Surface or flush), 4/- ea. BALANCED TWIN FEEDER 1/4. 64. 80 or 300 ohms. TWIN SCREENED cap. yd. 1/8. 30 ohms only. Wirewound Ext. Speaker Control, 10 1/2 5/8. 25 1/2 5/8. WIRE-WOUND POT. 5 WATT. Pre-set. Min. TV Types. All values to 10 ohms to 35 K. 3/- ca. 35K. 4/-. (Carbon 30 K. to 2 meg. 3/8). WIRE-WOUND 4 WATTS Pots. Long spindle. Value, 50 ohms to 50 K. 100 K. 7/8. PHILIPS TRIMMERS. 0-10 PF. 3-50 PF. 1/8. TRIMMERS, Ceramic. 30. 60. 70 PF. 64. 100 PF. 150 PF. 1/8; 250 PF. 1/8; 500 PF. 750 PF. 1/8. TV type. TRIMMER, 1000 PF. with knob, 2/8. RESISTORS. Preferred values, 10 ohms to 10 meg. 1/8. 54. 1 w. 64. 1 w. 64. 1 w. 94. 2 w. 1/8. High Stability. 1 w. 1/8. Preferred values 10 1/2 to 10 meg. Ditto 5/8; 10 1/2 to 25 meg. 94. RESISTORS. OZ1, 3/8; OZ2, 2/8; OZ3, 1/8. 5 watt WIRE-WOUND RESISTORS 1/8 10 watt 2/8 15 watt 2/8 12.5K to 25K 10 w. 3/8

Volume Controls 80 ohm COAX Semi-air spaced in. Stranded core 40 yds. 17/6 60 yds. 25/6 Ideal 625 lines. Low loss 5dB 1/8 yd. 1000. 600 Mc/s

MAINS TRANSFORMERS 200 250 v. A.C.

Postage 3/- each transformer. STANDARD, 250-0-250, 30 mA, 6.3 v. 3.0 a. Tapped 4 v. 4 a. Rectifier 6.3 v. 1 a., 5 v. 2 a. or 4 v. 2 a. 22/8, ditto, 350-0-350 19/6. HILFATURE 200-0-200 mA, 6.3 v. 1 a. 15/6. MIDGET, 220 v. 45 mA 6.3 v. 2 a. 15/6. SMALL, 250-0-250, 45 mA, 6.3 v. 2 a. 17/6. STD. 250-0-250, 65 mA, 6.3 v. 3.0 a. 17/6. KEATERS TRANS. 5.5 v. 1 1/2 a. 7/8. Ditto, tapped 1.4, 2, 3, 4, 5, 6.5 v. 8/8. Ditto, sec. 6.3 v. amp. 10/6. GENERAL PURPOSE LOW VOLTAGE, 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 18, 24, 30 v. 2/8. AUTO TRANSFORMER, 150 w. 22/8. 0, 110, 200, 250, 300 v. 2 a. 22/8. MULLARD "510" Main Transformer 22/6. PARMKO MAINS TRANSFORMER. Made for special contract, the ratings can safely be doubled. Guaranteed 3 years. Primary 0-110-230-250 v. H.T. 300-0-300 v. 50 mA. L.T. 6.3 v. 1 1/2 amp. Size 4 x 3 1/2 in. 17/8.

INTERVALVE TRANSFORMERS. 5.3:1 or 5:1. 9/- O.P. TRANSFORMERS. Heavy Duty. 5/6. Multi-ratio. 7/8. Multiratio heavy duty push-pull, 10 w. 15/8. Battery 4/8. Sub min. 5/8. 10 w. O.P. matching trans. 3/7. 150. 12/8. L.F. COUPLER 15/10H. 60/65 mA. 5/8; 10H. 50 mA. 16/8; 10H. 150 mA. 14/8. TUNED COPPER WIRE 16 to 22 awg. 1 lb. 3/8. 32-40. 4/8; D.C.C. 2R. 34 36 awg. 2oz. 3/8.

I.F. TRANSFORMERS 7/6 pair 400 Kc/s Ring Tuning Miniature Can. 2 x 1 1/2 in. Best Q and good bandwidth. Data sheet. Standard size Weyrad 10/6 pair.

FULL WAVE BRIDGE SELENIUM RECTIFIER. 2, 6 or 12 v. 1 1/2 amp. 3/8; 2 a., 11/3; 4 a., 17/6. GRABBER TRANSFORMERS. Tapped input. 200/250 v. for charging at 2, 8 or 12 v., 1 1/2 amp. 18/8; 2 amp. 17/8; 4 amp., 22/8. Circuit included. 4 AMP CAR BATTERY CHARGER with ammeter, Leads, Fuse Case, etc., for 6 v. or 12 v. 69/8.

BOOKS list S.A.E. Boys' Book of Crystal Sets... 2/6 'W.V.' Radio Valve Data... 9/6 High Fidelity Speaker Enclosure 5/8 Valve and TV Tube Equivalents... 9/6 TV Fault Finding... 5/8 Mullard Amplifier Manual... 6/6 Radio Valve Guide, Books 1, 2, 3... 4 or 5/- each Transistor Superhet Receivers... 7/6 Practical Radio Inside Out... 3/6 Master Colour Code Chart... 1/8 Transistor Controlled Models... 7/6 Principles of Colour TV... 18/- International Radio Stations... 2/6

4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER Size 3 x 1 1/2 in. A ready built miniature push-pull amplifier with Driver and output transformers, 4 transistors. Ideal for use with record players, intercoms. BABY ALARMS, etc. Complete with full instructions and circuit. Price 47/6 5v. Batt. 2/8. 2 1/2 in. Speaker 15/-

1964 RADIOGRAM CHASSIS



THREE WAVEBANDS FIVE VALVES L.W. 15 m. -30 m. LATEST MULLARD M.W. 200 m-500 m. ECH81, KP50, EB81 L.W. 800 m. -2,000 m. EL44, E280 12-month Guarantee. A.C. 200/250 v. 4-way Switch; Short-Medium, Long/gram, Fertite Aerial A.V.C. and Negative Feedback, 3 ohm output, 5 watts. Glass dial, horizontal wording, size 1 1/2 in. x 4 in. Aligned and calibrated. Isolated Chassis, size 1 1/2 in. x 5 in. high x 5 1/2 in. deep. £9.15.6 Carr. & Ins. 4/6.

BAKERS SELHURST LOUDSPEAKERS



12in. Baker, 15w. Stalwart 3 or 15 ohms, 45-15,000 c.p.s. 5 gu. 12in. Stereo, Foam Suspension, 12w., 35-18,000 c.p.s. 8 x 3 in. 21/-; 10 x 5 in. 22/8; 10in. Kola, 30/-; 12in. K.A. 30/- STENTORIAN HF1012, 10in. 3 to 15 ohms, 10w. 87/6 4in. HF121, 72/-; Tweeter T458, 30/-; Cross-over C3X300, 30/- EXTENSION SPEAKER CABINETS. 5in., 15/6; 6in., 18/8; 8in., 19/6; 10in., 29/6; 12in., 60/- C.R.T. BOOSTER TRANSFORMERS for heater cathode short circuit, or tubes with tailing emission. Full instructions supplied, mains input. Type A optional 25/-, and 50/-; Boosted 25/-, or 40/-, or 10.8X, or 12.5X. State voltage required. Price 10/6.

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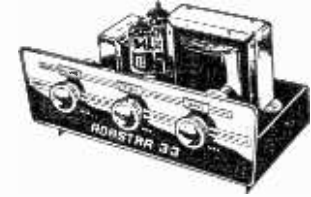
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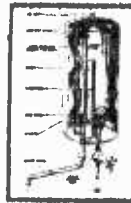
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# Practical Wireless

Vol. XXXIX No. 686 APRIL 1964

Editorial and Advertisement  
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## Right Tool for the Job

NOTHING offends the enthusiast more than a scarred spindle, a burred screw, a broken iron-dust tuning core or a Turk's-head bundle of twisted wires in place of a soldered connection.

Yet it is the enthusiast, the home handyman, the amateur experimenter who is the worst offender. Ask any full-time service engineer!

It would be easy to answer that the reason is a lack of proper facilities, or the high cost of tools. Easy, but not entirely accurate. What are the proper facilities, the correct instruments, the right tools for the job? The true enthusiast would answer that there is not a task beyond the scope of the kitchen table, a few basic items of test gear, a few well-chosen tools and an adequate file of back numbers of PRACTICAL WIRELESS and *Practical Television*.

Very often, the home-built chassis is spoiled because a few shillings have been begrudged in the purchase of the necessary tools. The tool-kit need not be elaborate: a few screw-drivers, good pliers, electrician's and radio types, side or top-cutters, large and small Phillips screw-drivers and a selection of spanners form the basis of the "hardware department". Desirable extras are: a small hammer, hacksaws, files, drills, taps and a bench-vice. And, most important for the radio enthusiast, a good, instrument-type soldering iron.

What has been left out? Quite a lot, we hear readers protesting. Each has his personal hobby-horse. But there is one glaring omission from our list—the tools that nowadays are almost indispensable. Those elusive plastic necessities, the trimming tools. A good set of these saves hours of filing away at knitting needles or cursing over cores despoiled by a clumsy grub-screw driver.

The problem is—where to obtain a set of tools at a reasonable price? Full-time engineers regard as a wise investment the commercially marketed "tuning kit". But our home enthusiast begrudges spending a couple of pounds for the sake of one or two tools that may be employed very infrequently. So he is faced with the prospect of a cracked core, jammed in its former, the victim of a makeshift tool.

Despite the arguments advanced by many radio servicemen, the amateur enthusiast is no fool. A regular reader of PRACTICAL WIRELESS is sufficiently well-informed to know when and how to adjust his receiver. In these days of mass-production, sets in the "popular" bracket have pre-tuned coils, and only the most perfunctory spot-checks are made before they leave the factory. And cores do shake loose occasionally—not surprising if one considers the vibration set up by the Mersev beat or the full blast and bellow of Wagner.

A touch of adjustment helps in these cases. And the constructor can hardly finish his job without recourse to the trimming tool. Which is why the PRACTICAL WIRELESS trimming tools should be worth much more than their intrinsic value to the home enthusiast.

Our next issue dated May will be published on April 7th

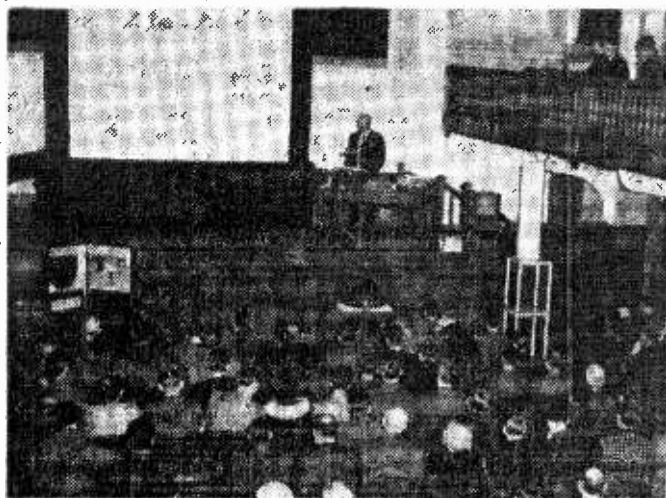


ROUND THE WORLD  
of

# WIRELESS

## P.W. FILM SHOW A SELL-OUT

NEWS AT HOME  
AND ABROAD



An attentive audience at the Practical Wireless Film Show listens to Mr. I. Nicholson of Mullard.

WITH readers from as far away as Southampton and Coalville among the audience, the 1964 PRACTICAL WIRELESS Film Show (held on January 31st) must have had the highest ever attendance figures for this annual event. There was hardly a seat vacant when the first part of the programme—an illustrated talk by Mr. I. Nicholson, of Mullard Limited, on colour and u.h.f. television—commenced at Westminster's Caxton Hall, where all the P.W. Film Shows have been held. Undoubtedly it was this first topic which prompted more people than ever to write for tickets and, as always, Mr. Nicholson's talk proved to be of great interest and value.

In the chair this year was the Editor of PRACTICAL WIRELESS, Mr. W. N. Stevens. Although present at last year's show, this was the first occasion on which Mr. Stevens has addressed an audience of his readers.

After an interval for refreshments, the audience returned to the hall to see a film supplied by Mullard Limited on the use and applications of ultrasonics. The meeting ended with a short question and answer session when Mr. Nicholson replied to queries put forward by members of the audience, mostly on the subject of colour and u.h.f. TV.

## Equipment Transmits Ship's Data Automatically

THE Marconi International Marine Company Limited has recently received an order from Shell International Marine Limited, for twelve sea-borne installations of newly developed equipment which automatically transmits hull and engine performance data from ships anywhere in the world to a central receiver. The order also includes a duplicate receiving terminal, to supplement the one which has been in experimental use for a number of months with trial transmitting installations on

board two of the Shell Company tankers.

The system, which demands exceptional accuracy of transmission to combat interference, noise and fading, was developed by the Marconi Marine Company in collaboration with Shell engineers. Data are transmitted from the ship in a special code provided by Marconi Autospec error correcting equipment fed with ordinary teleprinter signals.

The high frequency transmissions are received at either the G.P.O. station at Bearley, War-

wickshire, or at the Dutch P.T.T. station at Scheveningen. From here the signals travel by land line to the Shell central offices in London where detection is achieved in telegraph equipment, after which the Autospec terminal equipment provides the error correction. The output is next passed through teleprinter machinery to produce a punched tape similar to that presented to the Autospec on board the ship. A computer then processes the tape which contains the required data.



## New Tube "Sees" in Dark

A NEW electronic tube which can "see" in the dark, has been announced by EMI Electronics Limited. This tube is the first four-stage cascade image intensifier to be made available commercially and the two versions being marketed are the type 9694 and type 9692.

With the ability to multiply the strength of the available light a million times, these tubes achieve important improvements over existing image intensifiers, and will find applications in the armed services as a means of night vision and in the fields of nuclear and atomic physics.

## Gold Plating Improves Transistors

THE Bedford firm of Texas Instruments Limited manufactures a wide range of semiconductor devices for a variety of uses in the electronics industry, and for some time now has incorporated a form of gold plating in the manufacturing processes to increase the reliability of their transistors, etc. This is because gold has a number of special properties which give it advantages over other substances traditionally used. Some Texas transistors, for example, have an internal plating of 24 carat gold which effectively withstands the acid etching solution used during their manufacture. The gold is presented to the component parts of the transistors to be plated in the form of a solution called PMD 63 acid gold, which has been developed by PMD Chemicals Limited of Coventry.

These gold deposits, which can be as thin as 20 micro-inches, also reduce the risk of impurities being transferred to the semiconductor wafers; an important consideration in transistor technology.

## Plessey acquires S. African firm

THE share capital of the Instrument Manufacturing Corporation of South Africa Limited, has been acquired by the Plessey Company Limited. This was announced recently by Mr. A. E. Underwood, the Chairman and Managing Director of Plessey Overseas Limited.

The Instrument Manufacturing Corporation had previously been associated with the Group, making Plessey communications equipment under licence, and also with the South African Council for Scientific and Industrial Research in the development of electronic surveying equipment.

## CARIBBEAN COMMUNICATIONS PROJECT

FOR some years, wireless communications between the islands of the Eastern Caribbean and the rest of the world have been supplied by a limited number of h.f. radio channels. Recently, however, Cable and Wireless (West Indies) Limited, have announced their participation in a project to establish a multi-channel tropospheric scatter and microwave system which, together with existing links and submarine telephone cables, will provide improved and increased communications between the individual islands and the North American continent.

A tropospheric scatter system has been in use between Trinidad and Barbados since 1961 when a number of other inter-island links in the Leeward and Windward Islands were also inaugurated, and it is these links which Cable and Wireless (WI) Limited now propose to integrate in their new system. One of the main completely new links to be established will be a tropospheric scatter system between Barbados and Antigua, and on both these islands the installation of equipment will require extensive building.

To link this integrated system with the United States, an 80-channel submarine telephone cable is to be laid between the

islands of Antigua and St. Thomas, as from this latter island there extends another telephone cable (128 channels) to Florida. The Antigua—St. Thomas cable will be owned jointly by Cable and Wireless (WI) Limited and the American Telephone and Telegraph Company, and to complete the link to the mainland, the British company will negotiate the purchase of rights in the American-owned St. Thomas—Florida cable.

Inter-island communications using the new installations should be possible by June 1965 and during the latter half of the same year the telephone cables which will bring the West Indies into better contact with the Commonwealth and the whole of the world should be operational.

## New Relay Station for Northern Ireland

NORTHERN IRELAND's new BBC transmitting station near Enniskillen was brought into service on Monday, 24th February. This relay station will bring v.h.f. radio and channel 5 television to 48,000 people in Co. Fermanagh and South-West Co. Tyrone who previously were out of range of these BBC services. Also improved reception for a further 40,000 living in the fringe areas of the Divis and Londonderry stations will result from the introduction of this new transmitter.

The three Band II radio programmes are the Northern Ireland Home Service, The Light Programme and The Third Programme/Network Three, which are transmitted on 93.3Mc/s, 88.9Mc/s and 91.1Mc/s respectively.

## Recording Conference to be held at I.E.E.

FOR the first time, the recently established United Kingdom and Eire Section of the European Region of the Institute of Electrical and Electronics Engineers (see Round the World of Wireless, December 1963) is sponsoring an international conference, to be held in London at the Institution of Electrical Engineers. The International Conference on Magnetic Recording is also sponsored by the I.E.E. and the British Institution of Radio Engineers, and in a joint statement issued by the three official bodies, it is provisionally announced that the conference will be divided into audio recording, video recording, digital applications, analogue applications, recording media and general problems.

Synopses of papers were invited from foreign authors as well as from the U.K. for the conference which will be held during the week beginning 6th July, 1964. As part of the conference, a technical exhibition of displays relevant to the subject of the conference is to be staged at the I.E.E.

## THE PRACTICAL WIRELESS

# Trimming Tool Set

A USEFUL AID  
FOR THE AMATEUR  
CONSTRUCTOR

**T**RIMMING tools are the sort of equipment more often made than bought. In an emergency, one ransacks Granny's workbox for plastic knitting needles, or sharpens a match-stick, or breathes a prayer and resorts to the grub-screw driver.

This is usually because the need for alignment is comparatively rare, and toolkits that contain a comprehensive set of trimming tools are expensive. This month's free offer of a set of plastic trimming

flattened shank, usually of brass, which is used to move a ferrite core in the coil of many radios and television turrets. Again, the thick shank affords a firm grip.

No. 2 has a thin blade with long shank, of dimensions similar to the blade of No. 1. Purpose of the long shank is to insert through a recessed former, where No. 1 would not reach. An example is the oscillator tuning core of a television tuner unit. No. 1 should be used where possible to make final adjustments.

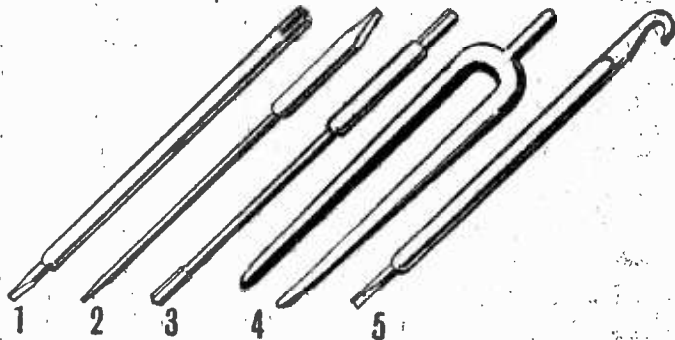
The wide blade of No. 2 fits mica and ceramic trimmers, ferrite pot-cores and slotted hex-nut compression trimmers. It should not be used as a screw-driver, for obvious reasons.

No. 3 is a double-ended hexagon trimmer. Tuning slugs with hexagon-shaped holes that go right through the slug are in common use. It is convenient to adjust the two cores of a transformer from the same end of the screening can.

The short-shanked end, adjusts the nearer slug: the long shanked end is inserted through the upper slug without disturbing its position, inserted in the lower slug, which can then be adjusted independently. The diameter of the long shank allows it to rotate in the hexagonal bore of the upper slug.

No. 4 is a pair of plastic tweezers—invaluable when working in the confined space of a small set. The upper end is finished in a substantial "plug", which has its use in pushing coil turns or formers on ferrite rods, where a metallic blade is impractical.

*This illustration shows each of the trimming tools in detail.*



tools should be more than welcome.

The tools are designed to fit the majority of tuning devices in current use. The material from which they are made is a plastic with sufficient elasticity to prevent chipping and premature wear, and is hard enough to make firm contact with slots and apertures of the slugs and screws to which they are applied.

No. 1 has a short blade at the lower end and a slot at the top. The short blade is suitable for the majority of iron dust cores employed in radio and television receivers, (excepting transistorised radios). The thick shank offers an adequate grip for controlled adjustment over a small arc.

The slotted end is suitable for turning the

No. 5 has a fine, narrow blade at the lower end for the adjustment of slotted cores widely used in transistorised radios. The slots are generally carried through the core, and the correct method of adjustment is to insert the trimming tool as far as possible before turning, to reduce torsion.

The hook at the other end of the tool is useful for dressing leads, holding tuning cords, and testing wire-end connections.

Other uses will undoubtedly be found for this set of five tools in its vest-pocket wallet, by our ingenious readers. When we discover Granny has borrowed the hooked tool to do up her button boots, we shall know the wheel has turned full circle!

# The ART of ALIGNMENT

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BY H. W. HELLYER

**T**HE successful alignment of the tuned circuits of a radio receiver needs three things: (a) a reliable signal source, (b) trustworthy trimming tools and (c) an intelligent assessment of the means and methods of carrying out the job.

The first two requirements are easy. If a signal generator is not available a suitable signal source is provided by the simple receiver alignment aid described on page 1155. The second requirement is fulfilled by the handy pack of trimming tools presented with this issue of PRACTICAL WIRELESS. This article is an attempt to provide the third requirement with an accent on *practice*.

A commercial receiver may be assumed to have its tuned circuits adjusted to or at least within working tolerances of the correct frequency. *Indiscriminate adjustment of tuning slugs, trimmers, coils, etc., is not to be recommended.* But by a logical approach to alignment and calibration many small improvements can often be made.

The home-built receiver is a different matter. Beginning with the assumption that all the circuits are completely out of tune but that the set is working—that a noise of some sort can be produced from the loudspeaker—we can “pull” the circuits into tune without recourse to the elaborate test instruments that we would like to have but cannot afford.

## Audio Output

We start at the audio frequency stages of the receiver. We are not concerned here with the quality of the signal except indirectly. For our present purpose it is enough to make sure that the audio stages are working by injecting an a.f. signal at a point immediately following the detector and hearing a note through the loudspeaker or phones.

The usual injection point, for convenience, is across the outer two terminals of the volume control. To avoid hum it is desirable to connect the screened or earthy lead of the signal generator (“alignment aid”) to the earthy connection of the potentiometer, which will normally be the left-hand tag viewed from rear. The live input should be isolated with a capacitor of about 0.1 $\mu$ F.

*In the case of a.c./d.c. apparatus it is advisable to check that the chassis is returned to neutral before connecting the generator.* Furthermore, an isolating capacitor should be used in the earthy lead from the signal generator as well as in the live lead.

The sound we now hear from the loudspeaker, a 400 or 1,000c/s note, for example, is sufficient

for most rough alignment tests. But if sensitivity assessment is to be carried out, or more precise tuning, it is necessary to provide a visual indication.

The ear is notoriously inefficient in detecting loudness variations; a change in sound intensity of about 1dB is about the smallest we can identify.

## Sensitivity

The sensitivity figure given for a radio is generally understood to mean the input r.f. voltage, with standard modulation (30% at 400c/s, amplitude modulated), required to produce a standard audio output. The snag is that the so-called standard audio output may vary widely from maker to maker. Usual standards are: For sets developing up to 1W, 50mW; for sets upwards of 1W, 500mW. (Car radios usually have a 1W standard.)

Where the sensitivity is simply quoted as so many microvolts this is understood to denote a 50mW output. A different method of expression is “. . . decibels below 1V” or, referring to input power, “. . . decibels below 1mW”. In addition the term “field strength input” may be met and this is used to define, for convenience, the sensitivity of receivers using loop or ferrite rod aerials.

A meter connected across the secondary of the output transformer is the usual convenient method of indicating output changes.

If the meter is used in place of the loudspeaker a substitute load should be provided to prevent damage to the output transformer (as R in Fig. 1a). This should be a wire-wound resistor of sufficient wattage to dissipate the audio power at full output and of equivalent resistance to the impedance of the loudspeaker it replaces.

The output meter could be an ordinary a.c. voltmeter with a full-scale deflection of up to 5V. More precise instruments do not concern us here. The a.c. ranges of a multimeter are not intended for accurate measurement of voltages at frequencies above 50 to 100 cycles.

An alternative method of measuring output is to read the anode current of the output valve. This can be done directly by inserting the meter in the anode lead or indirectly by using a meter with smaller f.s.d. and a shunt, or by measuring the voltage across the cathode bias resistor.

The indications, where these means are employed, will rise as the maximum output is approached. A rising indication is obtained when measuring current consumed by a transistorised receiver—a useful method of registering output.

A rising indication can also be obtained across the detector load, and alignment can be carried out with an unmodulated signal using this method.

An unmodulated signal will produce an accurate indication of varying current in a controlled i.f. stage as a.g.c. voltage varies. One advantage of the connection of a voltmeter at the screen grid of a controlled stage is that the meter reading *dips* as resonance approaches. Points of connection are shown in Fig. 2.

**I.F. Alignment**

General practice nowadays is for intermediate frequencies to be 470kc/s. Some older sets may have i.f.s of 455 or 465kc/s, and a number of receivers more than 15 years old used a 110kc/s intermediate frequency.

The exact frequency can be ascertained by injecting a signal across the final i.f. transformer primary. Damp the secondary with a resistor of about 470kΩ. Full r.f. input is then "forced through" and the generator tuned until an output peak is obtained. Then the transformer primary tuning is adjusted slightly, the generator frequency setting "rocked" (i.e. swung a little above and below the normal setting) and adjustment continued until the maximum possible response is obtained.

With a little patience it is possible to determine the exact point of resonance this way.

Next render the local oscillator inoperative by short-circuiting the appropriate section of the ganged tuning capacitor. First check whether d.c. is present at this point. If so use a capacitor as a shunt instead of a direct short-circuit: suggested value 0.1μF.

Remove the damping from the i.f. transformer.

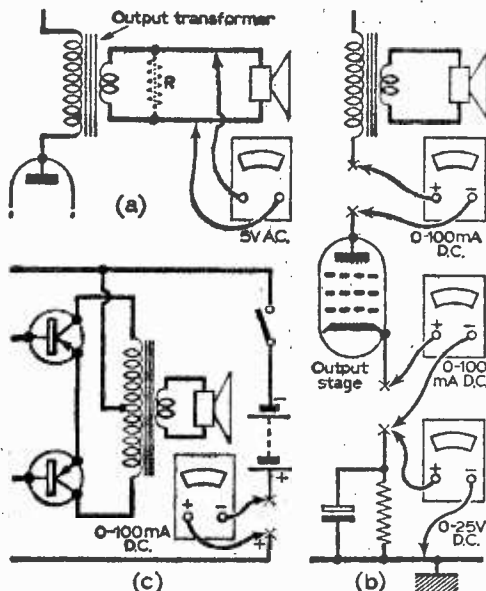


Fig. 1: Indication of audio output level. (a) across secondary of output transformer. (b) Measuring anode current, directly and indirectly. (c) Measuring current consumption of a transistorised radio.

set the generator to the correct i.f. as determined and adjust from back to front of receiver (i.e. final i.f. secondary, primary, first i.f. secondary, primary).

Always keep the volume control at maximum and the input level of the signal down to reduce the possibility of overloading occurring and the a.g.c. from coming into operation, which would dampen the effect of peaking at resonance. Where stagger-tuned or over-coupled i.f.s are used, as on some s.w. sets, refer to the maker's instructions for frequency settings and for any special procedure to adopt.

In some transistor sets the i.f. transformers have a single slug. Many of these slugs are small and easily damaged. Where the slot extends through the core use the appropriate tool, inserted carefully to bear on the full area of the walls of the slot. If a slug cracks it can be removed without damage to coil or former by chipping the brittle material out with a sharp point such as a scriber.

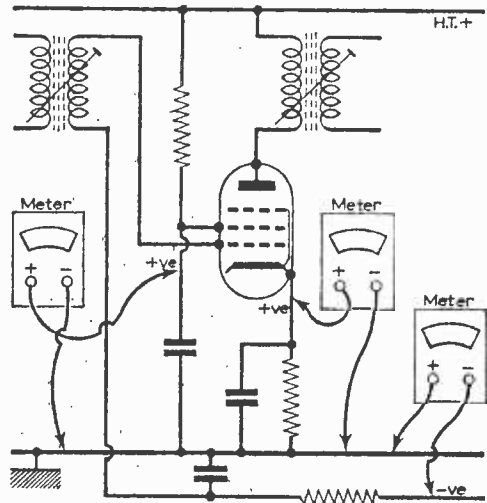


Fig. 2: Signal level in a controlled i.f. stage. Using a c.w. input, measuring anode and screen grid current, test for dip. Using modulated signal at higher level, a.v.c. voltage becomes more positive.

It is more difficult to remedy the error of cracking or burring the slot of a conventional slug. Better sometimes to remove its accompanying slug and withdraw the broken core through the coil former. In dire emergency a couple of drops of oil run down the former helps to release the scarred core, and can soften elastic sealing enough to allow a grub screw driver to do the rest.

Where cores are waxed first insert a grub screw driver in the slot—making sure you have chosen a size that fits—then apply heat to the blade with a soldering iron until the wax begins to soften, then unscrew the core a turn gently.

The plastic tool should then be reinserted for final adjustments. In the case of slugs with hexagon holes a suitable Allen key may be used in the same way. Never attempt to adjust one of these hollow cores with an ordinary screwdriver blade.

**R.F. Alignment**

Before starting any r.f. alignment ensure that the tuning pointer is correctly set. Check that with the tuning gang at maximum (vanes fully meshed) the pointer lines up with the low frequency (long wavelength) end of the scale and with the gang fully open with the h.f. (short wavelength) end. If the pointer does not line up adjust it at one extreme end. Then leave it strictly alone!

*The straight set:* Except where band-pass circuits are involved the principle of r.f. alignment is as for r.f. alignment of a superhet (see below). The tuned circuits of the demodulator stage are

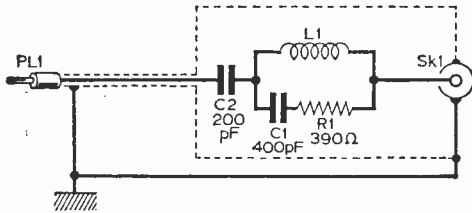


Fig. 3: A dummy aerial unit. The coil L1 consists of 40 turns of 28s.w.g. enamelled wire wound over lin. of a 1/4 in. diameter plastic rod. The unit should be enclosed in a metal can.

trimmed near the high-frequency end of the band. The r.f. tuned circuits are then adjusted for maximum output with correct calibration noted. Any low-frequency adjustment is made by slightly bending the split vanes of the tuning rotor or by adjusting the cores of the inductors if these are permeability tuned. Then final adjustments at the h.f. end are repeated. Adjust m.w. before l.w. as a general rule (depending on circuits).

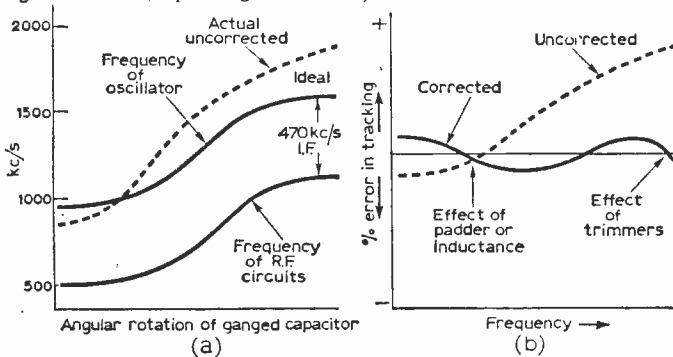


Fig. 4: Necessity for padding and trimming. (a) Rate of change of frequency and of angle of rotor of tuning capacitor is not equal for both r.f. and oscillator circuits. (b) Adding parallel and series capacitance modifies the tracking error. Alternative method consists of forming blades of oscillator rotor differently from r.f. (ganged) rotor.

*The superhet:* Having tuned the i.f. transformers for maximum remove the short-circuit from the local oscillator and apply signal generator input to the aerial and earth sockets via a suitable dummy aerial.

Note:—The construction of a dummy aerial unit was described in "Test Gear Accessories" (February issue of PRACTICAL WIRELESS). The circuit is reproduced here as Fig. 3.

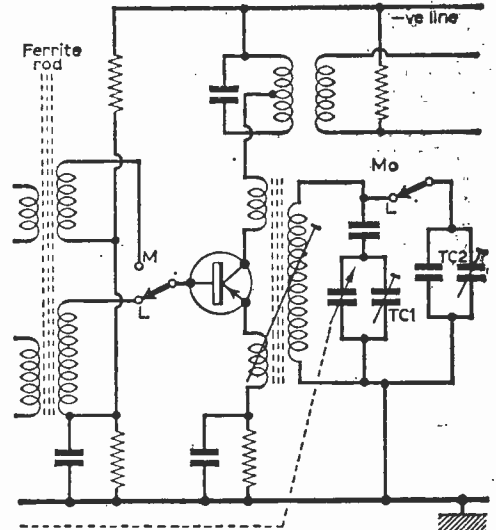


Fig. 5: Typical transistor receiver frequency changer. TC1 is a common trimmer, across the oscillator section of the ganged capacitor. TC2, plus a fixed capacitor, is switched across the circuit for l.w. reception. The coil is tuned by a common core.

Where a ferrite rod aerial is employed, as in the majority of transistorised portables, it is only necessary to couple the output from the signal generator loosely to the aerial coils.

For this purpose a coupling coil should be made by winding 20 to 30 turns of 22s.w.g. enamelled wire on a 3in. diameter former. This coil is connected to the signal generator leads and then placed close to the rod aerial. The positioning of the coupling coil may have to be varied until the right amount of coupling is achieved.

Exact procedure to be followed depends upon the circuit, and tracking points are stipulated by the manufacturer. Very often long-wave tuning is effected by adding capacity across the medium wave circuits and adding inductance in series: this means that m.w. circuits should be aligned first.

General method when in doubt is to tune to the high-frequency end of the medium wave band, say at 1,500kc/s (200 metres), adjust oscillator trimmer, advancing the screw until the first peak is tuned, then tune to 600kc/s (500 metres) and adjust the coil core or series padder capacitor, rocking the gang slightly for optimum results.

Retune at the high-frequency end and recheck again at the low-frequency end. Then switch to long wave and adjust the oscillator trimmer either at the 200kc/s position of the Light Programme, for best reception, or at the higher end of the band.

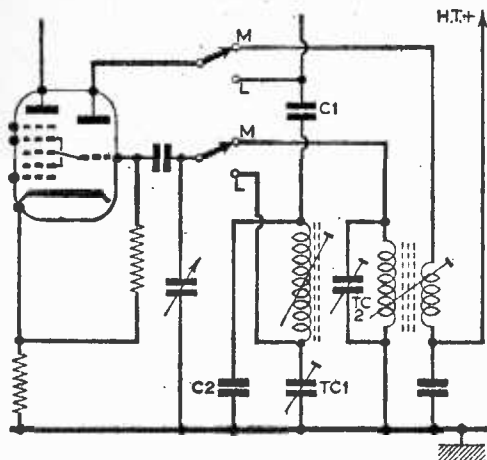


Fig. 6: Typical valve frequency changer. Separate bottom-coupled coils are used and the capacitors C1, C2 provide effective series capacitance for long-wave tuning.

Finally adjust aerial trimmers and cores or padders in the same sequence. In the case of ferrite rod aerials make final adjustments by sliding the coils along the rod.

#### Rejectors and Wavetraps

Many receivers employ tuned circuits in the aerial-to-frequency changer section for the purpose of removing unwanted signals. Unless one is familiar with these circuits the particular frequency to which they should be adjusted may not be

obvious. They are usually of two kinds, the i.f. wavetraps and the image frequency rejector.

The first may be a parallel-tuned rejector in the aerial circuit or a series-tuned acceptor across the input. It should be adjusted after the i.f. circuits are aligned and preferably before final tuning of the r.f. circuits.

The method is to tune the set to a point near the centre of the l.w. band, inject a strong signal at intermediate frequency to the aerial socket and tune the trap for minimum response.

The second is used to reject a signal at or near a frequency which is at a distance (frequency spaced) from the received signal such as to produce an i.f. To tune, inject a strong signal at the high-frequency end of the m.w. band (say 250m), then switch to l.w. and tune the receiver to a point exactly twice the i.f. from this point. For example, a 470kc/s i.f. would give  $1,200 - (470 + 470) = 260$ kc/s (1.154m). When a signal is heard, adjust for minimum response.

These adjustments are extremely important in the alignment of short-wave receivers but such rejectors and wavetraps are not always found on receivers covering only the broadcast bands.

#### F.M. Receivers

The foregoing has been a brief rundown on alignment of a.m. receivers.

The alignment of f.m. receivers is rather more complicated and especial care must be taken since comparatively small errors in alignment can have disastrous effects on the receiver performance.

An f.m. signal generator (wobbulator) is required and, preferably, an oscilloscope. Thus it will be apparent that the alignment of f.m. receivers should not be attempted by the inexperienced—or by the ill-equipped.

## Alignment Without Test Instruments

BY J. D. BENSON

To the amateur constructor with limited facilities for testing, the building of a receiver (particularly of a superhet) often culminates in disappointment. This is often because, although the receiver may be correctly constructed, it may not produce audible results after the initial switch-on, for the basic reason that the tuned circuits require adjustment.

It cannot be over-emphasised that optimum results can only be obtained with the aid of some test equipment. The article by H. W. Hellyer shows how alignment can be achieved using the simplest requirements in the way of test equipment.

The article which follows shows how alignment can be carried out, even with NO test instruments. It must, however, constantly be borne in mind that, at best, only an approximation to optimum results can be obtained in this way. The notes which follow explain the basic principles—and it will be seen that carrying out alignment under these conditions is in effect simply an application of common sense.

THE first thing is to understand the functions of the critical components. Trimmers are small variable capacitors connected in parallel with the main tuning capacitor; they affect the high-frequency (low wavelength) end of the tuning range.

Padders (sometimes called trackers) are connected in series with the main tuning capacitor and they affect the low-frequency (high wavelength) end.

In some receivers tracking is carried out by varying the inductance of the tuned circuits. In actual fact, of course, both trimmers and padders affect both ends of the range, but they are adjusted at the extremes mentioned above.

#### R.F. Circuits

In the signal frequency (r.f.) circuits the padder is often fixed and the trimmers (usually mounted on the tuning gang assembly) are of the "postage

stamp" type; adjustable by means of a small screw in the centre.

In the oscillator circuit, however, both padders and trimmers are generally variable (though not always). Fig. 1 shows a typical arrangement of a frequency changer, with trimmers and padders indicated.

### Pretuned Components

Commercial i.f. transformers are sold approximately tuned to the required frequency, so that if everything else in a newly built set is in order, some results (even if nowhere near optimum) should be obtained. A final adjustment, which will depend on the circuit capacitances of the individual receiver, is all that is usually required. In any event, it is rarely necessary to make any drastic alterations to the setting of the i.f. cores. In other words, never attempt to align a set by haphazardly screwing and unscrewing i.f. cores as this will certainly result in such utter misalignment that it will be virtually impossible to put things right without the assistance of calibrated test instruments.

One has only to remember that each tuned circuit must be aligned to an exact frequency for the best results, so that blind "twiddling" is obviously doomed to failure from the start.

### Commercial Coil Packs

Similarly, if a commercial coil pack is used for the r.f. tuned circuit, the variable will often only need a final touch or two to allow for individual strays. Otherwise, check that all trimmers are not screwed up tightly but are about half open. Where padding is achieved by the adjustment of a core in a coil, the notes given on i.f. cores apply; these cores are despatched from the factory in somewhere near the right position.

When a receiver is completed and the wiring thoroughly checked, switch on and leave it to warm up for ten minutes or so. This is to allow for the frequency drift which will occur during that period.

### Scale Calibration

Connect up an aerial (unless a ferrite-rod r.f. arrangement is used) and carefully search around the medium waveband for the local BBC programme, the volume turned toward maximum. In all probability it will appear well out of the marking on the scale. This can be corrected by *slowly* adjusting the medium wave oscillator trimmer. Unscrewing the trimmer moves the station towards the lower wavelength end of the scale and tightening it up moves it towards the higher wavelength end. Small movements of this trimmer are essential, otherwise the station could well be shifted out of the range of the tuning gang capacitor.

Having adjusted the position of the station to correspond with the dial reading, volume will probably not be very high. So now adjust the medium wave trimmer for optimum volume.

If, at this or any subsequent stage of alignment, the output becomes very strong this should be

reduced not by turning down the volume control but by reducing the signal input by the simple expediency of shortening the aerial or using a less efficient one, even a short length of throw-out wire. This is because excessive signal input will bring the a.g.c. circuits into operation and this can produce misleading results due to damping.

Next step is to retune the receiver to the Light Programme (still medium wave). To do this it may be necessary to adjust the m.w. oscillator trimmer slightly. After this adjust the m.w. trimmer for best output.

### I.F. Stages

Return to the Home Service and align the i.f. stages. Trim each core in turn, starting from the detector end and working back to the frequency changer. Do not over-adjust these cores as instability could result. The final position of the cores should be near their original position.

Having done this, retune the receiver to the Third Programme, Northern, or a strong continental station of known wavelength in the region of 450-550m. Now adjust the m.w. padder (or core if used) so that the station is brought to the right position on the scale. It will now be necessary to make the final calibration adjustments by alternately adjusting the oscillator trimmer for the Light Programme and the oscillator padder (or core) at the high wavelength end until both stations come in as near as reasonably possible correct on the scale.

Luxembourg enthusiasts can, of course, make the low wavelength adjustments on 208m, even though this may mean in some cases a falling off of sensitivity at the Light Programme wavelength.

### Long Wave Band

For the long wave band a similar procedure can be carried out. First locate the Light Programme (1,500m) and bring it into line on the scale by adjusting the l.w. oscillator trimmer, then adjusting the l.w. aerial trimmer if provided. Retune the receiver to Luxembourg and retrim. Retune to Paris (Allouis) and bring into calibration by adjusting the l.w. padder (or oscillator core). Then recheck the calibration on the Light Programme and readjust if necessary. The i.f. cores, of course, must not be touched.

### Ferrite Rod Aerials

In receivers with ferrite rod aerials the r.f. circuit final adjustments are made by sliding the appropriate coils along the rod. Once set for optimum they should be sealed.

In the above suggested procedure it is assumed that the builder will be relying on his ears for judging peaks. This, of course, is far from ideal, although experienced constructors can get reasonable results in this way. Far better to use a visual output indicating device: this presents no problems, for every constructor should have a test meter of some kind. Reference to the preceding article by H. W. Hellyer will explain how an ordinary test meter can be used for this purpose. ■

# simple TRANSMITTERS for model control.

BY F. G. RAYER

**E**FFICIENT model control transmitters are very easily made at low cost. The transmitters described here can be put into operation with a minimum of difficulty and may be used with any home-built or commercially manufactured valve or transistor c.w. receiver.

All the transmitters are of the tuned type and may be adjusted to operate on any frequency in the 26.96—27.28Mc/s Model Control Band.

It is illegal to operate transmitting equipment unless the user holds a G.P.O. licence. Licences for the operation of model control equipment are usually granted with the minimum of formality. Application should be made to the Radio Services Department, General Post Office, Headquarters Building, London, E.C.1.

### Single-valve Transmitter

A single-valve transmitter, to run from dry batteries is shown in Fig. 1. The 3D6 valve is used because it is easily obtained as surplus and works well in this type of circuit. With the filament sections connected in parallel, as shown,

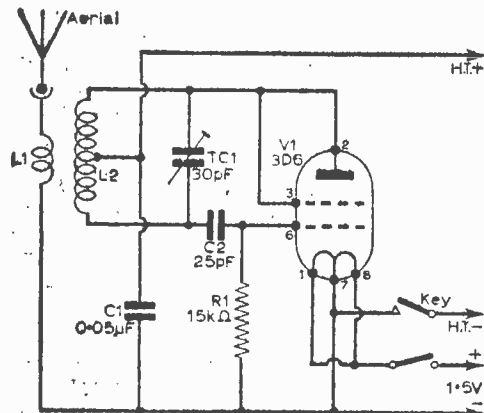


Fig. 1: The circuit of a one-valve model control transmitter.

the drain is 0.22A from a 1.5V dry battery.

Other output type valves are satisfactory. Miniature valves such as the 1S4, 3S4, 3V4 and 3Q4 may be fitted, if to hand, and will require a B7G holder instead of the octal 8-pin holder of the 3D6.

The components are best assembled on a small laminated plastic panel. The actual layout is not very important provided all leads are short and direct. The 25pF capacitor can be mica with a 350V disc or paper capacitor in the 0.05μF position. The 15kΩ resistor is 1W. Terminals or tags are provided to connect the control key switch.

An air-spaced beehive trimmer is suitable for tuning and can be adjusted with a length of insulated rod or tube suitably filed to engage with the top portion. If an ordinary short-wave tuning capacitor is used it must have an insulated extension spindle at least 4in. long.

The h.t. battery voltage can be chosen to suit the purpose in view. A 60V battery is sufficient for short-range working but if the model is to be controlled at a distance a 90V or 120V battery is needed. The filament is left switched on while the equipment is in use. The control key switch in the h.t. negative lead is closed when a signal is to be radiated.

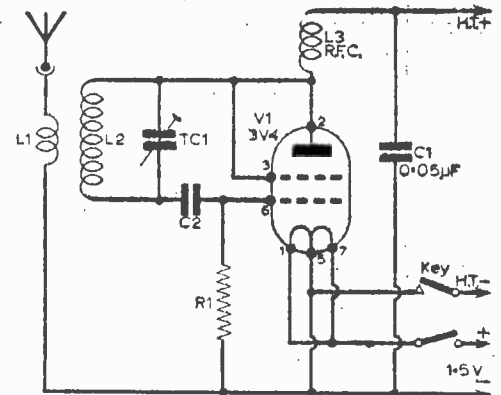


Fig. 2: Including an r.f. choke avoids the need for a tapped coil.

The transmitter, without an aerial, by bringing the lamp loop in Fig. 6 near the coil L1. The bulb should light when the key is closed. An aerial is not attached until the transmitter is tuned as described later.

Fig. 2 is a somewhat similar circuit but a r.f. choke (L3) is added to avoid any need for tapping the coil L1. Connections in Fig. 2 are numbered for a 3V4 valve, which requires a B7G holder.

Any ordinary receiver type short-wave choke is suitable. Or the choke can be made by winding 100 turns of 34s.w.g. enamelled wire, side by side, on a 3/4in. diameter insulated tube. Component values are as for Fig. 1.

### Two-valve Transmitter

If more power is required two valves may be used in the circuit shown in Fig. 3. Each valve drives the other and equipment of more powerful



type than this is not generally employed for model control. Two 3D6 valves are shown but 3V4s or other output pentodes or tetrodes may be used instead.

This transmitter is capable of radiating a strong signal. It can also be used as a one-valver merely by withdrawing either valve. This allows a suspected valve to be checked. Slight retuning will be necessary after inserting or removing a valve.

A symmetrical layout is most suitable with short grid and anode leads. Batteries and keying can be exactly as described for the one valve circuits.

**Transmitter Coil**

In all circuits L2 is the tuned part of the coil and L1 is an aerial coupling winding. A suitable coil can be made as in Fig. 4.

The winding L2 consists of 20s.w.g. tinned-copper or enamelled wire. L1 is of well-insulated wire such as thin flex, plastic insulated bell wire or bare wire provided with sleeving. Some modification in the wire gauge or other details will not be very important provided the coil can be tuned to a frequency in the band.

For the circuits in Figs. 1 and 2, L2 can be 11 turns on a 1/4 in. diameter former wound at about ten turns per inch. The circuit in Fig. 3 has more stray capacity and 10 turns will suffice. When a

handy for 6V running, either from a 6V accumulator or from a four-cell dry battery. The heater requires only 0.15A.

Fig. 5 shows a transmitter circuit for the 6C4 with pin connections. This is particularly convenient when a small rotary converter can be used to obtain the h.t. supply as all power may then be taken from a 6V accumulator.

The heater can also be run from a 6.3V a.c. supply obtained from a small 6.3V transformer. This is convenient when testing equipment indoors or using models indoors or in the garden. In these circumstances h.t. current may be drawn from a small eliminator or power pack. A supply delivering up to about 15mA at 200V or so will be satisfactory. Plug connectors may be arranged so that the transmitter can be operated from batteries, a rotary generator or a mains power unit as required.

**Loop and Wavemeter**

Fig. 6 shows the lamp loop previously mentioned and the bulb should light if the two-turn coil is brought near the tuning coil of any of the transmitters. For such tests it is necessary to short the transmitter key terminals with wire or close the key or switch. Such a lamp loop is very useful as it allows a quick check to be made to assure that the transmitter is working.

Fig. 6 also shows a simple absorption wavemeter circuit. L1 can be wound in a similar manner to the coil L2 in Fig. 4, but will need 13 turns. L2 is two turns, not overwound on L1 but situated about 1/4 in. from one end of L1.

Construction should be rigid and the 15pF miniature variable capacitor VC1 is fitted with a knob with pointer. All the parts can be assembled

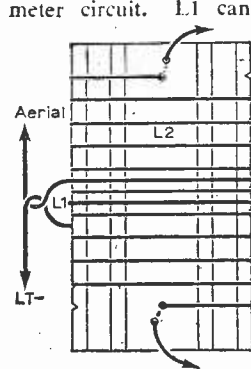


Fig. 4: Winding details for a suitable tuning coil.

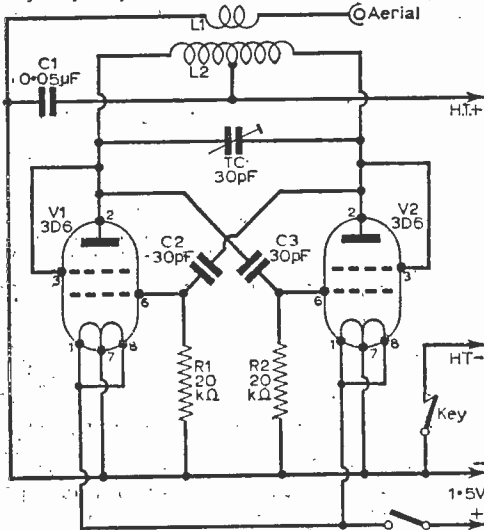


Fig. 3: A two-valve circuit for greater power.

centre-tap is required this is made by soldering a lead on the centre turn of the coil.

Stout self-supporting coils are satisfactory and can best be wound with 14s.w.g. or 16s.w.g. wire with ends soldered to tags bolted to the plastic panel.

The winding L1 has two turns and is wound over the centre of L2.

**Indirectly Heated Valve**

The 6C4 indirectly heated valve is particularly

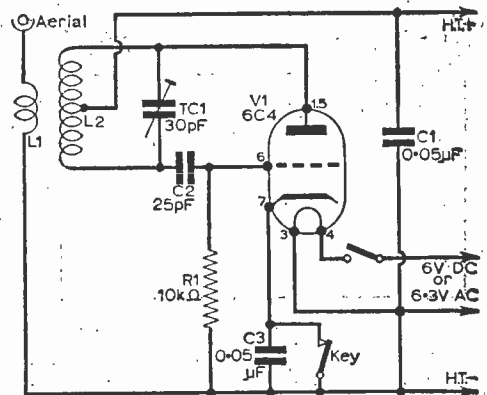


Fig. 5: A transmitter employing the 6C4 valve.

on a strip of laminated plastic or mounted in a small insulated box.

The wavemeter can be calibrated from a transmitter that is known to be already tuned into the 26-96—27-28Mc/s band. To do this hold the wavemeter near the transmitter coil and adjust the 15pF capacitor until the bulb lights. Withdraw the wavemeter from the coil until the lamp almost extinguishes, then carefully readjust VCI for maximum light. The tuning point is then marked on the scale.

To tune up any of the transmitters described set the wavemeter to the marked tuning point and hold it near the transmitter coil. The transmitter trimmer is then rotated for maximum brilliance in the wavemeter bulb.

In all cases when using the wavemeter keep it at such a distance from the transmitter coil that the bulb only just glows when tuning is correct. Exact tuning will then be more easily seen and errors caused by tight coupling will be avoided.

Any transmitter should be tuned roughly before fitting the aerial. Slight retuning will be necessary

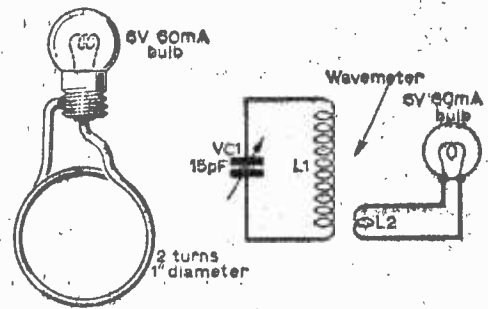


Fig. 6: Left: the lamp loop; right: a simple absorption wavemeter.

when the aerial is attached. All the transmitters described will work well with a vertical rod aerial some 3ft to 5ft or so long. For maximum range a quarter-wave aerial may be adopted and is 3ft 6in. long. For average purposes some change in the aerial length will not be important.

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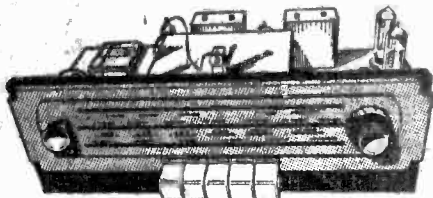
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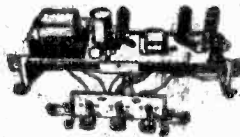
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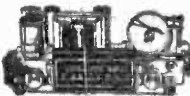
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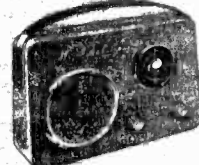
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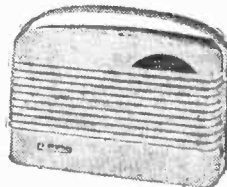
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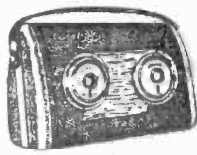
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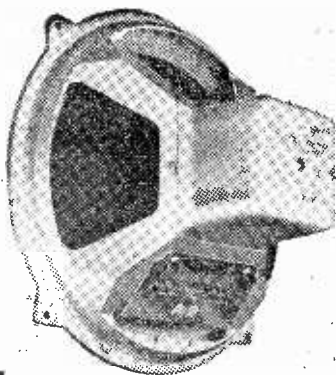
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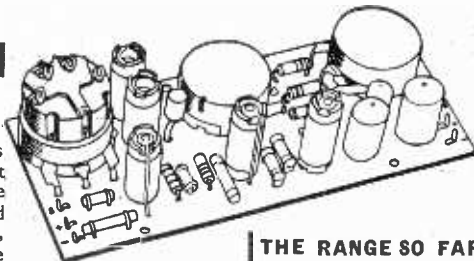
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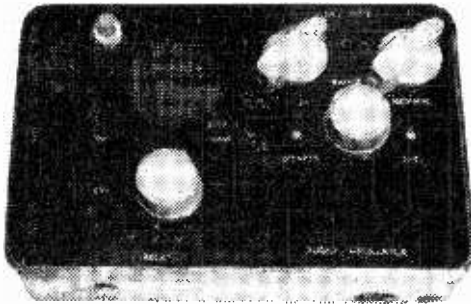
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BY G. M. SWEET

SEVERAL articles have appeared in this magazine employing multivibrator circuits, and the purpose of this particular article is to describe how the many functions of such circuits can be combined into a single compact unit. Some of these functions are as follows:

- Audio oscillator, for testing amplifiers, speakers etc.
- Square-wave and saw-tooth wave generator for oscilloscopes.
- Audible and visual metronome.
- Variable frequency switching unit.
- Simple monotone electric organ.

## THE BASIC MULTIVIBRATOR CIRCUIT

The basic circuits of a valve and a transistor multivibrator are shown in Figs. 1 (a) and (b), and illustrate the similarity between the two types. In view of the low cost of audio transistors nowadays, there is little point in using the valve circuit with its additional wiring, especially as transistors will enable the unit to be built far more compactly.

The sequence of oscillations in Fig 1(b) are as follows: Upon switching on, one or other of the transistors is bound to conduct slightly more current than the other. Suppose, for example, Tr1 conducts more current than Tr2, this will cause a voltage drop across R1 and result in a drop in voltage applied to the base of Tr2 through C1, causing still less collector current to flow in Tr2 through R2. This reduces the voltage drop across R2, and increases the voltage applied to base of Tr1 through C2, which in turn increases further the current in the collector of Tr1. The process continues until the voltage drop across R1 is too great for Tr1 to

conduct, then the sequence quickly changes over with Tr2 conducting and cutting off Tr1 and so on.

## FREQUENCY CONTROL

It is obvious that the frequency of operation depends upon the values of C1 and C2 and of VR1 and VR2, assuming the collector loads R1 and R2 are kept constant. Also, for the on/off periods of each transistor to be maintained equal VR1 must equal VR2 and C1 equal C2. It is impractical to make C1 and C2 variable, therefore fixed values in equal pairs are switched in to cover the ranges required as shown in the fully developed design which is depicted in Fig. 2. A fine control over the frequencies is given by VR1 and VR2 but these were not ganged together in the prototype, since there are occasions when the unit

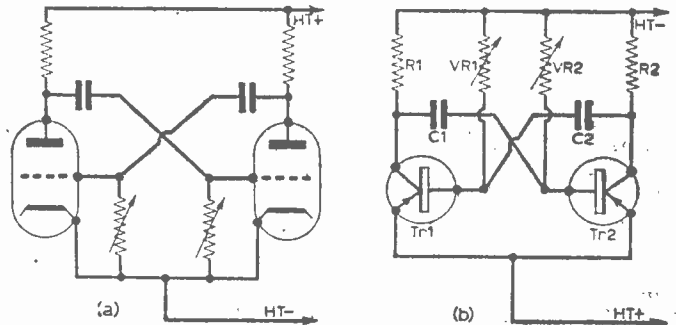


Fig. 1: Basic multivibrator circuits for (a) valves, (b) transistors.

operates as a switch when the on/off period is required to be unequal.

## THE MULTITONE CIRCUIT

In order to use the unit for the production of true saw-tooth and square type waves, one should bear in mind that in addition to controlling the

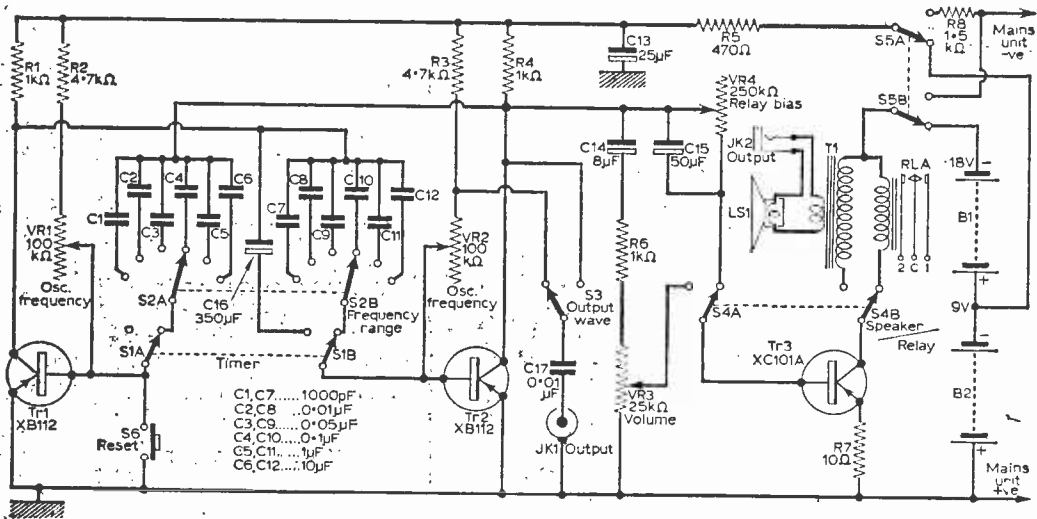


Fig. 2: The fully developed circuit of the instrument.

frequency. VR1 and VR2 also govern the d.c. bias applied to the transistors, and adjustment of these controls will therefore cause distortion of the waveform if made outside certain limits, which can be found by experiment. The switch S3 selects which waveform is required; this signal being fed to an output socket JK1, which is a miniature jack plug of the type generally used in transistor radios. No attempt should be made to insert an attenuator either fixed or variable in the unit, or distort-

and base R1. This allows Tr1 to conduct for a period of up to approximately 30 seconds, the interval being dependent upon the values of C16 and VR2. During this period the relay RLA will operate, after which it will cut-out until the process is started again by pressing S6, which causes C16 to discharge quickly. This form of timer has the distinct advantage that virtually no current is drawn from the battery during the off periods.

The switch S4 determines whether Tr3 is to

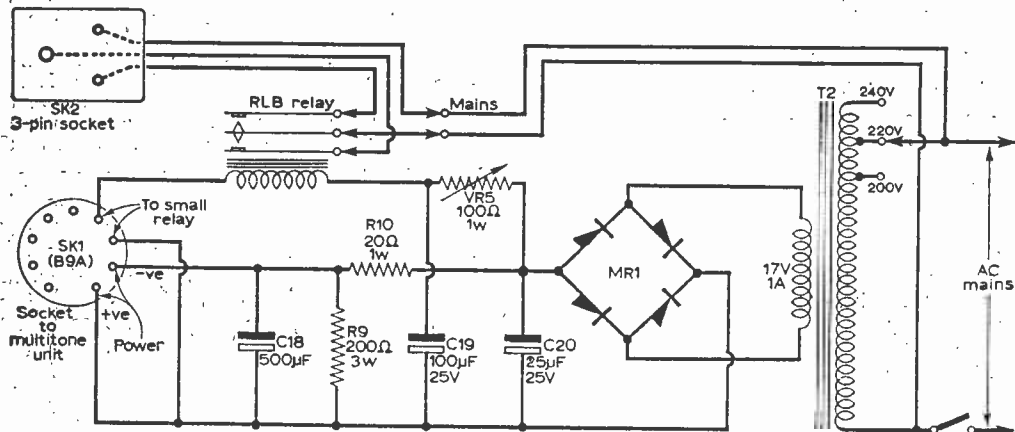


Fig. 3: A mains supply unit for the Multitone.

tion will occur. It should be possible to obtain a frequency coverage from approximately 1c/s to 100kc/s with the values of C1-12 shown.

**TIMING DEVICE**

The timer is controlled by S1 which switches off the capacitor selected by S2 and instead inserts a 350µF capacitor (C16) between collector Tr1 and base Tr2, with no coupling between collector Tr2

and operate the speaker or relay. When the speaker is in use, the volume is controlled by VR3; the bias for Tr3 is created by leakage through C14, limited by R6.

A surplus 80Ω balanced armature unit was used as an internal speaker, on the prototype. This speaker can be connected directly to the collector of Tr3 without employing an output transformer, but the use of the latter enables external speakers

to be tested directly if the leads are brought to another jack socket JK2. When the relay RLA is switched in, bias is applied only through VR4, thus ensuring that Tr3 does not conduct during the off periods. VR4 can take the form of a miniature pre-set type and should be adjusted so that the relay just operates and no more current is drawn by Tr3 than is necessary.

It will be seen that a supply of 18V is needed to energise the relay on the prototype, half of this voltage being dissipated in the transistor, whilst the oscillation section requires only 9V, which is in turn dropped to approximately 4½V through R5.

The relay illustrated is of the high speed type with dual 1,000Ω coils, these are connected in parallel and care must be taken to ensure that these are joined in phase. To check this one must first locate the tags running to the coils, join them in parallel, and check that the relay will function on only 9V. If it does not, the connections to one coil must be reversed.

#### Resistors: COMPONENTS LIST

R1	1kΩ	R5	470Ω
R2	4.7kΩ	R6	1kΩ
R3	4.7kΩ	R7	10Ω
R4	1kΩ	R8	1.5kΩ

All ½W, 10% carbon

VR1	100kΩ potentiometer
VR2	100kΩ potentiometer
VR3	25kΩ potentiometer
VR4	250kΩ potentiometer, preset

#### Capacitors:

C1	1,000pF mica or ceramic
C2	0.01μF paper
C3	0.05μF paper
C4	0.1μF electrolytic 12V
C5	1μF electrolytic 12V
C6	10μF electrolytic 12V
C7	1,000pF mica or ceramic
C8	0.01μF paper
C9	0.05μF paper
C10	0.1μF electrolytic 12V
C11	1μF electrolytic 12V
C12	10μF electrolytic 12V
C13	25μF electrolytic 12V
C14	8μF electrolytic 12V
C15	50μF electrolytic 12V
C16	350μF electrolytic 12V
C17	0.01μF electrolytic 12V

#### Transistors:

Tr1	XB112 (OC70, 71)
Tr2	XB112 (OC70, 71)
Tr3	XC101A (OC72)

#### Miscellaneous:

RLA	High speed relay, 1,000Ω + 1,000Ω
T1	Output transformer
LS1	Small speaker unit (see text)
JK1, 2	Miniature jack sockets
B1, 2	9 volt battery (PP4)

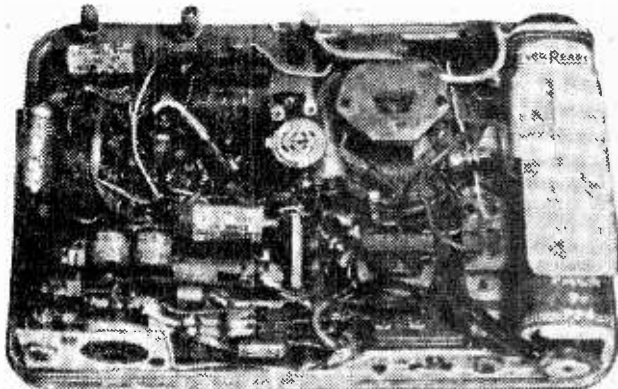
#### Switches:

S1	Slide switch, d.p.d.t.
S2	Rotary switch, 6 way
S3	Slide switch, s.p.d.t.
S4	Slide switch, d.p.d.t.
S5	
S6	Press button switch

## CONSTRUCTION

A photograph of the prototype is shown, but no exact details of component layout are given since this is in no way critical and will in any event depend on the size of components used: such as the relay and speaker. However, a few details of the housing may be of interest.

The original unit was built in a 6½in. x 4½in. x



A rear view of the assembled instrument.

#### POWER UNIT COMPONENTS LIST

##### Resistors:

R9	200Ω 3W
R10	20Ω 1W
VR5	100Ω potentiometer, wire-wound

##### Capacitors:

C18	500μF electrolytic 25V
C19	100μF electrolytic 25V
C20	25μF electrolytic 25V

##### Miscellaneous:

MRI	Bridge rectifier, 12V
T2	Mains transformer, battery charging type
RLB	Heavy duty relay, 12V coil
SK1	B9A valve holders
SK2	Mains power outlet socket, 3 pin

1½in. plastic lunch box (such as are obtainable from many multiple stores). All the components are mounted on a bakelite baseboard cut to fit exactly in the plastic lid. Holes must be drilled in the lid to accept the potentiometer spindles and switch heads; also an opening for the speaker cut and suitably covered.

The baseboard and the lid can eventually be held together by additional nuts on the potentiometer spindles. Care must be taken in drilling the lid and case as this is somewhat brittle. The embossing on the lid can be filed off and the surface painted or covered. As can be seen from the photograph the back was left transparent to enable the operation of the relay to be inspected.

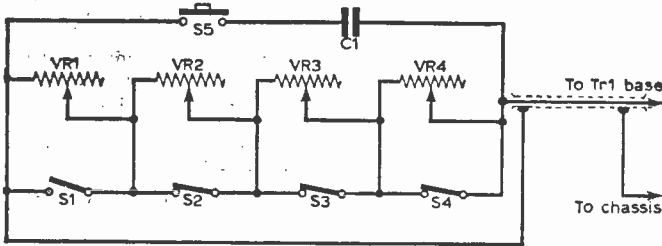


Fig. 4: The electronic organ keyboard circuit.

**MAINS SUPPLY UNIT**

It is always difficult to acquire a relay sensitive enough to operate off a small transistor, but having contacts sufficiently large to control the mains supply for controlling lighting etc. A far easier method is to use the small relay in the main unit to control a heavy duty relay energised by a low voltage with contacts strong enough to tackle several amps of mains current. Furthermore, as this second relay is bound to draw several milliamps through its coil, it is better to run this from a 1t. supply from the mains rather than impose a heavy strain on batteries. At the same time there will be power available to operate the oscillator unit, hence the reason for the double-way action of S5 of Fig. 2.

**POWER-PACK COMPONENTS**

An illustration of a compact mains unit with heavy duty relay is shown and the circuit is given in Fig. 3. A 12V relay was used in the unit shown, but there is little point in quoting an exact value to replace the 100Ω potentiometer VR5 as this will depend upon the resistance of the relay coil. This potentiometer should be set to ensure that the relay operates without more current being drawn than necessary. It is suggested that the connections from the relay contacts and mains be brought to

recessed terminal blocks as illustrated, and leads from a three-pin socket be joined according to circumstances. A B9A valve-holder makes a suitable socket for inter-connections between the power unit and the multitone unit.

If difficulty is experienced in obtaining clean make and break of the relays when used as a timer, try arranging for the first relay switch on the energising current for the heavy duty relay

during the long off periods, thus keeping the voltage from the mains supply unit down, during these intervals.

The transformer shown is the standard type used for battery charging and the bridge rectifier a-12V type as used also for this purpose.

**MONOTONE ELECTRONIC ORGAN**

Anyone who has a copy of the February 1958 issue of PRACTICAL WIRELESS will see a similarity between the valve circuit of the "Simpletone" Electric Organ described by the present author and the circuit of the multitone unit. In fact a similar keyboard can be coupled to the circuit of Fig. 2 between the base of Tr1 and chassis since any resistance connected to these points will

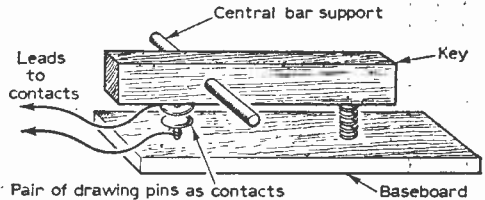


Fig. 5: The basic construction required in an organ keyboard.

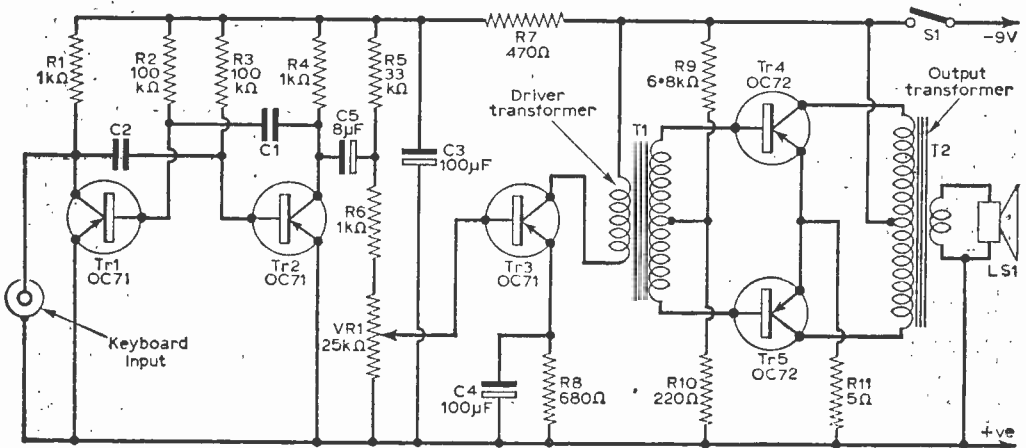


Fig. 6: The circuit of a monotone organ.



effectively shunt VR1 and R2 through the power supply and C13. In order that the keyboard can have maximum coverage VR1 and VR2 should be set to maximum resistance.

The circuit of the keyboard is shown in Fig. 4. It will be seen that this consists of a number of potentiometers (one for each note) wired in series, each one having a switch connected across it, which takes the form of the keys. When all the keys are at rest, as are S2-4, there will be a complete short circuit. This means that Tr1 in Fig. 2 receives no bias from VR1 and R1 and therefore does not conduct, and so the unit stays muted. Immediately one of the keys is pressed, as S1, the "short" across one of the tuning potentiometers is broken (as VR1 in this case) and the unit will

produce a note depending upon the value set by VR1 etc.

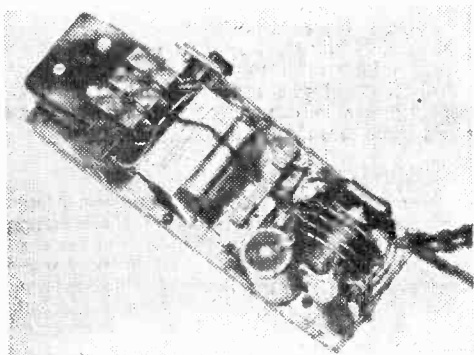
The basic idea of how a keyboard can be adapted or built is shown in Fig. 5. Contacts consisting of drawing pins are held together by pressure from a light spring embedded in small indents drilled in the key and baseboard at the front end. The keys are supported by a central bar passing through the keys.

It must be made clear that this organ can, of course, produce only *one* individual note at a time.

#### IMPROVED ORGAN CIRCUIT

Anyone more concerned with building this organ rather than the rest of the unit of Fig. 2 may prefer to use the more suitable circuit of Fig. 6. In this the components of VR1 and VR2 of Fig. 2 are replaced by fixed resistors and the output stage improved. The values of C1 and C2 will be chosen according to what part of the musical scale the keyboard is to cover.

Only four notes are shown in Fig. 4 but in practice it is possible to tune over several octaves if tuning potentiometers of up to 500k $\Omega$  are employed. In large keyboards not all these potentiometers should be as high as 500k $\Omega$  for only a resistance of a few thousand ohms will be needed to tune the higher notes. On smaller keyboards, separate notes need not be made for half-tones (black notes). If a capacitor of about 0.01 $\mu$ F is switched in with a press-button switch (C1 and S5 in Fig. 4) any note emitted will be dropped by a half-tone. ■



A view of the mains power pack.

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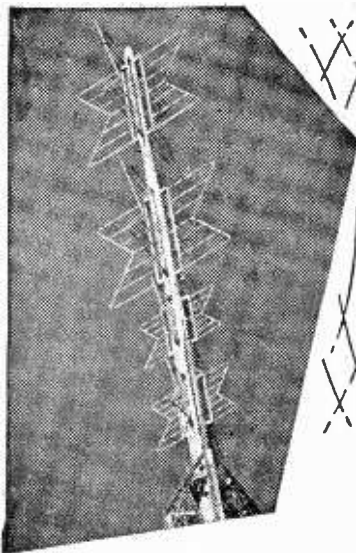
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# On Your Wavelength

## By THERMION

the so-called popular programmes with their mass following are listened to with varying degrees of indifference, or are even related to the indignity of background sound by many of their reputed devotees.

I know this is election year, but the BBC should not allow itself to be caught up in the Opinion Poll fever. If the Corporation is to preserve the fine tradition of public service created over the years it must not allow itself to be unduly influenced by (Dr. Gallop) Silvey's reports, but should obtain second opinion before performing a major operation on the established programme structure.

### When We Were Young

Although the title *Children's Hour* was dropped some time ago, this programme for the younger listeners has been as much a traditional feature of sound broadcasting as the late lamented 9 o'clock news. It was one of the first regular programmes to be established in the early days of broadcasting, and listening to *Children's Hour* soon became an essential part of the daily routine in countless homes throughout the country. I expect quite a few readers can recall the names and the voices of the radio "aunts" and "uncles" of those far gone days, and the delight and enthrallment they brought to our firesides. The greatest thrill was to hear one's own name coming over the magical ether when birthday greetings were read out. Remember the special treatment accorded to twins? But of course if you did listen in as a child you have plenty to recall without any further prompting by me.

### Speed the Service

A newly opened restaurant not far from my office is really "with it", in a communication sense. When visiting this establishment the other day I was intrigued by odd chirping sounds that came spasmodically from various directions. After a moment or so the source of these cricket-like sounds was traced to small receivers carried by the waiters in the top pockets of their jackets. Then it became apparent that a selective calling system was being used to give each waiter an audible warning when his orders were ready for collection from the servery. A laudable attempt to speed the service, but perhaps a little disconcerting to the customer. I felt.

This is just another of the varied uses to which the magnetic induction paging or personal call system is being applied. Although truly a wireless method of communication, this system relies upon the magnetic field created by an r.f. current flowing in an enclosed loop of wire, and not upon electromagnetic waves propagated into space, reception being confined more or less to the area enclosed by the loop.

**T**HE BBC claims that sound broadcasting is able to provide a wide choice of programmes for all sections of the community because of the alternative services available, and that such services are economical in cost and equipment when compared with television. In view of this, one is all the more astonished to learn that as from the end of March there will be no more daily programmes for children.

This decision is surely irreconcilable to the spirit of the BBC's charter, furthermore I believe it can be shown to be completely illogical when the policy adopted in respect of other programmes is examined.

### An Insignificant Minority?

The axe is to fall because the total number of listeners has diminished to some undisclosed figure which apparently represents an "insignificant level" in the minds of the programme planners of Portland Place. One appreciates that the rival television will hold a greater attraction for youngsters nowadays, but is it fair that the minority who cannot for some reason or another, see TV programmes should be deprived of their own daily programme on sound radio? The BBC has a particular duty and responsibility to cater for this group of young impressionable aged listeners, even as it caters for those other "special minority interests" through the medium of the Third Programme and Network Three where, incidentally, the average audience is only 50,000.

Don't misunderstand me; this is no snide attack on the "Third", for indeed I applaud the enterprise shown by this service. My own sympathies are, as often as not, with the minority interests and the craze for popularity ratings leaves me cold. In any case, aren't many of these listener research figures a dubious criterion to apply when attempting to assess the real worth of a programme? We can be pretty certain that anyone who takes the trouble to tune in to a programme of minority appeal will listen to it, whereas I suspect some of

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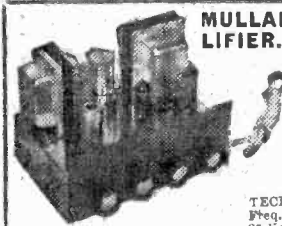
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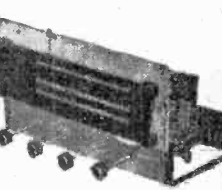
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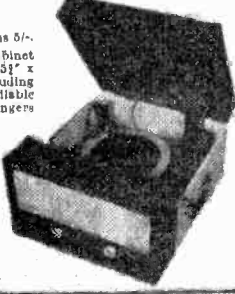
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# Alignment Aid

## An r.f. and a.f. oscillator for receiver adjustment

**A**LTHOUGH beginners often make use of broadcast signals for alignment and test purposes it is usually better to employ a signal source more under one's own control.

Although the aid presented here follows in the main a fixed pattern, it does possess the advantage of being entirely self-contained and because transistors are used requires no external connections to the domestic mains supply.

### Facilities Provided

Two outputs are provided. From socket SK1 a fixed audio frequency sine wave signal may be extracted and this may be used to test audio amplifiers, etc. A portion of this audio signal is also allowed to modulate a radio frequency oscillator operative over two bands, viz., 550-1,500kc/s approximately (Range 1) and 200-480kc/s approximately (Range 2). This r.f. modulated signal is available at socket SK2 and may be used to align and test broadcast band receivers.

A switch (S2) is also provided to enable the user to cut out the audio modulation at any time leaving the r.f. signal still present. When the unit is operated in this manner current consumption is very low indeed, being in the region of 600 $\mu$ A (0.06mA).

The circuit diagram (Fig. 1) shows that three transistors are employed. The broken vertical line shown almost at the centre of the diagram does not here indicate screening but is drawn to show the division between the two sections, that portion to the left of this line comprising the r.f. oscillator.

### Audio Oscillator

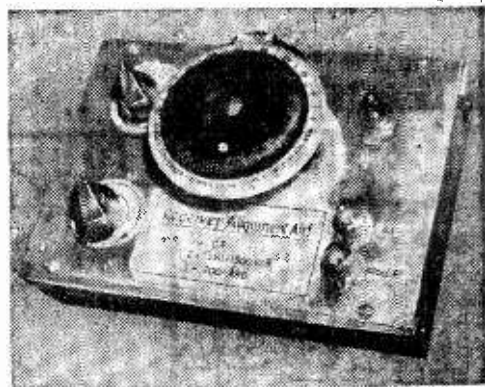
The two transistor configuration to the right of the line mentioned, is the audio oscillator which may be dealt with first for it is a very reliable arrangement based on one recommended by Mullard Ltd. for use with their transistors. This circuit is essentially a Wien bridge network.

Considering TR2, if oscillation is to be obtained a 360° phase shift must be made to occur between input and output, and although this can be achieved with only one transistor plus sufficient passive components in an external reactive network, heavy losses tend to prevent the circuit from functioning unless high potentials are employed. A

single transistor can also be made to oscillate at audio frequencies by using with it a suitable a.f. transformer in a reversed feedback circuit. However, a method superior to either of these lies in the use of an additional transistor which costs no more than a transformer and is also less bulky. The 2-transistor arrangement oscillates readily and with care can be made to provide an excellent sine waveform.

The main frequency determining components associated with TR2, TR3 are C7, R10, C8, R9, and in similar valve circuits it is not unusual to

**BY K. F. PERRY**



find either the equivalent pair of resistors or capacitors made ganged and variable so that a wide frequency range may be covered. In a transistor circuit of this kind varying the resistor values is not practical except over a very limited range or the operating conditions are seriously upset. The operating frequency can be varied though by changing the capacitor values (C7, C8 in this case). Usually the values are R9=R10 and C7=C8, but where a single frequency output is required dissimilar values may be chosen. In the relevant section here R9=R10, but if C7=C8=0.1 $\mu$ F (10,000pF) the operating frequency approximates to 3kc/s. Putting instead C8=C7 $\times$ 10=0.1 $\mu$ F

lowers this to about 1,000c/s. This may be further lowered by increasing the value of C7 but was not done in the prototype since as the frequency is lowered it becomes increasingly difficult to obtain a good waveform of adequate amplitude.

Waveshaping is effected in the emitter circuit of TR2 where a.c. feedback is introduced due to only partly bypassing the emitter resistor. The value of R11 is actually somewhat critical if a pure sine waveform is required, for if too high in value amplitude is seriously affected whilst on the other hand a low value ensures a distorted waveform. If no oscilloscope is available it will generally be satisfactory to adjust R11 to as high a value as possible whilst listening to the note produced in headphones. Although a square wave sounds "clicky" this is not really a reliable guide—and anyway temperature changes may also introduce discrepancies later. A variable "form" control is hardly worth while here, however.

The output is extracted at TR2 emitter circuit via C11 whilst the section is rendered inoperative as required by opening S2, whereupon the base and collector feeds are broken to the transistors. With S2 closed total current consumption is 2mA.

**The R.F. Oscillator**

As mentioned earlier current consumption falls to about 600µA when TR1 circuitry is working alone to produce the necessary r.f. oscillations.

Using a reversed feedback circuit, energy is returned from collector to base in TR2, due to C2, via T1 or T2 whichever is in use at a given time and in the correct phase to maintain oscillations for as long as supplies are connected.

The transformers used here are of a type originally designed for use with valve circuits and although the turns ratio might not be optimum construction is simplified in that they are readily obtainable. Either transformer winding, as selected by S1A, is tuned by VC1, 2. This variable capacitor is a miniature twin-gang, the sections have values of 208pF and 176pF, and these are paralleled, the measured capacitance of the specimen used in the prototype being 400pF due to "extras" being contributed by the inbuilt trimmers. If a 50pF (nominal) single-gang type tuning capacitor is to hand this might prove slightly better particularly on Range 2; physical size is of some importance, however, and solid dielectric types sometimes tend to act sluggishly.

The oscillations may be extracted at various points but in this design the lower member of the base feed potentiometer is selected, a crude attenuator (VR1) being employed.

If S2 is in the "open" position there is no audible indication that TR1 is functioning, unless this is made to beat with another r.f. signal; but when S2 is closed audio signals of suitable amplitude are injected into TR1 collector circuit via

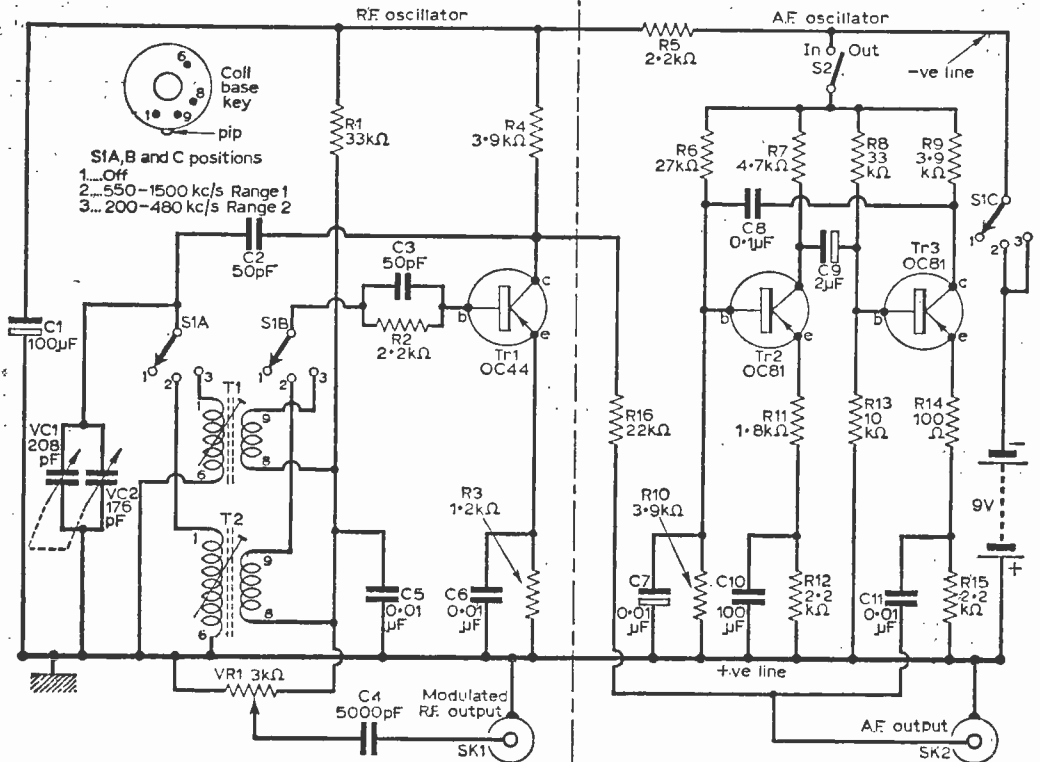


Fig. 1: The complete circuit of the unit.

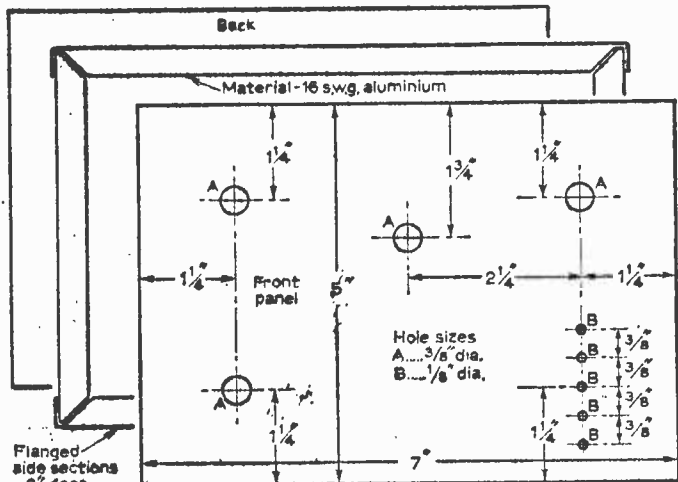


Fig. 2: Details of the instrument's case.

wiring also. It will be noted that space for the PP6 battery used exists below the tag board but a larger size battery could also be used by fitting a suitable two-pin socket to a side-member, leads from the external battery being connected when required.

If four self-tapping screws are removed from the front panel all the items shown in Fig. 3 pull away leaving a shell. The drive and scale associated with VC1. 2 is a Muirhead reduction type 3in. diameter and graduated 0-180, this having been pruned from a now discarded RF27 unit. Both Eddystone and Jackson manufacture a suitable alternative, however, but these are graduated 0-100. If preferred, a simple card scale traversed by a suitable pointer may be used instead, and this may be calibrated direct instead of using a graph as was

R16. These a.f. signals mix with the r.f. signal and, in effect, render the latter audible.

**Range Coverage**

Range 1 covers the medium waveband whilst Range 2 is adjusted to cover 200kc/s-480kc/s which necessitates modifying T1.

Ignoring unseen capacitances and assuming use of a variable capacitor with a sweep of 50-400pF, an inductance of some 1.600μH is required to cover the desired range and to this end 50 turns are removed from the main winding of the transformer. In this way the Light Programme transmission on 200kc/s, can be used as a marker for subsequent scale calibration whilst allowing oscillations to be produced at 470kc/s and thereabouts for i.f. alignment purposes. Some suggestion regarding setting up this range will be given later.

**Housing the Unit**

A closed-in metal container must be used in order to minimise radiation. For the original model a six-piece sectional aluminium chassis was used. The side sections are supplied flanged with flat top and base plates and with nuts and bolts and self tapping screws with which to put them together.

The unit may also be built into a convenient OXO tin or similar container if the lid is strengthened. The dimensions of the container are shown in Fig. 2.

The unit proper is built on to the inside of the front panel, the small items being secured to a miniature 18-way tag board. The general layout adopted may be clearly seen in Fig. 3, the back being shown removed to reveal some of the

done with the original model.

**Preliminary Work**

First work consists of preparing the casing on the lines of Figs. 2 and 3 and mounting the respective items thereon. Details relating to the tag board are shown in Fig. 4 and to simplify matters the

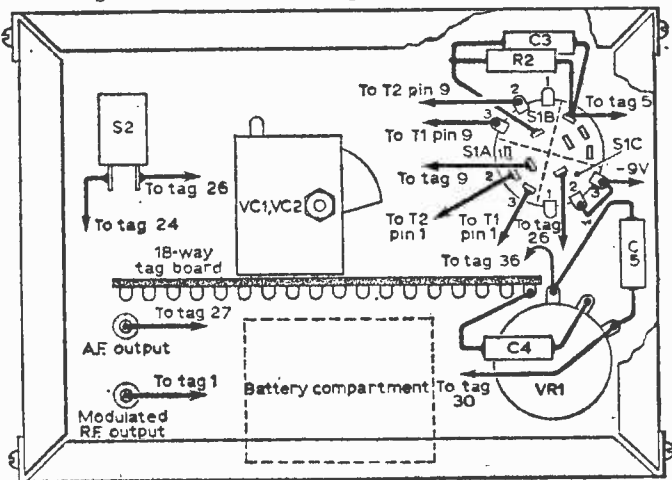


Fig. 3: Layout of major components and SI connections as viewed from the rear.

36 tags are given imaginary numbers, although these may be marked on a paper strip and glued to the board to facilitate wiring up.

To avoid defacing the front panel unduly only two points are used on the board (tags 19 and 36) for fixing, although VC1. 2 also assists. The 6BA bolt at tag 19 also helps retain one side of the coaxial type output socket carrying a.f.

Before placing the board in position VC1. 2 should be fitted, holes being drilled at "A" and

"B" (Fig. 4a) to enable the fixed vane base spills to project through. A stiff copper wire is then passed through the holes in these spills and solder applied. A 6BA solder tag and bolt are also affixed to the base outer casing of VC1, 2—a threaded hole exists—and a further short stiff wire is soldered between it and tag 12. Tag 12 must also be connected to either tag 19 or tag 36 if connection is not likely to be automatic via VC1, 2 shafting, etc. When the tuning capacitor is correctly located it should stand neatly and firmly on the board

the vanes of the variable capacitor do not foul the windings at any point of travel.

But before finally mounting T1 snip the wire leading to the underside of spill 6 and carefully unwind 50 turns cutting off the freed lengths as they become troublesome. It might be found that to remove the turns they must pass below the leads associated with the other winding at spills 8 and 9, but if care is taken no problem need arise for the wire may be made to pass between the two pieces.

When the correct number of turns have been removed the end is tinned, wound round the spill base No. 6, and soldered quickly. Both coils may then be locked in position using thumb pressure only on the polystyrene nut provided. The tag board can then be affixed to the inside of the front panel but spacers must be fitted to keep tags 20-35 from coming into contact with the metal.

The board may then be wired to agree with Fig. 4a, b, c, the transistors being left until last to avoid damage. All items used must be modern miniature types. The connections shown in Fig. 3 must also be made.

Finally a pair of black and red leads are twisted together and connected to carry the battery supply potential, stud connectors being soldered as appropriate. The cores of T1, T2 are then unscrewed so that the brass stems project at the underside of the board.

**Testing**

When the wiring has been checked thoroughly S1 should be set to position 1 and a temporary lead soldered from the link across VC1, 2 sections to tag 12 and the negative lead from a meter set to read 0-10mA connected to the battery negative terminal. The positive meter lead is then connected to the negative stud connector and the positive stud connector clipped to battery positive. With S2 closed S1 is rotated one point and the current noted on the meter; this should approximate to 2mA. If the meter tends to read full scale switch off and investigate for this indicates that a fault exists. If all is well a pair of headphones may be connected to the a.f. socket whereupon the note should be heard.

The frequency may be checked against an audio generator or a well-tuned piano, etc. If an oscilloscope is available the waveform may also be adjusted as was mentioned earlier, the headphones being removed for this purpose. Finally the unit is switched off and placed in its case after removing the temporary short applied to VC1, 2.

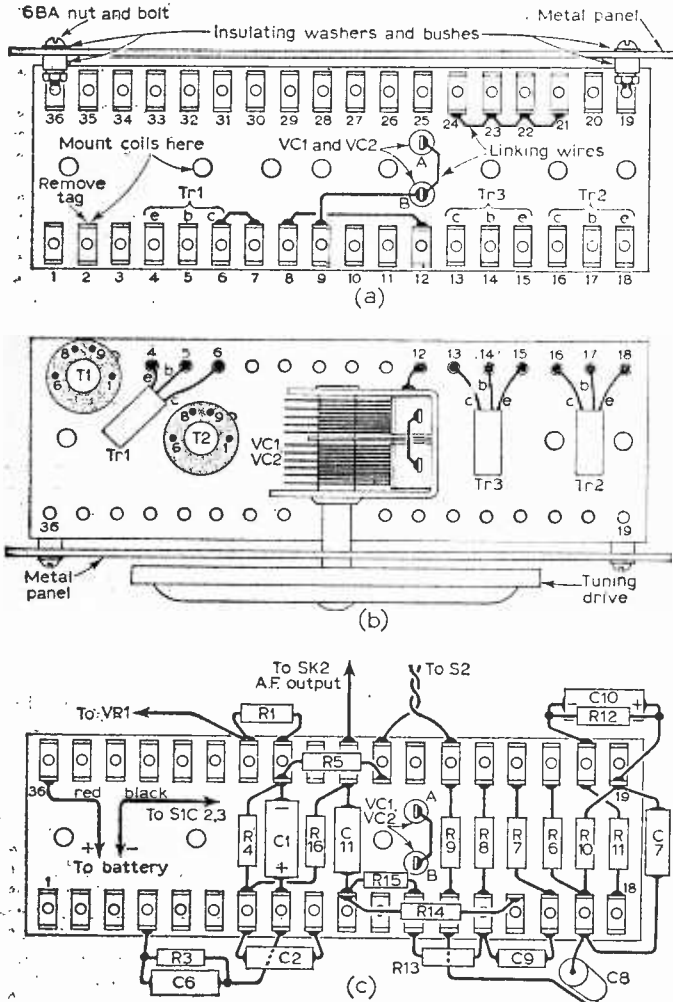


Fig. 4: (a) Tag board numbering and mounting arrangement; (b) top view of tag board; (c) tag board wiring.

between the two rows of tags without touching them at any point.

Tag 2 is then removed carefully and the hole enlarged just sufficiently to allow the fixing stem of T1 to pass through; one of the holes running along the centre of the board is similarly enlarged to accept T2, a check being made here to see that



**Calibration**

Range 1 can be calibrated with the aid of a broadcast band receiver. Remove the aerial from the receiver and connect the unit by means of screened leads or coaxial cable.

By first tuning the receiver to a known frequency and then making the generator output coincide with this (making certain the fundamental frequency is being generated) many points can be located around the scale, the readings being jotted down in order later to be transferred to a graph relating scale divisions to frequency. These points may then be joined and a curve obtained, (see Fig. 5).

On range 2 use can be made of the very accurate Light Programme transmissions on 200kc/s. With the unit switched off this transmission is tuned in on the receiver before exchanging the aerial for the generator output. Swinging the generator pointer or dial hard over to fully engage the variable

capacitor vanes should cause the output to coincide at this setting of the receiver dial if the generator is set to Range 2, but should it not do so the core of T1 may be adjusted until it does. The vanes of VC1. 2 *must* be almost fully engaged at 200kc/s.

After noting the dial reading and leaving the generator set the receiver is switched to medium wave and tuned around 500 metres (600kc/s) until the generator note is again heard. If the generator is now switched to Range 1 and adjusted to 600kc/s the fundamental frequency will be heard. If either dial is now moved the signal will disappear. Leaving the generator set at 600kc/s the receiver pointer is slowly rotated anti-clockwise when the note will again be heard at 1,200kc/s.

With the receiver so set further calibration points on Range 2 can be obtained for by switching to this range and searching for the original 200kc/s signal. Slowly rotating the generator dial will cause the signal to be heard at 240kc/s (1,200kc/s to which receiver is tuned is the 5th harmonic of 240kc/s), 300 kc/s and 400kc/s, and if 600kc/s can be obtained on this range also so much the better although this could not be done with the prototype.

**COMPONENTS LIST**

**Resistors:**

R1	33kΩ	R9	3.9kΩ
R2	2.2kΩ	R10	3.9kΩ
R3	1.2kΩ	R11	1.8kΩ (see text)
R4	3.9kΩ	R12	2.2kΩ
R5	2.2kΩ	R13	10kΩ
R6	27kΩ	R14	100Ω
R7	4.7kΩ	R15	2.2kΩ
R8	33kΩ	R16	22kΩ

All ±10% ½W carbon  
VR1 3kΩ potentiometer

**Capacitors:**

C1	100μF electrolytic 6V
C2	50pF mica
C3	50pF mica
C4	5000pF ceramic
C5	0.01μF ceramic or paper
C6	0.01μF ceramic or paper
C7	0.01μF ceramic or paper
C8	0.1μF paper
C9	2μF electrolytic 6V
C10	100μF electrolytic 6V
C11	0.01μF ceramic or paper
VC1.2	208 + 176pF twin-gang (Jackson '00')

**Switches:**

S1	4-pole, 3-way rotary
S2	On/Off Toggle

**Transistors:**

TR1	OC44	} Mullard
TR2	OC81	
TR3	OC81	

**Transformers:**

T1	Miniature dual purpose coil (Denco, Blue, Range 1)
T2	Miniature dual purpose coil (Denco, Blue, Range 2)

**Miscellaneous:**

Six-section aluminium chassis 7in. x 5in. x 2in. (Home Radio) or suitable tin. Tag board, miniature 18-way, 4½in. x 1½in. Two coaxial sockets, surface mounting type. Drive and reduction gear (see text). PP6 9 volt battery. Three control knobs. Stud connectors, wire, sleeving, solder, etc.

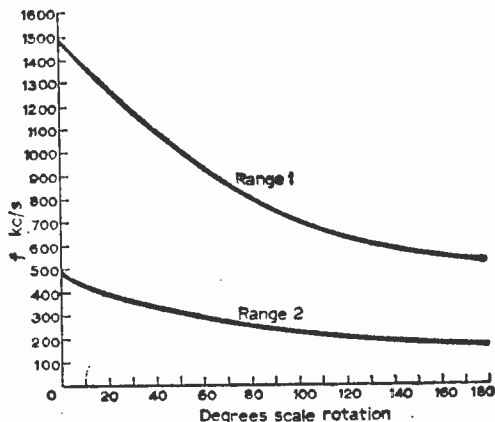
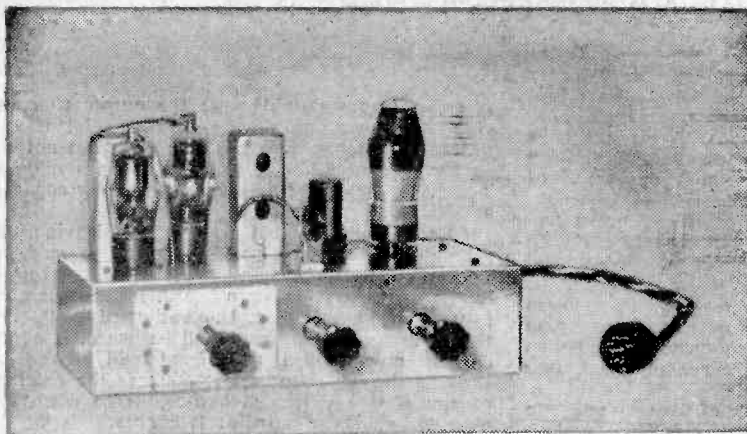


Fig. 5: A frequency/degrees of rotation graph.

These readings should be jotted down but if the receiver in use is a superhet expect spurious responses at around 470kc/s and 235kc/s for the i.f. stages of the receiver are affected. These frequencies can be easily spotted however, because oscillations will occur all around the receiver dial. It should be found that 470kc/s occurs before the vanes of VC1. 2 are quite fully open. Harmonics can be made use of to fill many spaces in the calibration and 440kc/s, for example, can be located via the Wales Home Service (81kc/s) and so on.

To check on the 300kc/s reading (Range 2) set the receiver pointer to 1,000 metres. It may be noted that if the generator is used with a transistor receiver or other receiver fitted with a ferrite aerial no direct connection need be made if the output lead is brought close to the rod.



**T**HIS receiver was designed and constructed in response to a request from a friend for the installation in the cabinet of an existing obsolete radiogram of a new radio chassis and modern four-speed record player unit. The requirements were that the completed instrument should provide reliable reception of the local B.B.C. programmes, plus Radio Luxembourg, together with realistic reproduction of gramophone records, possibly with emphasis on the "pop" variety in the case of the latter!

The receiver was to be used in an area where the B.B.C. programmes are reliably received, free of interference, and thus the complication and expense of providing for v.h.f.-f.m. reception, as well as a.m. broadcasts, could be avoided. Also, as no short-wave listening was envisaged and the only continental station required was Radio Luxembourg on 208m, it was evident that a receiver embodying preset tuning had much to recommend it.

This latter arrangement also avoided possible difficulties in obtaining a suitable dial and drive mechanism to suit the existing cabinet. With preset tuning no dial is required and the existing cut-out in the cabinet was "blocked in" with a suitable rectangle of veneered wood, drilled to accept the control spindles and red indicator light of the new chassis.

The only drawback to the use of preset tuning was that it had been found in past experience that unless extremely carefully constructed and wired, such arrangements tend to drift "off tune" after a period of use and require periodical readjustment. However, a solution to this problem was found in the use of a complete ready-made four-station tuning coil pack with "gram" position on the selector switch. This coil pack is manufactured by Denco Ltd. and after a lengthy period of use, with several hundred operations of the selector switch in the course of domestic use, the tuning has been found to remain perfectly stable and no readjustments have proved necessary.

This coil pack is available in two versions: four medium wave stations or three m.w. and one long wave stations. The area in which the set is intended to operate will be the deciding factor in the choice of coil pack. If the B.B.C. Light Programme is well received at all hours of the day on 247m (medium wave band) then coil pack

chassis via the aerial tuning coils. type CP4/MG will be required, but if the Light Programme is normally best received on 1,500m (long wave band) then type CP4/LG will be required.

Owing to the fact that each individual station will, when alignment is completed, be accurately adjusted for padding and trimming of oscillator and aerial tuning circuits, rather than the compromise adjustments which have to be made when a receiver with variable tuning has to be capable of "sweeping" across each complete waveband, the sensitivity will be found to be of a high order and ample volume will be obtained on a short indoor aerial in most locations, although, of course, the best possible aerial should always be used in the interests of minimum background "noise". As the receiver utilises a completely isolated full-wave power supply an external earth may be used and this will be found to further aid towards stable and interference-free reception.

Having dealt with the main features of the design in so far as radio reception is concerned let us now turn to the "gram" requirements. The present-day popularity of records featuring a pronounced "beat" with an accompaniment of guitars, double bass, etc., calls for a circuit which will give some emphasis to the lower frequencies, particularly as a loudspeaker unit (8in. diameter) in the moderate price range was to be incorporated. With this in view a "bass boosting" preamplifier stage, operative on "gram" only, was incorporated, this being V4 on the circuit diagram (Fig. 1).

#### CIRCUIT DESCRIPTION

Referring to Fig. 1, it will be seen that for sake of clarity the internal coil switching arrangements of the coil pack have been omitted but all points of connection to the colour-coded tags provided on this component are clearly shown.

The incoming radio signal is tuned by switching in the appropriate coil between point "green" and chassis, the capacitor C1 acting as a fixed tuning capacitor in place of the conventional two-ganged variable. The selected signal is applied to the control grid of the mixer section of the frequency changer valve V1, for which a 6K8 is specified. C2 is merely a d.c. blocking capacitor to prevent the passage of the a.v.c. voltage to

# The Hillingdon RADIOGRAM

The oscillator section of V1 is wired as a Colpitts oscillator. This circuit is noteworthy for its long-term stability and freedom from drift as a result of slight supply voltage changes. Tuning is performed by switching the appropriate coil between points "red" and "blue" and by the existence of fixed capacitors C7 and C8.

The i.f. signal appearing at the mixer anode of V1 is selected by the preset tuning of the primary of T1 (465kc/s) and impressed on the control grid of V2 via the secondary winding of T2. V2, which is a 6B8, is a multi-purpose valve and fulfils the function of i.f. amplification in its pentode section. The output at the pentode anode is coupled via T2 to one of the diodes (pin 4), which acts as a demodulator. The resultant a.f. signal is filtered of residual r.f. by R12, C14 and C15 and the a.f. voltage is developed across R11.

A portion of the i.f. signal appearing at the anode of V2 is fed to the second diode (pin 5) via C13, which acts as a.v.c. rectifier, and the resultant voltage is applied to the grid of V2 (decoupled by R8 and C10) and to the grid of V1 (further decoupled by R6 and C9). The application of a.v.c. bias voltage to two stages will be found to considerably assist in counteracting the fading which tends to afflict after-dark reception, particularly of Radio Luxembourg on 208m.

Returning to the passage of the a.f. signal appearing across R11, this is now applied to the "radio/gram" changeover switch S1 included in the coilpack. This switch is so wired that in each of the four pre-selected radio station positions the signal is fed via C16 to the "top" of VR1, the volume control.

The desired level of signal is tapped off by the slider of VR1 and applied to the control grid of V3, which is a high-slope output pentode of type

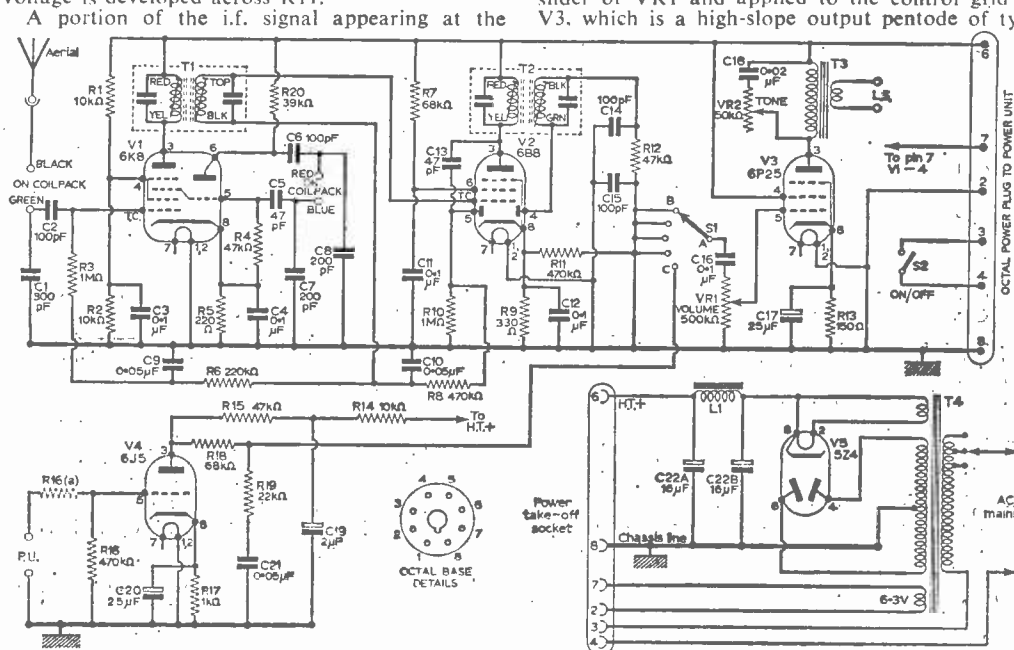


Fig. 1: The complete circuit including the power pack.

6P25 (or EL33). Thus no intermediate stage of audio amplification is provided for radio reception and in practice it will be found that a more than adequate signal is available to "drive" V3. The output from V3 is fed to the output transformer T3 and thence to the loudspeaker output sockets. A simple top-cut tone control comprising C18 and VR2 is wired across the primary of the output transformer.

#### GRAMOPHONE PRE-AMPLIFIER STAGE

When the selector switch is turned to the "gram" position ("C" in Fig. 1) the radio circuit is isolated and the output from V4 is fed via the volume control to the output stage V3.

The purpose of V4, which is a 6J5 valve, is, as previously explained, to provide some pre-amplification, particularly of the bass frequencies. The signal from the pick-up, which in the original

can be omitted, resulting in a fixed value of negative voltage feedback over the latter stage, which will be an aid to improved quality in reproduction but with some loss of maximum available volume.

The components R18, R19 and C21 provide the desired emphasis of the bass frequencies before the signal is fed to V3.

The power supply circuit is entirely conventional. In actual practice this portion of the circuit is mounted on a separate chassis which can conveniently stand on the floor of the cabinet in which the receiver is installed.

The output voltages are terminated in an octal socket at one end of the chassis. A suitable octal plug, fitting into the above socket, conveys the various supplies to the main chassis by a six-way flexible cable. Four leads convey the h.t. and I.T. supplies, the remaining two leads go to the on/off

#### COMPONENTS LIST

##### Resistors:

R1 10kΩ 1W	R8 470kΩ	R15 47kΩ
R2 10kΩ 1W	R9 330Ω	R16 470kΩ
R3 1MΩ	R10 1MΩ	R17 1kΩ
R4 47kΩ	R11 470kΩ	R18 68kΩ
R5 220Ω	R12 47kΩ	R19 22kΩ
R6 220kΩ	R13 150Ω	R20 39kΩ
R7 68kΩ	R14 10kΩ	

All  $\pm 10\%$ ,  $\frac{1}{2}$ W carbon unless otherwise stated  
 VR1 500kΩ potentiometer  
 VR2 50kΩ potentiometer with switch (S2)

##### Capacitors:

C1 300pF silver mica
C2 100pF silver mica
C3 0.1μF paper 350V
C4 0.1μF paper 350V
C5 47pF silver mica
C6 100pF silver mica
C7 200pF silver mica
C8 200pF silver mica
C9 0.05μF paper 350V
C10 0.05μF paper 350V
C11 0.1μF paper 350V
C12 0.1μF paper 350V
C13 47pF silver mica
C14 100pF silver mica
C15 100pF silver mica
C16 0.1μF paper 350V
C17 25μF electrolytic 25V
C18 0.02μF paper 350V

C19 2μF electrolytic 350V
C20 25μF electrolytic 25V
C21 0.05μF paper 350V
C22 16 + 16μF electrolytic 450V

##### Transformers:

T1 1.F. transformer, 465kc/s (Denco IFT6B/465)
T2 1.F. transformer, 465kc/s (Denco IFT6A/465)
T3 Output transformer 5000Ω primary (Parmeko P2641)
T4 Mains transformer. Secondaries: 250-0-250V 80mA; 6.3V, 3A; 5V 2A (Douglas MT1)

##### Valves:

V1 6K8	V3 6P25	V5 5Z4
V2 6B8	V4 6J5M	

##### Miscellaneous:

L1 Smoothing choke 10H 80mA  
 LSI Speaker unit 8in. dia., 3Ω  
 Coil pack, Denco CP4/MG or CP4/LG  
 Six I.O. valveholders. Two I.O. grid clips. One I.O. plug. Indicator lamp holder, panel mounting, red lens and 6.3V lamp. Tagstrips; three 2-way, one 4-way, two 2-way. Three 2-way socket strips. A.E., P.U., L.S. Three control knobs. Six  $\frac{3}{8}$ in. grommets. Aluminium chassis: one 12in. x 5in. x 3in., and one 8in. x 4in. x 2in. (Home Radio). Screened, single core cable; insulated flex, various colours (for power cable); connecting up wire; insulated sleeving; nuts and bolts, washers and solder tags.

is developed across R16 and fed to the control grid of V4.

It may be found that some crystal pick-ups provide a sufficiently high output to overload V4, which will be evidenced by distortion on loud passages irrespective of the setting of the volume control. In such cases the insertion of R16a (shown dotted in Fig. 1) will put matters to rights. A suitable value for R16a will be 47kΩ to 100kΩ.

The anode of V4 is well decoupled from the h.t. line by R14 and C19 and no feedback troubles should be encountered in spite of the high overall gain of the audio stages. In many areas C17 connected across the cathode resistor R13 of V3 receiver was of the "standard" low-priced crystal type with turnover head to suit 78" or l.p. discs,

mains switch which for convenience is mounted on the main chassis. The author's preference is to combine this switch with the tone control (VR2) rather than, as is more usual practice, with the volume control (VR1). This avoids constant movement of the volume control every time the receiver is switched on or off, with consequent unnecessary wear of the track of this component; which can quickly lead to "noisy" operation.

#### CHOICE OF COMPONENTS

Components of any reputable make can be employed throughout this receiver and, apart from the Denco coil pack, no hard and fast specifications are laid down in the list of components.

A mains transformer of the top mounting type

is shown in the illustrations and on the drilling diagram of the power supply chassis (Fig. 3). Naturally if a different type is used there may be need of alteration here.

In the interests of long-term tuning stability good quality silver mica capacitors of the close tolerance (2% or better) must be used in the C1, C2, C6, C7, and C8' positions. All other resistors and capacitors can be of the standard 20% tolerance type.

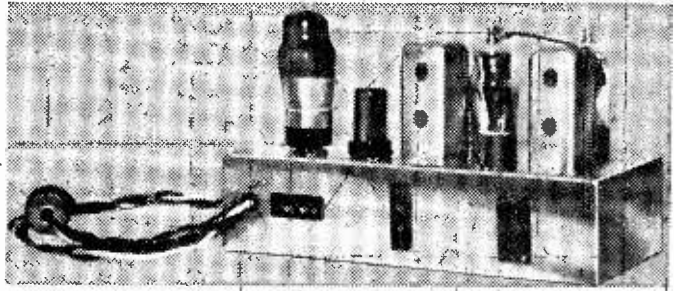
The oft-repeated warning against using ex-equipment capacitors of doubtful origin is again emphasised as these can lead to disappointing results and tedious efforts to trace the cause of unsatisfactory or erratic operation.

The i.f. transformers T1 and T2 are of the standard rather than the possibly more popular "midget" type as they are then more in keeping with the octalized valves. The colour coding of their leads may not necessarily agree with that shown in

them. A component with a top fly-lead, (for connection to top cap grid of V2) is essential in the first i.f. transformer T1.

**PREPARING THE CHASSIS**

The two aluminium chassis of the specified size are a standard pattern obtainable, ready folded to shape, from several advertisers in this magazine.



A view of the main chassis when finished.

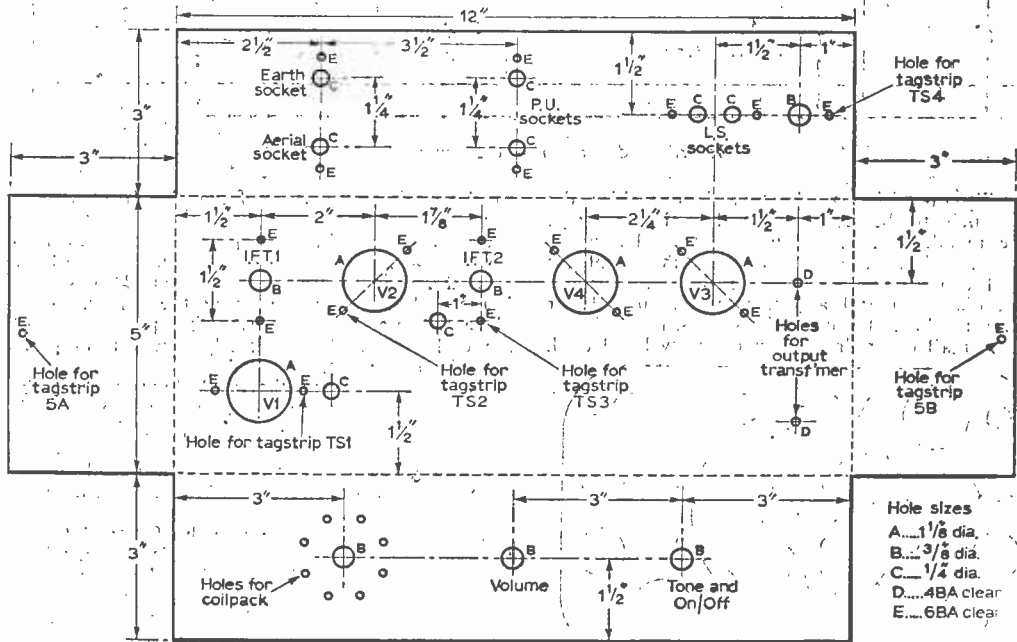


Fig. 2: The main chassis drilling details.

ic diagrams, as manufacturers often have their own preferences in this matter. However usually a data chart is supplied when the components are purchased giving the necessary "key" to the terminations.

If a type of i.f. transformer having tags or pins as output terminations rather than coloured fly-leads is obtained it will, of course, be necessary to amend the drilling of the chassis to accommodate

Constructors who have the necessary workshop facilities for making up the chassis from sheet aluminium can, of course, do so, and in that case all drilling and cutting can be done whilst the metal is in the flat state.

All positions and dimensions of drilling holes are clearly seen by reference to Figs. 2 and 3.

It is strongly recommended that both chassis are completely drilled before commencing on any

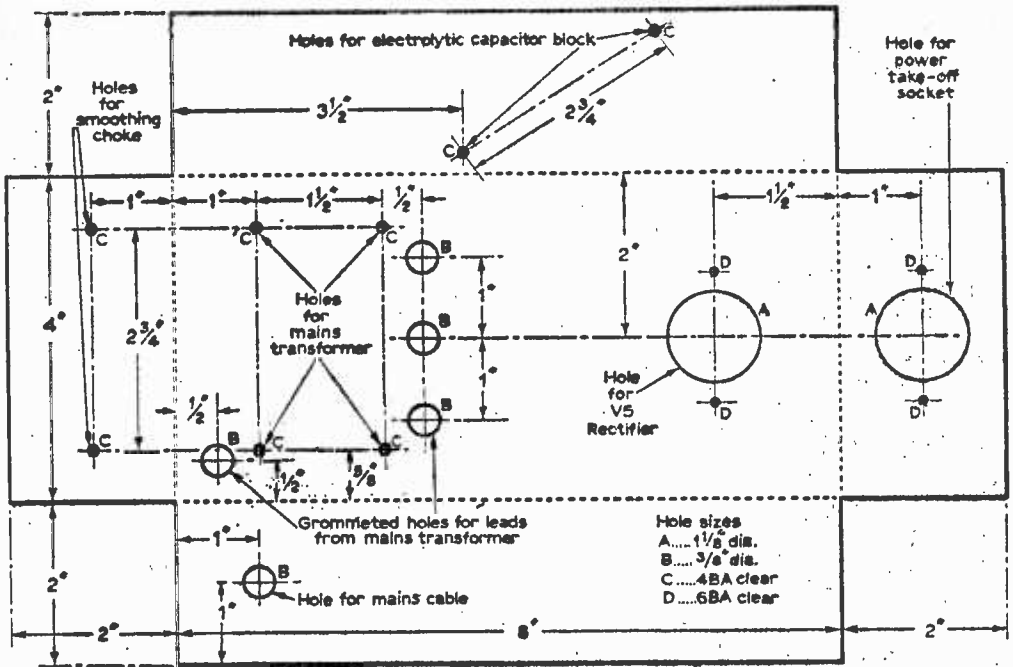


Fig. 3: Drilling dimensions of the power pack chassis.

assembly or wiring work; this then enables the workbench to be completely cleared of filings, waste metal, etc., before proceeding. The large valveholder holes are best cut out with one of the special chassis cutters available for this purpose (1/4 in. diameter) and a 1/4 in. punch is useful for making the holes for control spindles, mains leads, etc. For all other drilling an ordinary hand drill,

to the tuning coil cores from the front of the chassis. The best way to mark their positions with accuracy is to obtain a piece of stiff card (a postcard will suffice) and cut from it a piece of the same dimensions as the coil pack, i.e. 3 1/2 in. x 2 1/2 in. Make a 1/4 in. diameter hole in the centre. Now place this piece of card over the spindle bush of the coil pack and temporarily fasten it in place with the fixing nut.

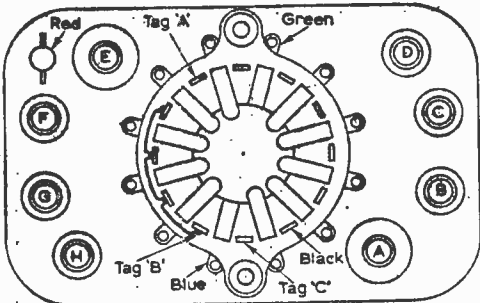


Fig. 4: Coil pack layout.

By firmly pressing the card down against the base of each coil (which will be found to protrude slightly above the surface of the metal baseplate) an outline mark of the position of each coil can be made. Now remove the card, pencil in the exact position of each coil and punch 1/4 in. holes at each of these positions.

with bits to provide holes of 1/4 in., 4B:A. or 6B:A. clearance, will be adequate.

The punched card can now be fastened to the front runner of the chassis, using Sellotape, taking care that the central hole is aligned with the coil pack spindle hole. The actual chassis runner is now drilled with 1/4 in. holes through the marker holes in the card.

The exact position of fixing holes for the valveholders, mains transformer, choke, output transformer and the electrolytic smoothing capacitor C22 is best marked out by using the actual components as a template.

If desired the card can be left affixed to the chassis and the appropriate "key letters" applicable to each coil core, ascertained from Fig. 4, neatly written alongside. This will serve as an easy reference when alignment is carried out or if any future adjustments have to be made to the preset tuning at a later date.

The group of 1/4 in. diameter holes shown around the hole which accommodates the control spindle of the coil pack selector switch is to provide access

When all holes have been drilled, clean up any rough burrs with a round file and make a final check with Figs. 2 and 3 to make sure that none have been omitted.

TO BE CONTINUED

# versatile Tremolo unit

A FIVE-TRANSISTOR INSTRUMENT

BY J. HITCHIN

**N**O self-respecting dance band or jazz group is now complete without at least one instrument making use of a tremolo unit. A new amplifier bought or made now would almost certainly incorporate such a unit, and the effect is beginning to be used with other instruments than the guitar—with which it was first associated. For instance, the effect can be very pleasing when used with the piano accordion, especially if this has a built-in microphone, as many of the latest models have.

Even when a tremolo unit is built in to the amplifier there are still very good arguments for an independent unit. The instrumentalist may not be able to reach the main amplifier as he is moving around the stage, and a separate unit enables more than one instrument to use the same main amplifier.

There are also, of course, many thousands of perfectly good amplifiers already in existence which do not have a built-in tremolo unit. These can, of course, be modified by building in a tremolo unit, though this would not give the flexibility of a separate unit.

Most of these existing amplifiers are of the valve type and the construction of a separate valve unit involves trouble with power supplies and the use of long and unwieldy leads.

The obvious answer is the use of a transistorised unit with its own battery supply. This can be in the form of a small box suitable for slipping in the pocket, or in the case of a guitar or accordion can be built into the instrument.

The unit described here is of this type. It provides facilities for the control of depth and speed of tremolo over the ranges of 0 to 100% and 5 to 15c/s and also for adjustment of gain. The unit has a maximum gain of approximately 15 and so provides a useful preamplifier which may be installed close to the microphone or pick-up.

Unlike some other tremolo units the output signal amplitude is independent of any control setting other than that of the gain control since the modulation is of the downward type and the peak amplitude of signal remains constant whatever the modulation depth. Whilst there is obviously a decrease in the total amount of power in the final output signal the effective volume level is very little affected. This can be very important to the user as the need to readjust volume levels during the course of a complicated performance as the tremolo is switched in and out is eliminated.

The circuit uses five transistors and can be assembled on to a circuit board 3½ in. by 6½ in. This

circuit board may be of the printed circuit type (a layout for a printed circuit board is given in Fig. 3) or may be a plain sheet of insulating board with inserted tags (a wiring sketch is shown in Fig. 4). The layout of components is the same in each case.

## Description of Circuit

The transistors Tr1 and Tr2 form a collector-coupled multivibrator whose speed of oscillation is controlled by the capacitors C1 and C2, resistors R1 and R2 and potentiometer VR1.

Variation of the potentiometer VR1 provides the speed control and a range of from 5 to 15c/s is available. It will be noted that the control is effective in only one base return and so the output at any other than one setting must be asymmetrical. Various forms of symmetrical control were tried, such as ganged potentiometers in the two base returns and the return of equal base resistors to a variable voltage divider.

The final decision to use the circuit shown in Fig. 1 was taken on the grounds of simplicity and because in a series of comparative listening tests at various speeds and depths of modulation it was found the most satisfactory. It should be remembered that there is no standard that defines the shape of modulation in such a unit and the practical results of a test are the only final answer.

Those wishing for a "different" sound for their tremolo effect should try variations in the multivibrator networks, checking each time with the musician who will be using the unit.

The modulation is transferred from the collector of transistor Tr2 via the 33kΩ resistor R6 to the top of the modulation depth potentiometer VR2. This potentiometer is bypassed by a 10μF capacitor (C3) which removes the higher harmonics from the modulating waveform. Unless this is done some of the higher harmonics will appear in the output, resulting in a ticking sound at the modulation frequency.

Transistor Tr3 is the modulating device and acts by varying the impedance of a potentiometer chain of which it forms the lower half. The input signal from the pick-up is applied via a 30kΩ resistor, R7, to the emitter of Tr3 and via C4 to the base of transistor Tr4. The modulating signal is applied from the slider of the modulation potentiometer to the base of Tr3. The signal causes the emitter-to-collector impedance of Tr3 to fluctuate in sympathy with the signal.

The signal arriving at the base of the first amplifying transistor Tr4 is therefore modulated at the multivibrator frequency. As the emitter-

base impedance can be reduced to a very small value, it is possible to achieve virtually 100% modulation. The values of the feed resistor for modulation R6 and the input resistor R7 have been chosen so that with commonly used magnetic pick-ups the full range of rotation of the potentiometer is required to produce 100% modulation.

The remaining two transistors, Tr4 and Tr5, form a preamplifier with a gain from input terminals to output of approximately 15 and can provide a maximum output signal of about 1V. The first stage is of the grounded collector type and was chosen so that its high impedance input should not damp the modulator section. This stage is directly coupled into the base of Tr5, a grounded emitter stage.

Gain control is applied to the final stage by means of the potentiometer VR3 and the capacitor C6, which act so as to vary the a.c. feedback applied to the stage. A gain control range of 20dB is provided which is adequate for adjustment at the instrument itself, coarse gain control being carried out by using the controls on the main amplifier or on the pick-up itself.

The output is taken from the collector of Tr5 via C7 and R11, the time constant of these being selected to be as high as possible while still giving attenuating at the modulating frequency.

In the case of modulation not being required, the multivibrator is stopped by joining the collectors of Tr1 and Tr2 together by means of S1. This method of stopping the multivibrator was chosen because it maintains the correct d.c. conditions on the base of the modulator transistor Tr3.

The unit is powered by a divided 9V line, that is to say plus and minus 4½V. Such a supply system was chosen because it made the problems of decoupling simpler and enabled smaller capacitor to be used and, furthermore, kept input and output terminals sensibly close to earth.

Before describing the construction in detail the following point should be noted.

It was assumed throughout the design of the unit

that it would be used with either an a.c.-only amplifier or with a properly designed a.c.-d.c. amplifier incorporating an isolating transformer in the input terminals. No musical instrument should be connected to the terminals of an a.c.-d.c. amplifier which make direct contact with the chassis. Many musicians have received severe shocks as a result of not taking these precautions and fatalities have occurred.

### COMPONENTS LIST

#### Resistors:

R1	56kΩ	R8	47kΩ
R2	33kΩ	R9	10kΩ
R3	27kΩ	R10	68kΩ
R4	27kΩ	R11	22kΩ
R5	68kΩ	R12	27kΩ
R6	33kΩ	R13	27kΩ
R7	39kΩ		
VR1	50kΩ linear		
VR2	2kΩ linear		
VR3	1kΩ linear		

#### Capacitors:

C1	2μF electrolytic 350V
C2	1μF electrolytic 350V
C3	10μF electrolytic 25V
C4	0.04 paper 150V
C5	2 x 100μF electrolytic 12v
C6	100μF electrolytic 12v
C7	0.02μF paper 150V

#### Switches:

S1	Push-on, push-off type switch (Bulgin S360, S560 or S561)
S2	Toggle switch, d.p.s.t.

#### Transistors:

Tr1	OC71	Tr4	OC44
Tr2	OC71	Tr5	OC71
Tr3	OC71		

#### Miscellaneous:

Input jack socket, if required (Bulgin J6 shorting type). Output jack, if required (Bulgin J2). Insulated board 6½in. x 3½in. or printed circuit board.

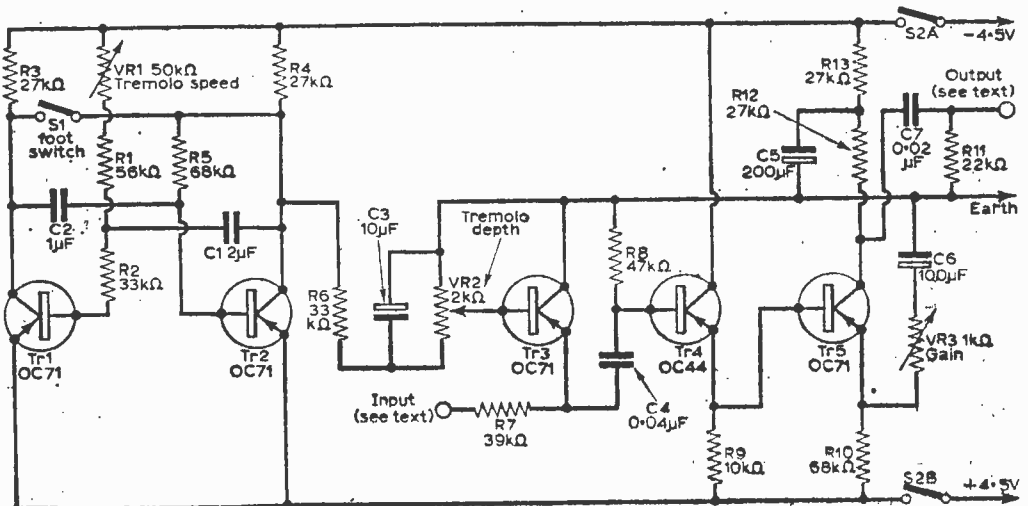


Fig. 1: The tremolo unit circuit.



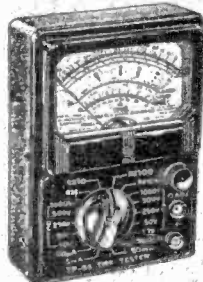
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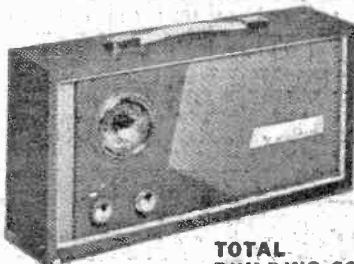
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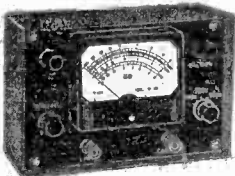
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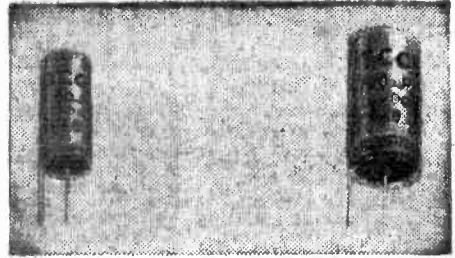
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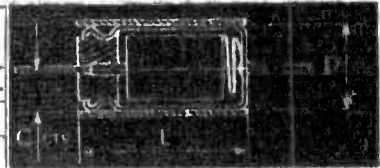
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**Construction**

The tremolo unit has been constructed in two forms: as an independent unit suitable for placing on the floor close by the player and with the modulation switch operated by foot; as a sub-unit suitable for building into an existing amplifier or into a musical instrument such as a guitar.

In either form the basic construction may employ either an insulating board with tag inserts or a printed circuit. Details of each method are shown on the diagrams. Where the tag-board construction is used all the wiring is carried out on one side of the board and the components are fitted to the other side.

**Drilling Diagram**

Drilling details for the component board are given in Fig. 2.

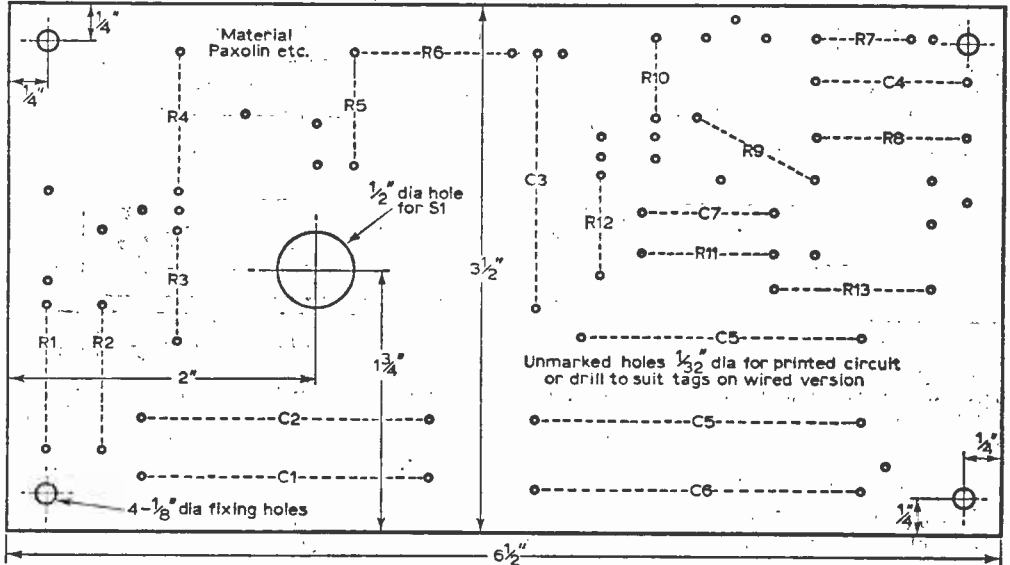


Fig. 2: The drilling dimensions of the panel.

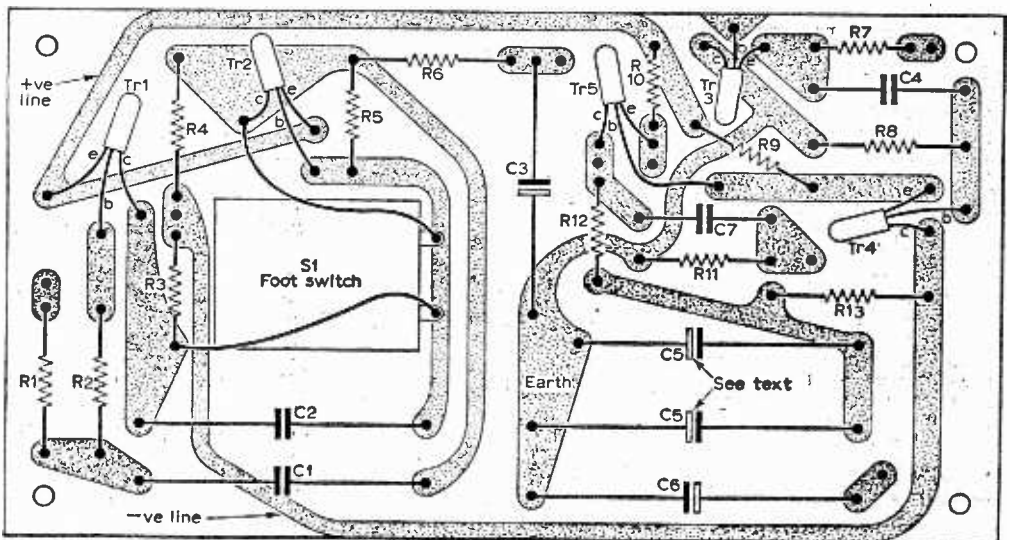


Fig. 3: The printed circuitry and component layout and wiring.

Take-off leads apply to printed circuit version also.

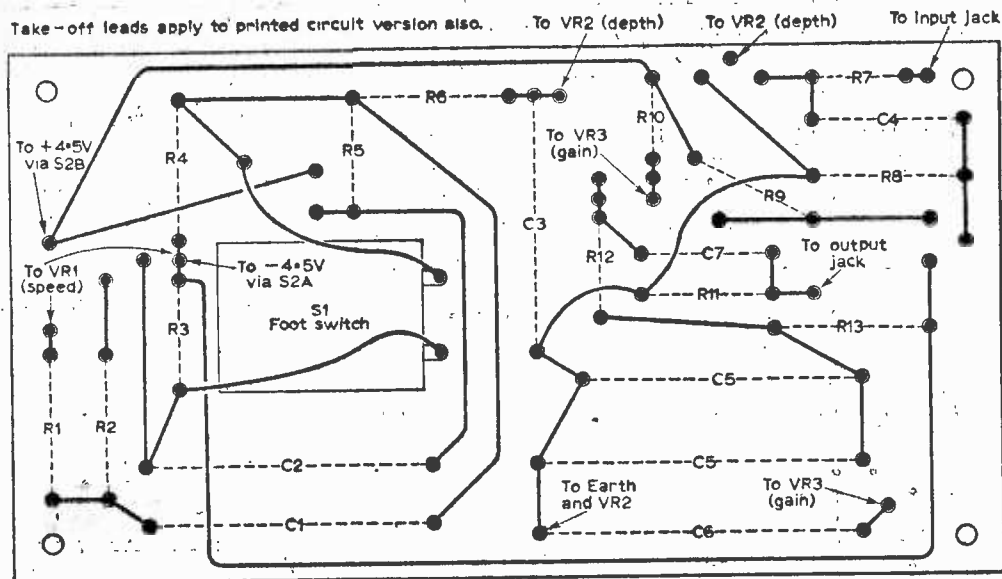


Fig. 4: Point-to-point wiring for a component board using tags fixed into a plain sheet.

The small holes should be located on to the panel by drawing out this diagram full size and pricking through on to the panel. In the case of a printed circuit being used it is necessary to ensure that the holes are drilled centrally in the printed track.

The same drilling diagram is used for both methods of construction, i.e. printed circuit or wired tags. Single printed circuits can be produced by painting the required pattern direct on to the board in a resistant paint and etching in diluted nitric acid.

The board used measures 6½in. by 3½in., this size being chosen because it fits neatly inside one of the Eddystone series of cast boxes, making a strong and reliable unit for floor use. The modulation switch is fitted to the board, while the on/off switch and the three potentiometers are mounted separately either on a strip of material or directly on the cast box or instrument panel.

The batteries are mounted in simple clips on the bottom of the box or in a suitable place in the instrument or amplifier.

If the unit is mounted inside an existing amplifier it is a good idea to change the main on/off switch to a type that carries additional contacts, enabling both switches to be combined. This eliminates the risk of forgetting to turn off the tremolo unit and thus draining the batteries.

The components lists gives the recommended components, though suitable alternatives for many of them exist. The transistors are all OC71s with the exception of Tr4, which should be an OC44. Construction is straightforward and even when using the tag-board method it is impossible to use overlong leads. The flying leads to the potentiometers should not exceed 18in. in length; screening was found unnecessary for these leads, though they should be neatly twisted into bunches.

Because of the relatively high sensitivity of the

unit it is recommended that a shorting-type jack should be used for the input to avoid stray "pick-up" when it is not connected to the instrument pick-up.

The wired panel is mounted on simple spacers when installed to avoid trapping the wiring or shorting out the printed track.

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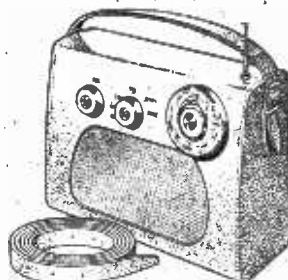
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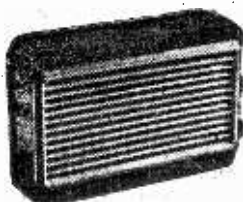
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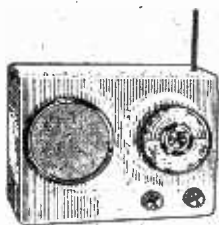
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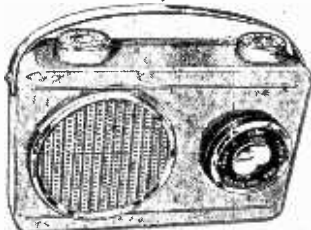
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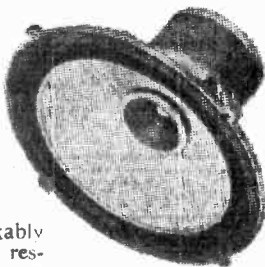
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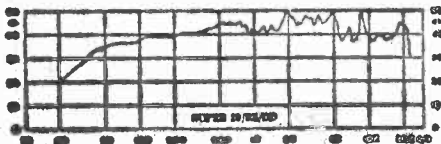
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*The text is written for the young beginner and naturally more advanced readers will find some of the information superfluous. The author is sure that any beginner will be able to make this radio as a result of this article.*

CONTINUED FROM PAGE 1035 OF MARCH ISSUE

BY E. V. KING

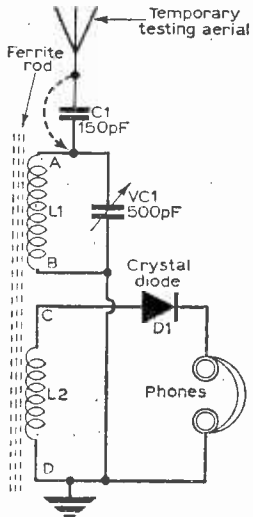
COMPARING the circuit of Fig. 3(a) with that of Fig. 7(a) readers will note the additional coil L2 which will pick up electro-magnetically the oscillating voltage on L1.

The advantages of this arrangement are that the diode circuit will not now "damp down" the coil L1 and render the circuit "flat" or non-selective, and also that the circuit will match into the transistor, which will later be substituted for the diode.

Reference to Fig. 4 (stage 3) will show that the coil L1 is now covered with a layer of thin card and 30 turns of thin plastic-covered wire wound on in two layers, definitely all in the same direction. As before the start is knotted. Sellotape keeps the coil in place. The ends are designated as C and D for start and end respectively.

Fig. 7(b) shows the rearranged circuit wiring. The following alterations are made to the wiring in Fig. 3:

1. The lead AU is removed entirely.
2. Coil lead D is soldered to tag B, the thin coil lead being also left intact.
3. The coil end C (knotted) is joined to the end of the diode at U.



### Testing the Aerial Transformer

The long aerial is now connected to A, the water pipe earth to B and the phones as before.

The ferrite rod is placed almost out of the coil, then the Light Programme is tuned in and VC1 should be about one-sixth out; i.e. the vanes are almost in. The sound will be very slightly fainter than previously, but if the tuner or the ferrite rod is moved the selectivity will be found to be very much improved.

If a reasonable signal is received a further and better test is to connect the aerial to the far end of C1, when the signal will be much weaker; the best tuning being with the coil in the centre of the rod and VC1 almost in (one-quarter out). Experiment should show that the tuning is now very critical and care is required to get it correct.

### Adding an A.F. Amplifier

Later it is planned to fit an r.f. amplifier stage

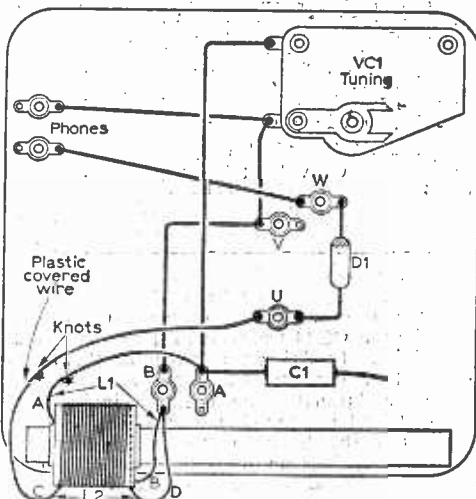


Fig. 7a (left): Crystal detector with aerial transformer consisting of L1 and L2; b' (right): the new wiring.

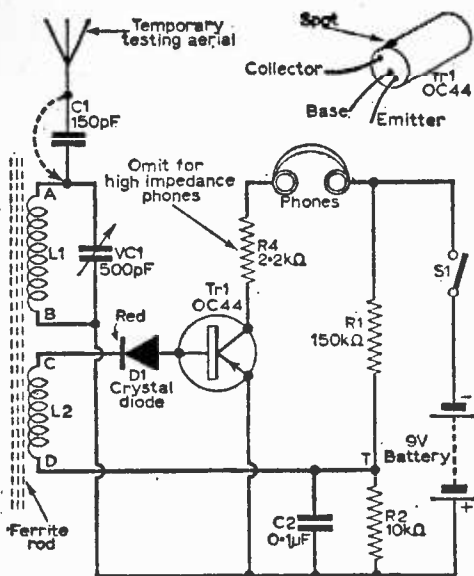
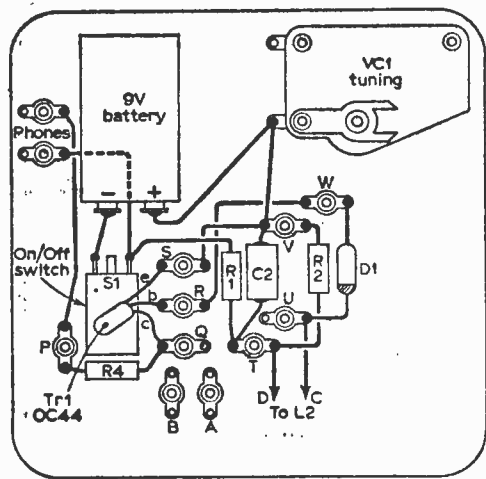


Fig. 8a (above): Incorporating a simple transistor amplifier into the circuit; b (below): the wiring of the amplified set.



so that the aerial "pick-up" is itself amplified and the ferrite rod will then suffice on its own. Meanwhile the OC44 transistor Tr1 is wired as an a.f. amplifier. In doing this much of the future wiring will be performed and many components tested. All additional wiring is shown in Fig. 8(b).

The switch S1 is fitted (Fig. 8 and Fig. 2). Some battery clips should be obtained from an old battery. The following connections are removed:

1. The end of L2 connected to tag B.
2. Both leads going to the phone terminals.

The following connections and components are added (refer to Fig. 8):

1. Wire from switch S1 to battery negative, using a clip.
2. Wire from rotor (moving vanes) of VC1 to battery plus.
3. Check for certain that polarity of battery is correct.
4. Remove battery temporarily.
5. Position diode D1 with red end on U if this is not already so.
6. Join the end "C" of L2 to red of diode.
7. Join the other end of L2 to tag T.
8. Connect C2 between T and V, shortening the leads and covering them in sleeving.
9. In the same way R2 is wired between V and T. Make a good, round soldered joint every time.
10. Connect tag V to tag S (emitter of transistor Tr1).
11. Connect tag W to tag R (base of transistor Tr2).
12. Connect R1 between tag T and switch S1.
13. Connect switch S1 to phones.
14. Connect R4 between Q and P.
15. Join P and spare phone terminal.
16. Check the wiring now carefully against the theoretical diagram (Fig. 8a), inking this in as each part is traced. Rectify any errors made.
17. Look carefully for tags touching adjacent tags in error and whiskers of wire causing shorts.

### Testing the Amplifier

The phones are connected as usual. If high resistance phones are used, short out R4 with a wire loop. If a crystal insert is used wire it to either side of R4 and short the actual phone terminals.

Clip on battery, put ferrite in the coil, connect earth to tag "B" and aerial to "A". Switch on and a station is almost sure to be heard at once. The vanes of VC1 and the ferrite rod will be almost out for the Light Programme. The sound will be so loud that it should be heard about two yards from reed-type phones.

If the aerial is now moved to the spare end of C1 the selectivity will be much better and the optimum tuning position will be with the ferrite rod well in and the vanes of VC1 about a quarter turn out. When no station is heard a slight hiss should be heard, and if the base wire of the transistor Tr1 or tag R is touched with a metal object (such as a screwdriver blade held in the hands), mains hum will be heard if the house is wired for a.c. If a milliammeter (on 10mA range) is placed in the positive battery lead it will show the collector current of the transistor. This should be between 1mA and 2mA but can safely be up to 3mA.

The diode D1 must be connected the correct way round and in fact it may be damaged by incorrect use. Some diodes now have no colour and the direction of the "catswhisker" means nothing. Thus, if in doubt (when the red end is

—continued on page 1181



**Power Pack 23A.** Intended for the receiver 1132. This however is ideal for general workshop use. Input is normal A.C. 50 c/s but the output gives a fully smoothed D.C. supply of 200 volts at 150 milliamperes and A.C. heater supply of 6.5 volts and 5 volts. Totally enclosed in a metal case these are perfect except for the meter on the front panel which will probably need repairing or can be dispensed with altogether. Price 29/- Carriage 10/-

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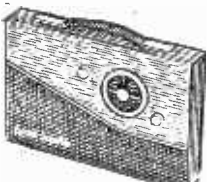
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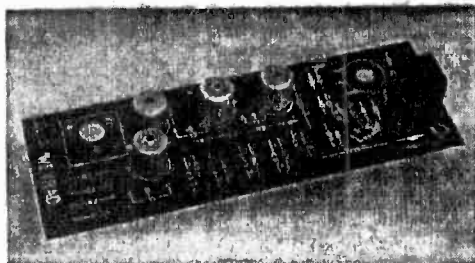
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By M. H. Thomas

**T**HIS receiver is a straightforward t.r.f. design and as such is a simple set for the beginner to build. As well as construction details, brief notes on the working of each of the main components will be given. The set will tune the medium waveband, 200-550m and reception of both Home and Continental stations will be found to be quite satisfactory, even on a fairly short aerial, although the more distant stations will require a slightly longer aerial for best results.

### H.F. and Detector Stages

L1 incorporates the aerial coupling coil and the tuned grid coil for V1. This coil is the Wearite PA2, while L2 is the Wearite PHF2. This latter coil is the anode coupling coil and tuned detector coil for V2.

The aerial is connected to tag "Y" of L1 via C1. VC1 and VC2 are a 500pF twin gang tuning capacitor fitted with trimmers and slow-motion tuning drive. This gang tunes the secondaries of

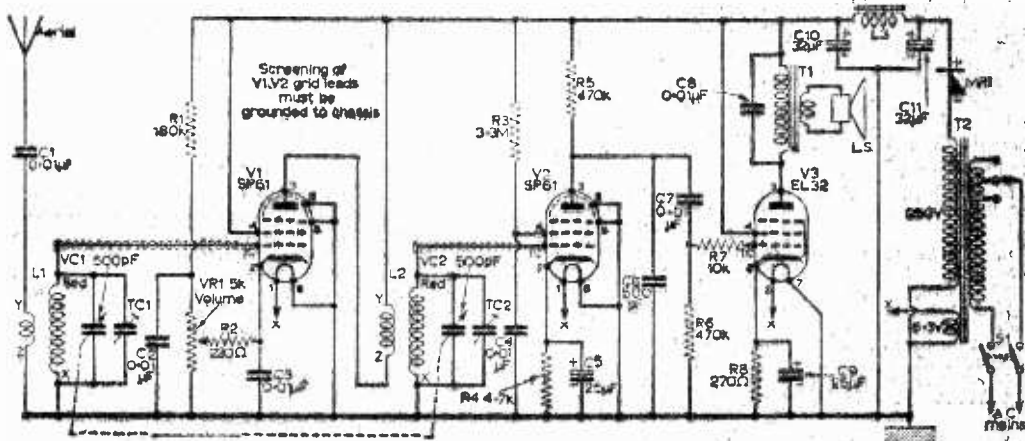


Fig. 1: The simple circuit of the receiver.

### The Power Supply Circuit

The power supply is derived from the 200-240V a.c. mains. Output from the 250V winding on the mains transformer T2 is rectified by the metal rectifier MR1 to a pulsating d.c. current. MR1 should not be rated at less than 40mA and, in fact, a 50mA rectifier would be most suitable.

Another winding on the mains transformer supplies 6.3V to the three valve heaters and also to the dial lamp.

C10/11 is a dual electrolytic capacitor, 32+32µF 350V. C10 is the smoothing capacitor working in conjunction with the smoothing choke (L3), while C11 is the reservoir capacitor.

L1 and L2 to the required frequencies.

R1 and VR1 form a potentiometer between h.t. positive and negative. The voltage tapped off at the slider of VR1 is applied to the cathode of V1 and thus controls the amplification of this stage.

### The Output Stage

The output stage uses an EL32 pentode valve. C7 is a 0.01µF 350V capacitor which couples the audio frequency signal at the anode of V1 to the grid of V3. It is important that this capacitor be reliable as a slight positive voltage on the EL32 control grid would prevent the receiver functioning normally.

C8 is a 0.01µF 450V paper capacitor fitted across

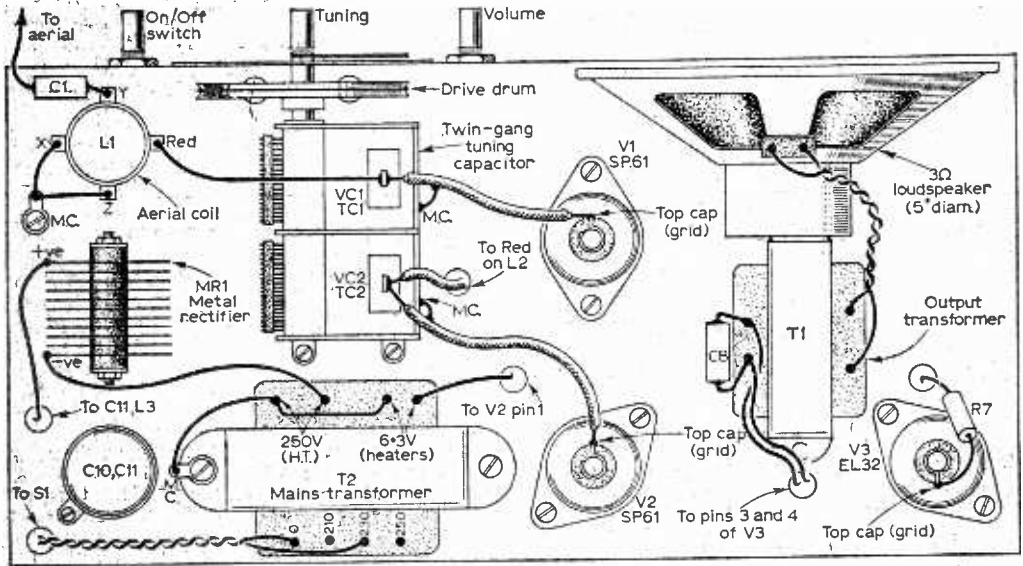


Fig. 2: The layout of the larger components, most of which are mounted on the top side of the chassis.

the secondary of T1 in order to reduce the high note response, since this is rather excessive with pentodes, while at the same time it helps to cut out heterodyne whistles due to neighbouring stations on medium waves—which can otherwise become quite objectionable, particularly after dark when many more Continental stations are received at good strength. T2 is a standard output transformer—it provides an anode load for V3 and the secondary matches a 3Ω loudspeaker. A 5in. diameter loudspeaker unit should be satisfactory.

**Chassis and Construction**

A chassis about 6in. by 12in. with 2½in. runners would be a convenient size. It is recommended that the main components be to hand when marking the chassis for drilling.

The construction is fairly straightforward and the beginner should have no difficulty if Figs. 2 and 3 are followed with care. Ensure that all solder joints are good. All leads must be kept reasonably short and should also be well separated as far as possible.

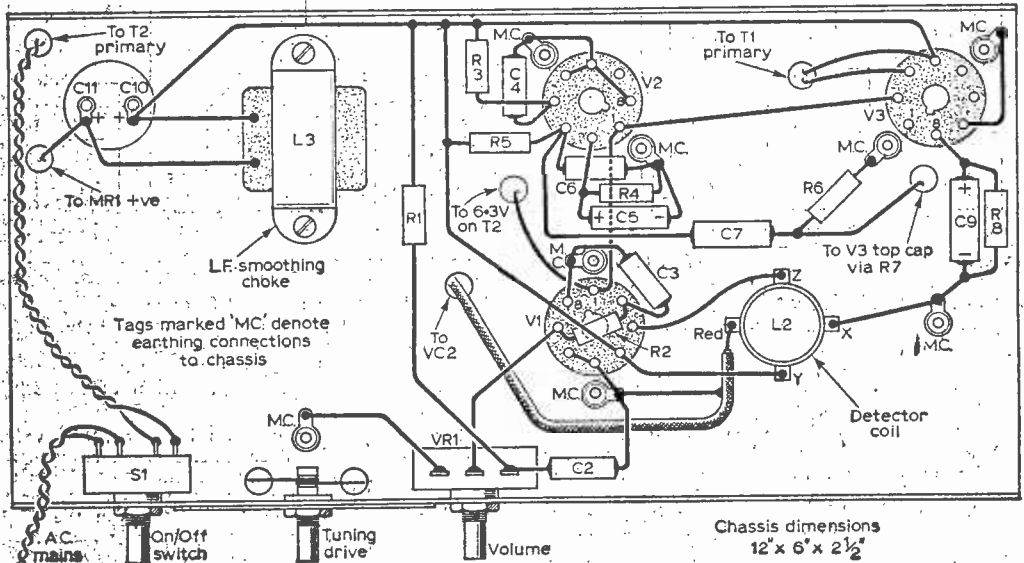


Fig. 3: The underchassis wiring.

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Famous Autochanger or Single Player Units supplied with brand new, two-tone, de-luxe portable cabinets, 17 x 15 x 8 1/2 in. Strong carrying handle, gilt finish clips and hinges as used by famous make for 22 gu. model. Ready cut, out motor board, 14 x 1 1/2 in. Front baffle 7 x 4 in. High flux loudspeaker and 3 watt amplifier. Amplifier ready built on metal chassis with output transformer, volume and tone controls. All items fit together perfectly. Special instructions enable assembly in 30 minutes. Only 5 wires to join. 12 months' written guarantee. Available separately or package deals as below.

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<b>Single Players</b>			
E.M.I. Autostop .....	£5.7.6	P.P. 4/8	
Garrard S.R.P.10 .....	£5.7.6	P.P. 4/8	
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B.S.R. 4 H.P. ....	£12.0.0	P.P. 5/-	
Philips A.G.10/18 .....	£12.0.0	P.P. 5/-	
Garrard A.T.6 .....	£10.5.0	P.P. 5/-	

● **SCOOP!** 10in. Speakers by W.B. of Mansfield. Magnet flux density 12,000 lines gauss. Die-cast chassis. Finish Anodic Gold. A beautiful hi-fi Speaker in maker's carton. Fully Guaranteed. O.T.R. price 3 ohm 42/6, 15 ohm 45/6. P. & P. 1/10. Please send for our complete Speaker List. Our prices the most competitive in the trade.

### FACTORY FRESH

● **SCOOP!** Top Quality Recording Tape (1/- per tape, 6 or more post free).

5in. Std. 600ft. ..	8/6	4in. O.P. 600ft. ..	9/-
7in. Std. 1200ft. ..	12/6	5in. D.P. 1200ft. ..	15/-
5in. L.F. 900ft. ..	10/-	3 1/2in. D.P. 1800ft. ..	22/8
5 1/2in. L.F. 2400ft. ..	12/6	7in. D.P. 2400ft. ..	25/-
7in. L.F. 1800ft. ..	15/-		

### TRANSISTOR SECTION

● **SCOOP!** A First Class 2 waveband (L.M.) superhet chassis, 6 transistor. By world famous manufacturer. Fully built, aligned, tested. Guaranteed. O.T.R. price £4.4.0 only. Suitable speaker 350 ohms, 10/6. A cabinet can be supplied for 22/6 only. Hundreds of satisfied customers. Ideal for the car and picnics. P.P. 2/8.

● **SCOOP!** The Famous Handbox 2 waveband (L.M.) transistor Car or Caravan Radio. Brand new in maker's carton with maker's guarantee. Size 8 x 5 x 2 1/2 in. Large speaker. S/M tuning. In beautiful pastel colours. Uses PFG battery. List price £8.15.0. O.T.R. price £4.10.0. While stocks last. This is a winner. P.P. 2/8.

● **SCOOP!** The Wiltonia—Pre-assembled for only 75/- P.P. 2/6 extra. Real call carrying case and earpiece included free of charge. Six transistor superhet miniature personal radio. Ferrite rod aerial. I.F. frequency 470 Kc/s. 3in. speaker. Printed circuit 2 1/2 in. Slow motion drive. In beautiful plastic case, size 4 x 2 x 1 1/2 in. In order to ensure perfect results the Wiltonia is supplied to you with R.F. and I.F. stages. Driver and output stages ready built with all compartments mounted on the printed circuit. The Wiltonia pre-assembled can be completed in half an hour with no soldering and tools whatsoever.

● **SCOOP!** "NOTON" Seven Transistor 2 waveband. Brand new design. For car radio and general purpose giving 1 watt output when connected to any standard 5 ohm speaker. All parts available separately. Size 7 x 6 x 1 1/2 in. Building plans 9/6 (Free with kit).

This versatile unit has been designed to fit into a variety of cases, and all components down to control knobs and battery clips are supplied together with clear illustrated plans. It gives a superb performance with dozens of stations including Luxembourg when connected to a 9-volt battery and speaker. Only £8.15.0 complete. P.P. 2/6.

● **SCOOP!** "NOTON" Mains Power Pack Kit for Transistor Radios. Boosts and generally extends life of old batteries, in attractive two-tone plastic case. Assembled in one hour. Miniature size, 4 x 2 x 1 1/2 in. Normal output 9 v, 100mA. Full mains transformer. Full wave germanium diodes. Cartridge fuse. Runs radio direct from mains. Complete kit with plans 83/-, P.P. 1/6. Ready Assembled 42/-, P.P. 1/8.

● **SCOOP!** Transistor Tape Recorder. The best obtainable, by very famous manufacturer. Brand new, boxed and guaranteed. Reduced from 12 gns. Now 27.10.0, complete with microphone, tape, batteries and operational booklet. P.P. 3/8. Features four transistor push-pull amplifier, two motors, single switch operation, pause, speed, wind/rewind, record/playback. Can be used in any position, indoor or outdoor.

● **SCOOP!** 1964 Radiogram Chassis. STEREO, 3 wavebands (L.M.S.), 5 watts per channel. 6 valves, latest Mullard, A.C. 200/250 v. Ferrite aerial. Glass dial, horizontal winding. Size 13 x 4 1/2 in. Aligned and calibrated. Isolated chassis size 13 1/2 x 9 in. high x 5 1/2 in. deep. 12 months' Guarantee. Product of national manufacturer. Brand new and boxed. OUR price £14.6.0 while stocks last.

● **SCOOP!** Car Aerials. Wing mounting, 3 section, heavily chromed. Complete base seal, leads and all fittings supplied. Brand new in manufacturer's carton. OUR price 21/- only. List price 45/-.

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● **SCOOP!** 17in., £11; 14in., 27. 12 months' fully written guarantee. Channels for all areas. Insured. Carr. 14in., 20/-; 17in., 30/-. These TV sets are ex-Rental, already well maintained. We regun tubes ourselves. Valves and parts are manufacturers' surpluses. ALL SETS have a written guarantee covering valves, tubes and components.

Remember we are Agents for the Full Range of Brittmore Empress Radiogram Chassis with full stock always available. PLEASE SEND FOR DETAILS.

OUR LISTS 1/- CREDITED AGAINST YOUR ORDER



# L.K. ELECTRONICS

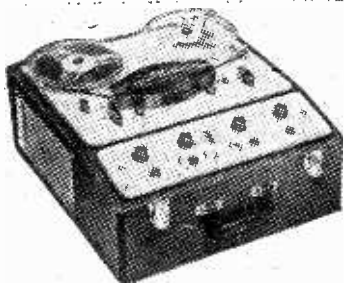


27 OLD BOND STREET, LONDON, W.1.

The cheapest, the best, the quickest service

If not advertised it is still in stock

MAIL ORDER ONLY — TO THIS ADDRESS PLEASE

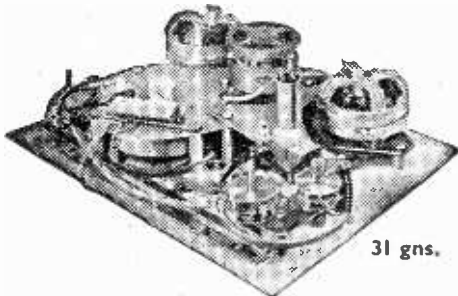


69 gns.

**The new**  
**Mark 5 Series 2**  
**TAPE RECORDER**

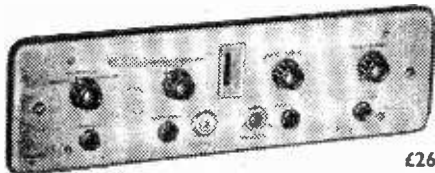
... with this specification:

4 speeds 1½, 3½, 7½ and 15 ips—frequency correction at all 4 speeds—3 independent motors—exceptionally low 'wow and flutter' content—double-gapped ferrite erase head to minimise erase noise—narrow-gapped record/playback head to give extended frequency response—pause control—superimpose control—recording level indicator (meter extra)—takes 8½ in. dia. reels—fast rewind (1200ft. in 45 seconds)—digital rev. counter.



31 gns.

... and the MARK 5 Series 2 deck for 8½ in. reels.  
(and the MARK 510 Series 2 deck for 10½ in. reels.)



£26

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Write or phone for  
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CDS90

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We manufacture a complete range of all types of cabinets at very competitive prices. Please give exact dimensions of cabinet required. We will also make to your design.

**LINE OUTPUT TRANSFORMERS**

BUSH TV26	17/6 ea.	} Post and Pack. 3/6 each
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PHILIPS 1446 U, 1458 U	17/6 ea.	
McMICHAEL MP14	17/6 ea.	
SOBELL T346	17/6 ea.	
SCAN COILS for above Models 10/- ea. P. & P. 3/- ea.		

**RECORD PLAYER AMPLIFIERS**

**2 WATT AMPLIFIER.** A compact unit with tone and volume controls. With valves (PCL82, PY82) on a board complete with 6/2 transformer and 6in. speaker. Crisp reproduction. Absolutely ready to play. **ONLY 39/6**, plus 2/6 P. & P.  
**4 WATT AMPLIFIER.** Valve line up 6BR7 or EF80, E1.84, EZ80. Fitted with volume, bass, and treble lift controls. Absolutely complete. **ONLY £3.12.6**, plus 4/6 P. & P.

**PORTABLE TRANSISTOR RADIOS**

**QUALITY 6 TRANSISTOR RADIO**, giving sparkling reception on medium and long waves. Good tone from 3in. speaker. Socket for car aerial. In robust, stylish case in mixed colours. **£6.15.0**.  
**DE LUXE VERSION** of above with 5in. speaker **£7.7.0**. Either set plus 2/6 post and packing.

**TURRET TUNERS for:—**

EKCO 221, 231	FERGUSON 204, 206, 306
PHILIPS 1446U, 1458U	McMICHAEL MP14
PYE V4, V114, V117, CTM4.	

ALL AT 7/6-EACH P. & P. 2/6.

**COMPLETE 14 TV SETS—Untested**

Choice of **PYE, PHILIPS, EKCO** and **SOBELL**, well packed—but at owners' risk. **£2 EACH**, plus 10/- carriage and packing.

**VALVES EX-EQUIPMENT TESTED & GUARANTEED**

EB91	2/-	EZ80	4/-	PY80	3/6	6X5	4/6	7V4	5/-
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EBF89	4/6	KT36	7/-	PY82	3/6	6F12	2/6	6BW7	4/-
EC851	3/6	PC84	4/-	PY83	6/-	6F13	6/-	14G7	10/-
EF782	4/-	PC80	4/-	EG50	7/-	6F14	5/-	30F5	5/-
EC885	5/-	PC82	4/6	EG5	6/-	6F15	6/-	35Z3	5/-
ECH45	6/-	PC182	5/-	U26	6/-	6F19	6/-	35Z4	5/-
ECH42	6/-	PC183	5/8	U91	7/-	6L1	7/-	30P11	7/-
ECH51	6/-	PC184	6/8	U91	9/-	6L19	6/-	PL12	5/-
ECL82	6/-	PL33	7/-	CA42	5/-	6P25	5/-	30P13	6/8
EF83	4/6	PL26	6/6	UC41	5/-	6P28	6/-	30F11	7/-
EF91	2/6	PL1	5/8	UC84	7/8	7B6	6/-	950L2	7/-
EL33	5/-	PL82	4/-	UC180	7/8	7C5	6/-	R19	6/8
E1.84	6/8	PL83	5/-	UF42	2/6	787	10/-	30CD6	16/-
EY31	3/-	PY22	7/8	8C9	10/6	787	6/-	6CD90	12/-
EY36	4/8	PY33	7/8						

EF80 in a batch of 12 for 20/-. ECL30 in a batch of 6 for 20/-. Postage and Package is 6d. on each valve.

**TV TUBES**, all ex equipment set tested, CRM141 17/6 ea. MULLARD 14 in. tubes of all types, AW and MW. All 17/6 ea. P. & P. 10/-.

**SPEAKERS EX EQUIPMENT**, 5 in. 5/-, 7 in. x 4 in. 6/-, 6 in. 6/6. 8 in. 7/-, P. & P. 1/6 each.

**JAG ELECTRICS & CABINET MAKERS LTD.**  
2c Church Street, Slough, Bucks.  
TRADE INQUIRIES INVITED

Mount the following items in the order given:

- (a) The valveholders.
- (b) The coil L2.
- (c) The volume control and the on/off switch.
- (d) The mains transformer.
- (e) The smoothing choke.

Complete as far as possible all the under-chassis wiring, leaving suitable lengths of wire to run to the upper side of the chassis to the output transformer, the V3 grid cap and to the dial lamp.

**COMPONENTS LIST**

**Resistors:**

- R1 180k $\Omega$
- R2 220 $\Omega$
- R3 3.3M $\Omega$
- R4 4.7k $\Omega$
- R5 470k $\Omega$
- R6 470k $\Omega$
- R7 10k $\Omega$
- R8 270 $\Omega$   $\frac{1}{2}$ W
- All  $\pm 10\%$ ,  $\frac{1}{2}$ W, except where otherwise stated.
- VRI 5k $\Omega$  wire-wound potentiometer.

**Capacitors:**

- C1 0.01 $\mu$ F paper 750V
- C2 0.01 $\mu$ F paper 350V
- C3 0.01 $\mu$ F paper 350V
- C4 0.01 $\mu$ F paper 350V
- C5 25 $\mu$ F electrolytic 25V
- C6 500pF mica or ceramic
- C7 0.01 $\mu$ F paper 350V
- C8 0.01 $\mu$ F paper 450V
- C9 25 $\mu$ F electrolytic 25V
- C10 32 $\mu$ F } dual electrolytic 350V
- C11 32 $\mu$ F }
- VC1 500pF } twin gang, with trimmers TC1,
- VC2 500pF } TC2.

**Valves:**

- V1, V2, 6X4, V3, EL32

**Inductors:**

- L1 Medium wave aerial coil (Wearite PA2)
- L2 Medium wave h.f. coil (Wearite PHF2)
- L3 Smoothing choke 10—20H, 50mA

**Transformers:**

- T1 Pentode output transformer, to match 3 $\Omega$  loudspeaker
- T2 Mains transformer with tapped primary. Secondaries: 0—250V 50mA; 6.3V 1.5A

**Other Circuit Components:**

- MRI Metal rectifier, 250V 50mA
- S1 Double-pole, on/off switch
- LS1 Loudspeaker, 5in. diameter, 3 $\Omega$  speech coil.

**Miscellaneous:**

- Chassis, dial drive drum and pointer. Knobs, nuts, bolts, etc.

Mount the main components on the upper side of the chassis and complete the wiring above and below.

The wiring should be carried out throughout with insulated wire and all chassis fixings (marked "MC") should be to solder tags screwed on with the main components.

The polarity of the electrolytic capacitors and the metal rectifier MRI must be carefully observed when wiring in these components.

**Setting Up and Alignment**

When the set has been plugged in to the mains rotate the gang capacitor until the BBC Light Programme (247m) is heard. The maximum signal

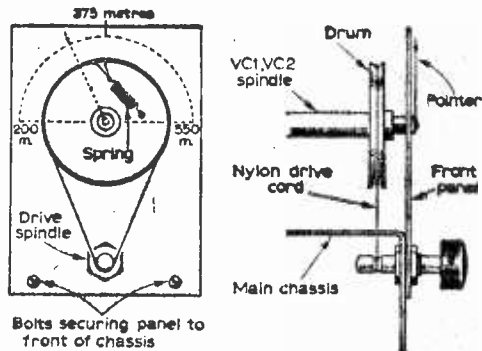


Fig. 4: A suitable dial for the receiver, with details of the tuning drive.

and volume can then be obtained by the adjustment of the trimmers TC1 and TC2. For best results the aerial that is intended to be normally used should be attached to C1 during the alignment procedure.

**Cabinet and Dial Construction**

Fig. 4 illustrates a suitable dial and tuning drive design. The necessary calibrations can be made during and after the alignment procedure. The metal plate of the dial is bolted to the chassis and the drive cord passes through two suitably placed holes in the chassis upper.

A pleasing, but simple, cabinet can be constructed from 5-ply 1/2in. board with a pegboard back which will allow sufficient ventilation. When the cabinet has been constructed it can be painted or covered with a suitable adhesive plastic sheeting.

**"JUNIOR" Crystal + I**

—continued from page 1174

not marked) try reversal for a few seconds only at a time. Some diodes appear reddish at one or both ends due to a copper seal in the glass. Ignore this coloration.

**Simple Theory of the Circuit**

The rectified d.c. from the rectifier is now used to cause base current to flow from the base of the OC44 transistor to the emitter. This in turn causes a larger collector current to flow from collector to emitter. This flow is the amplification of the transistor and the current will depend on the signal picked up.

The end of the coil D could be connected to the battery plus line but R1 and R2 (bias resistors) are ready connected for future use and so end D is taken to their junction. The capacitor C2 bypasses the r.f. signal to earth (battery+). The 2.2k $\Omega$  collector resistor R4 limits the transistor currents to a safe value but may be omitted if high resistance phones are used.

Next month the design will be further developed and the transistor utilised to provide both r.f. and a.f. amplification.

# BOOKS REVIEWED

## ABCs OF COMPUTERS

By Allan Lytel; published by W. Foulsham & Co. Ltd.  
128 pages, 5½ ins × 8½ ins. Price 16s.

TO the uninitiated the seemingly incredible tasks the modern computer can perform are as bewildering as its physical appearance is forbidding—a huge metallic carcass with electronic entrails beyond the comprehension of ordinary man. Many take one look, from a safe distance, then walk away convinced that the mysteries of the computer are entirely beyond them.

It is just for such people that Allan Lytel has written *ABCs of Computers*. This is a basic introduction to the subject and the author's teaching experiences have obviously been applied with good effect in the planning of the book. First published in America, this book will be very useful to the British reader, since the basic principles of computer technique are similar in both countries.

The whole field of computer activity is covered, as suggested by the title. After a general description of digital and analogue computers the electronics each employ are broken down to their fundamentals and the operation of these basic circuits is explained. Then follows information on components, numbering systems, logical circuits, calculating circuits, information storage, etc.

A final chapter deals with the subject of Programming—this is the procedure that has to be carried out before a computer can be put to work on a particular task. Perhaps a fitting subject to conclude with, for this frightening monster is at last cut-down to size; it cannot think for itself and is dependent upon us humans after all!—*F.E.B.*

## PRINCIPLES OF FEEDBACK DESIGN

By G. Edwin and Thomas Roddam; published by Iliffe Books Ltd. 238 pages, 5½ ins × 8½ ins. Price 45s.

THIS is a book for the design engineer who wishes to obtain practical guidance in respect of the problems that have to be solved when designing feedback amplifiers. This particular aspect of circuit design has assumed considerable importance with the increasing use of automatic control systems. To design the rather sophisticated wide-band amplifiers incorporated in these systems, a rather fuller understanding of the principles of feedback is demanded than if one were only concerned with the application of feedback in ordinary audio amplifiers.

The first part of the book deals with the application of feedback to simple amplifiers and shows how the response can be easily determined before the amplifier is built. The second part deals with signal flow diagrams, the analytical approach and the use of feedback amplifiers as

cut-off filters. How a knowledge of basic principles can assist the understanding of closed loop systems in general is discussed in the final chapter.

Feedback is dealt with at a rather more advanced level than that found in the normal textbook, but without delving so deeply into the mathematical treatment as the very advanced works on this subject. As might be expected from these two "old hands", the authors have produced a polished and lucid text.—*D.B.*

## STEREO FOR BEGINNERS

By B. J. Webb; published by Miles Henslow Publications Ltd  
118 pages, 5½ ins × 8½ ins. Price 7s. 6d.

SOONER or later every recorded music devotee is faced with the problem—mono or stereo. Those already possessing a hi-fi equipment and previously quite contented with the quality of reproduction become assailed with doubts and wonder whether they should convert to stereo. Others about to purchase or build up a sound reproduction system from scratch must, of course, resolve any doubts on this subject one way or the other before making the initial purchase.

What is stereo? Is it just a gimmick, is it worth while in a small room, does the end effect justify the additional cost? These are the kind of questions likely to perplex many who enjoy and appreciate good music and drama but who have little or no knowledge of the technicalities involved in the reproduction of sound from radio, disc or tape sources.

Mr. B. J. Webb has set out to explain what is implied by the term stereo and illustrates how stereo can give added pleasure to the serious listener.

The scene is set with a short history of stereo and explanations of the differences between single-channel mono and twin-channel stereo. Then, each link in the chain of the reproducing apparatus is discussed and considered from the various points of view such as expense, size of listening room and other personal factors. Examples of typical commercial amplifiers, speakers, pick-ups and turntables are given. Since this book is directed to those who are musical enthusiasts first and foremost, and who are concerned with the ultimate sound output rather than with the methods whereby this is achieved, technicalities have been kept to a minimum but guidance is provided regarding the salient features one must look for in commercial equipment and the more important terms and expressions quoted in manufacturers' sales literature are explained sufficiently adequately.

While the emphasis is, understandably, on reproduction from gramophone discs, information concerning tape recording and experimental stereo transmission by the BBC is also included.—*D.D.R.*



**HE-30 SUPER AMATEUR COMMUNICATION RECEIVER**



4 bands covering 550Kc/s to 30Mc/s continuous. Operation 200/240 volt. A.C. Special features include: Easy to read illuminated slide rule dial—Built in Q multiplier—Aerial trimmer—calibrated electrical bandspread on amateur bands—0-100 logging scale—noise limiter—AVC/MVC selector—stable oscillator and B.F.O. for clear CW and SSB reception—built in edge-wise "B" meter. Output for phones or 8" D speaker. Supplied brand new and guaranteed with manual. £42 carriage paid. S.A.E. for full details. Part exchanges welcome.

**HE-40 4-WAY BAND COMMUNICATIONS RECEIVER**

Junior version of HE-30 similar style. 550 Kc/s—30 Mc/s. Meter—A.Y.L. Bandspread—220/240 v. AC/DC. £24.15.0. Post Paid. S.A.E. for details.

**LAFAYETTE BRAND RECORDING TAPES**

First grade quality American tapes. Brand new and guaranteed. Discounts for quantities.

5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1200ft. D.P. mylar	15/-
5 1/2in. 1200ft. L.P. acetate	12/8
5 1/2in. 1800ft. D.P. mylar	22/8
7in. 1200ft. std. mylar	12/6
7in. 1800ft. L.P. acetate	15/-
7in. 1800ft. L.P. mylar	20/-
7in. 2400ft. D.P. mylar	25/-

Postage 2/- Over £3 post paid.

**ERSKINE TYPE 13 DOUBLE BEAM OSCILLOSCOPE**

Time base 2c/s—750Kc/s. Calibrators at 100Kc/s and 1Mc/s. Separate Y1 and Y2 amplifiers up to 5.5 Mc/s. Operation 110/230 volt A.C. Supplied in perfect working order. £27.10.0. Carr. 20/-.

**CV2193/89D. DOUBLE-BEAM C.R.T.**

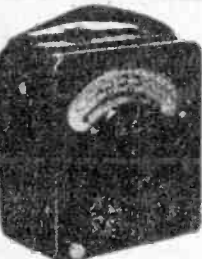
As used in Cosor 1035 scope etc. Brand new and boxed. 59/8 each. P. & P. 4/6.

**COSOR DOUBLE-BEAM OSCILLOSCOPE 1035**

4in. tube. Calibrated Y1 amplifier from 50mV to 30V. Bandwidth 10Mc/s. Calibrated Y2 amplifier from 5V to 300V with bandwidth up to 100Kc/s. Directly calibrated X shift providing time measurements from 15 microseconds to 150 milliseconds. Supplied in guaranteed perfect condition. £37.10.0 each. Carr. 30/-.

**NATIONAL H.R.O. RECEIVER**

**SENIOR MODEL.** Supplied complete with full set of nine coils covering 50Kc/s to 30Mc/s. Each receiver thoroughly checked before despatch and available as follows:  
**Table Model.** Good used cond. £19.19.0  
**Rack Model.** As new cond. £22.10.0  
**Rack Model.** Good used cond. £18.18.0  
**A.B.—Rack model** is identical to table model with extended front panel to fit a 19in. rack. Carriage £1 extra.  
 200/250 volt A.C. power supplied for all above receivers, also sold separately 59/6, carr. 5/- S.A.E. for details.



**MINE DETECTOR No. 4A**  
 Will detect all types of metals. Fully portable. Complete with instructions. 39/8 each. Carr. 10/- Battery 8/6 extra.

**SILICON RECTIFIERS**

SCR. 400V. P.I.V.	
4.7 amp. . . . .	7/6
200V. P.I.V.	
6 amp. . . . .	5/6
800V. P.I.V.	
500mA . . . . .	5/6
400V. P.I.V.	
500mA . . . . .	3/6
70V. P.I.V.	
1 amp . . . . .	3/6

**0A20** miniature silicon rectifiers, 1/- each. Discounts for quantities. Please add postage.

**UNIVERSAL AVOMETER MODEL "7"**

50 ranges. Guaranteed perfect working order. Supplied complete with leads, batteries and instructions. £11 each. Registered post 5/- extra.



**CLEAR PLASTIC PANEL METERS**

By Aronval Movement Jewelled Movements. 1 1/2" dia. Square Front. 1 1/2" Overall Behind Panel. 1 1/2" Dia. Panel Hole. Accuracy 2% of Full Scale. Silver Dials, Black Numerals and Pointers. Front Zero Adjustment. All types moving Coil. Individually boxed and guaranteed. Available as follows:

10mA . . . . .	22/6	50V. DC . . . . .	22/6
50mA . . . . .	22/6	100V. DC . . . . .	22/6
100mA . . . . .	22/6	150V. DC . . . . .	22/6
200mA . . . . .	22/6	200V. DC . . . . .	22/6
500mA . . . . .	22/6	600V. DC . . . . .	22/6
50-0-50mA . . . . .	22/6	750V. DC . . . . .	22/6
100-0-100mA . . . . .	27/6	15V. AC . . . . .	22/6
300mA . . . . .	27/6	50V. AC . . . . .	22/6
1mA . . . . .	22/6	150V. AC . . . . .	22/6
		300V. AC . . . . .	22/6
		500V. AC . . . . .	22/6

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# TEST GEAR accessories

## Part 3

BY C. MACKAY

CONTINUED FROM PAGE 1095 OF THE MARCH ISSUE

**T**HE cathode follower is a device which employs 100% negative feedback and therefore cannot amplify. The reader may begin to wonder why it is ever used at all. The reason is that although it has a very high impedance input it has the ability of being able to work into almost any output impedance. It could, therefore, be described as an impedance transformer.

When using an oscilloscope in the examination of low-level phenomena the high input impedance is very important and necessary, but if there is a high degree of amplification inside the 'scope the hum picked up from the mains wiring by the test leads may be so extensive as to mask any other low-level signals present. If the test leads were connected to a low impedance, pick-up of hum is

Fig. 9: The circuit of the cathode follower probe unit.

virtually eliminated. The cathode follower, therefore, fulfils the requirements of having a low output impedance while retaining a very high input impedance.

### A CATHODE FOLLOWER PROBE UNIT

It is now proposed to give full details for the construction of a cathode follower probe unit. The theoretical circuit is given in Fig. 9. It will be seen that a simple attenuator has been included which gives a 10:1 reduction ratio. If this is not required it could easily be omitted.

Fig. 10: A suitable power supply circuit for the probe unit.

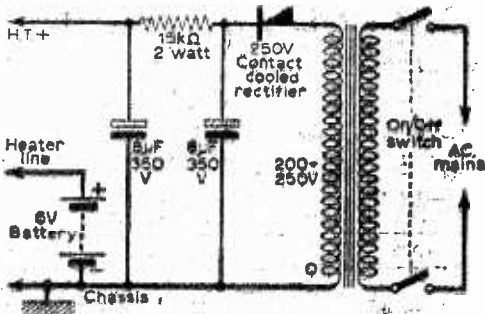
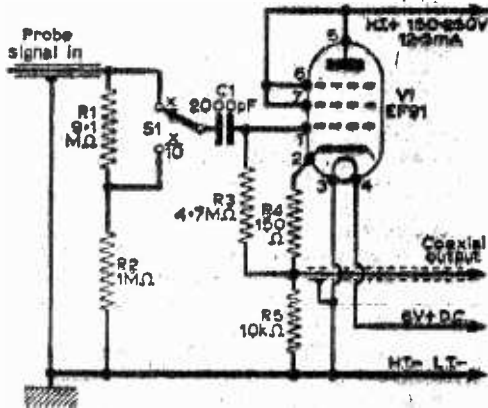
Power supplies required are 150-250V d.c. at about 12.5mA and 6.3V at 0.3A. In order that no hum should be induced inside the unit a 6V battery was used for the heater supply, while h.t. was derived from a small workshop power unit:

If a power supply is available from the

oscilloscope then this should be used. On the other hand, if the reader wishes to make a small power pack a suitable circuit which may be cheaply constructed is shown in Fig. 10.

### BUILDING THE PROBE UNIT

The probe unit was built inside an old cylindrical i.f. transformer screening can and it



would seem very likely that most constructors have some old screening can which would do.

The size and shape of the screening can is unimportant so long as all the components can be comfortably mounted inside. The author's screening can was 2½ in. in diameter and 3½ in. high with a twist-on base. Inside, a circular piece of paxolin 2 in. in diameter was mounted about 1 in. above the base on pillars. A ¼ in. hole and other smaller holes were drilled in the centre of the

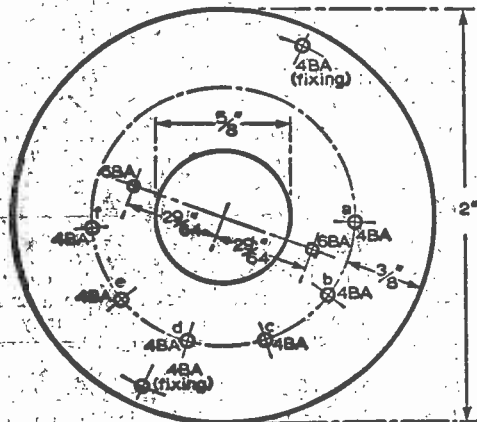


Fig. 11a: (above) Drilling details of the paxolin panel; 11b (right) complete wiring diagram of the probe.

paxolin to take the valveholder as in Fig. 11a and the components were mounted on the valve side of the paxolin in a manner similar to that used for printed circuits as shown in Fig. 11b. In fact a printed circuit could have been used effectively and this method of construction of the probe unit is well worth investigation by the experimenter.

The actual probe part was constructed in exactly the same manner as that used for the detector probe (see last month's issue). The attenuator switch used was a two-pole, two-way wave-change switch, although only one pole was

#### COMPONENTS LIST FOR CATHODE FOLLOWER PROBE UNIT

- R1 9.1 MΩ (or 4.7 MΩ ± 4.3 MΩ in series)
- R2 1 MΩ
- R3 4.7 MΩ
- R4 150 Ω
- R5 10 kΩ
- C1 2,000 pF ceramic
- S1 1 pole, 2 way (see text).
- V1 EF91 Mullard.

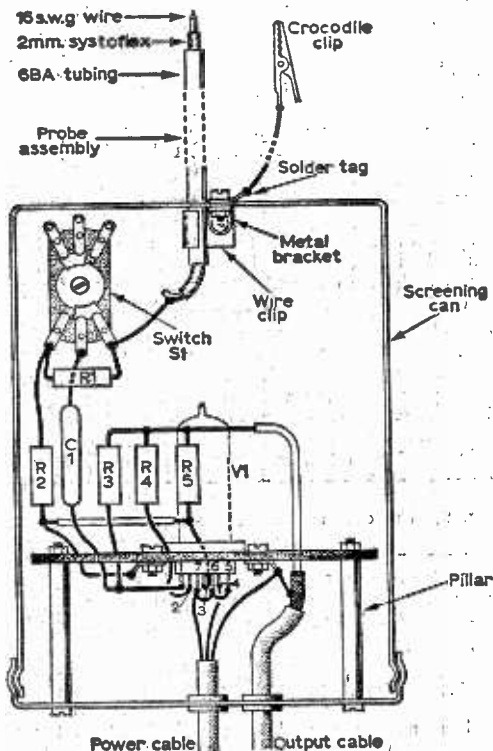
#### Miscellaneous:

- 1 B7G valveholder, 16 S.W.G. wire (about 6 inches), 2mm. Systoflex (about 6 inches), 4 inches of copper or brass tubing to take 6 B.A. studding, 2 yards of coaxial cable, 6 yards of single flex OR 2 yards of 3-way flex, 1 crocodile clip, 1 wire retaining clip, 1 Meccano right-angled bracket, 1 screening can (see text), Nuts, bolts, solder tags.

required, since this type of switch did not project out into the can and thus did not interfere with the other components. The switch was mounted well up on the can as near the probe as possible. The connecting cables are passed through suitable holes in the base. The output to the oscilloscope consists of a length of coaxial cable. Several (say six) ventilation holes should be drilled to keep the unit cool and a length of flex, terminating in a crocodile clip, should be attached to a solder tag on the top of the can.

#### OPERATING INSTRUCTIONS

The unit is connected to the oscilloscope and to the power pack. The clip is attached to the chassis of the instrument under examination and the probe



is used as if it were an ordinary test probe. The unit gives a reduction of the input voltage by about one part in 40.

No hum is either induced within the probe unit or picked up from outside the unit.

There is no phase shift or phase distortion and the unit shows no distortion of waveform at 10 Mc/s.

The completed unit is very reliable, sturdy and efficient. Note that the output voltage to the oscilloscope has a d.c. component which is normally removed by the isolating capacitors of the oscilloscope.

Next month Part 4

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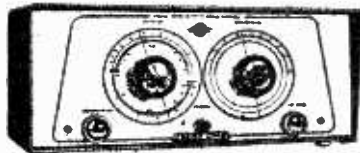
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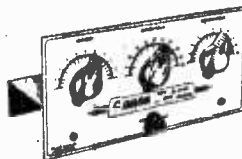
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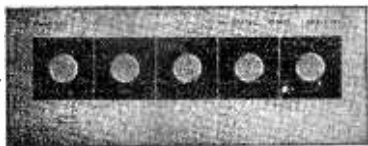
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# this “j” business

To those with but a limited knowledge of mathematics, the operator “j” encountered in textbooks, is a quite mysterious and deterring character. This article sets out to explain in simple terms the meaning of “j” and how it makes circuit calculations easy.

By Roy Hartkopf

**M**OST of us, when we think of numbers, usually think in terms of things. The figure 5, for instance, conjures up thoughts of five people, or five apples, or five radio sets waiting to be repaired. Because of this it is only natural that, when we think of manipulating numbers, we instinctively think of manipulating things. Five minus three raises in our minds the vision of three of our radio sets repaired and returned to the customers and only two remaining. And so on.

The limitations of this way of thinking about numbers starts to show up when we come to negative (or minus) quantities. We can imagine five radio sets minus three, but how about five radio sets minus six, leaving one minus radio set. Silly, isn't it. It's bad enough trying to visualise negative quantities at any time, but when we open a book on radio theory and find that this “j” which is often referred to is, not only a minus quantity but the square root of a minus quantity, we are likely to give this “imaginary” quantity away as being well beyond the limits of our particular powers of imagination. Try to imagine what the square root of minus one radio set looks like!

What most of us overlook, and what teachers of mathematics seldom seem to get round to explaining, is that there isn't really one mathematics, but a whole host of them, and in each one the numbers and symbols and processes, such as addition, multiplication etc., all have slightly different shades of meaning. At the moment we are concerned with two of the varieties. For want of better names we could call them the “Mathematics of Things, and the “Mathematics of Measurement”.

The Mathematics of Things is the kind of mathematics we have already mentioned. It is concerned with things like apples and people and radio sets, and is oldest kind of mathematics known to man. All of us know this mathematics and can use it without trouble, and there is no need to explain it further.

The Mathematics of Measurement, however, although it uses the same numbers and symbols and processes, is actually a far more sophisticated business, and only began when man had learnt to

cultivate the soil; and the ownership of land and the exchange of commodities had begun. Let us compare the mathematics of measurement and the mathematics of things, and see how different they really are despite their superficial resemblance to each other.

### *Distinction Between Things and Ideas*

The first fact we discover is that numbers, like one, two, three etc., have a distinctly different shade of meaning in the mathematics of measurement to their meaning in the mathematics of things. One man or one apple or one radio set is an exact description of quantity. It means exactly, precisely and definitely one. But in the mathematics of measurement, one inch or one gallon or one mile hasn't got the same kind of meaning at all. One can draw two lines and say they are an inch apart as near as can be measured, but who can say they are absolutely and definitely and exactly one inch apart? And anyway what is one inch? It isn't two lines on a piece of paper, it isn't even the piece of paper between the two lines. It isn't anything which we can see or feel or weigh. In short, an inch is not a thing at all. It is an idea which exists in our minds, and which we can use to help to explain the world around us. So the first great difference is that the one mathematics deals essentially with things, while the other deals with ideas.

This fact enables us to do, in the *mathematics of measurement*, what would be impossible and absurd in the *mathematics of things*.

If we chop a radio set in half we cease to have a receiver at all in any sensible meaning of the word. But if we chop an inch in half, the two bits are exactly the same kind of thing—that is, length—as the original inch was. If we divide our radio set into enough bits we will finish up with a collection of molecules and atoms which have completely lost every trace of their original radio character. But we can go on dividing a length indefinitely without its ever ceasing to be a length.

Even when we do simple addition there is a subtle but very distinct difference. In the mathematics of things, we can add three radio sets to two radio sets and have five radio sets: In the

mathematics of measurement, however, when we add three inches and two inches we don't really have five separate inches, but we get *one* length of five inches. So while it may be a kindergarten howler to say five ones make one, it would be quite correct to say that *five* lengths of *one* inch make *one* length of *five* inches. So, next time junior tells that five ones make one, don't laugh. He may be quite right!

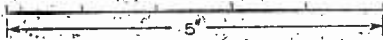
When we come to subtraction, and minus quantities, the differences between the mathematics of things and the mathematics of measurement really begin to show up. Suppose we have five radio sets and take three away. Three from five, leaves two. Suppose we have a length of five inches and take three inches away. Again three from five leaves two. The situation is exactly the same, or is it? It might appear to be until we ask what has happened to the things which were taken away.

In the case of the radio sets we must literally have taken three away; sent them back to the customers, or dumped them on the local rubbish tip or broken them up. But what about the three inches which were "taken away"? They've completely disappeared, not a whisker or even a smell is left. Lewis Carroll, who when he was not writing children's books, was Charles Dodgson, a professor of mathematics at Oxford, must have had this kind of subtraction in mind when he wrote about the Cheshire Cat gradually disappearing until only the grin was left floating in the air. This is typical of the kind of paradox we can get into when we start thinking of ideas as if they were actual things.

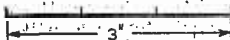
**Negative Quantities**

In the example of subtraction given above, it is at least possible to do it in both cases. But what if we have five radio sets and try to subtract six. We immediately get into the realms of absurdity. One just can't have minus one radio set consuming minus a couple of hundred watts and occupying a negative amount of space. True, we often speak of negative quantities of things in the sense that we may owe somebody a set which isn't in stock. But, here again, we are really dealing with measurement of amounts, and are no longer working with the mathematics of things.

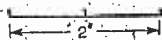
Although we can't make sense of subtracting six radio sets from five, we can make very real sense of subtracting six inches from five inches. The best way to explain this is to begin by drawing a diagram of what happened when we subtracted three inches from five inches. We began with five inches, like this,



Then we subtracted three inches, which looked like this,

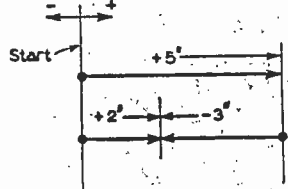


and we finished with two inches, which looked like this.

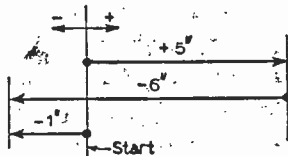


If we had actually "taken away" three inches, they ought to be lying in a little pile in the corner.

But they aren't. So the only way we can really make sense of the subtraction is to consider the five inches as a *distance in one direction*, and the minus three inches as a *distance in the opposite direction*. So what we are really doing is not subtracting at all but **ADDING** a positive distance (which is a distance in one direction) to a negative distance (which is a distance in the opposite direction). Looking at things in this way we can draw a diagram like this.

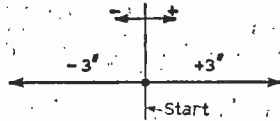


And now, when we try to subtract six inches from five inches we don't have the slightest trouble. We finish up with minus one inch and our diagram looks like this.



The minus one inch, simply means that we've finished up in the opposite direction to that in which we first started.

Let us take another example as shown in the sketch below.



Here we have a diagram showing plus 3in. and minus 3in. separately. What is the difference between them? Simply that they are going in the opposite directions. Now we know in mathematics that if we multiply a number such as 3 (plus 3; that is!) by a minus quantity we get a minus answer. For instance  $3 \times -1 = -3$ . But we have just seen that the only difference between 3 and -3 is that they are going in opposite directions. So multiplying a quantity by a minus quantity means "swinging" it round to the opposite direction. For instance in multiplying 3 by -5 we are really doing two things. We are swinging the 3 round so that it goes in the opposite direction, and becomes -3 and then we are "stretching" it to five times its previous length.

Both of these processes would be meaningless in the language of the mathematics of things, but make common sense in the mathematics of measurement.

**An Operator**

When used in this way in multiplication, the minus sign is no longer a symbol for mere subtraction. Its meaning has been changed and extended

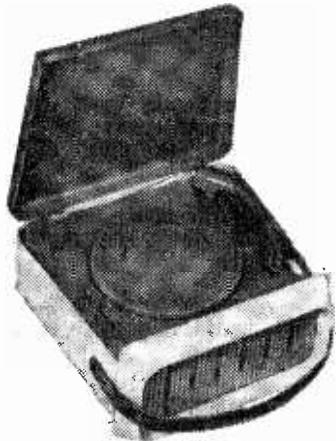


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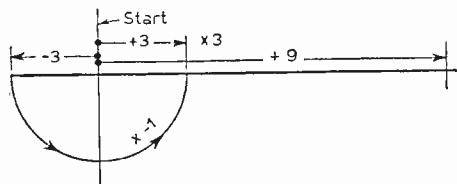
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until it would more accurate to call it an "operator", that is, a symbol which "operates" on a quantity to change it.

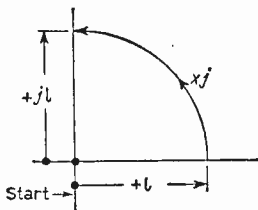
This, of course, doesn't apply to length alone. It applies to any measurement we like to think of. A negative electric current, for instance, doesn't mean a kind of ghostly counterpart of a "real" current. It simply means a current flowing in the opposite direction to the direction which we have chosen to call positive.

This explanation also makes sense of the business of multiplying a minus quantity by another minus quantity, a thing which many people find confusing. What actually happens can be illustrated by the sketch below. The example shows  $-3 \times -3$ .



What really happens is that we begin with a minus 3, that is three units in the direction opposite to the one we call "plus". Multiplying this by  $-1$  swings it round to the opposite direction, which, in this case is the plus direction. In addition, the 3, now plus 3, is stretched three times making it into plus 9. From this we can also see that, regardless of what direction we start with, each time we multiply by a minus, we swing our length round to the opposite direction. So multiplying something by  $-1 \times -1$  has exactly the same result as multiplying by  $+1$ , and that, of course, is the same as leaving it alone.

There is, by the way, no fundamental reason why we should choose a direction to the right as being positive, or assume that the line is swung round in an anticlockwise direction. These conventions are a kind of mathematical rule of the road to prevent the confusion which would be caused by everyone using different conventions. In mathematics, as in life, one thing leads to another. Having found that the minus sign is an operator which swings a length round to the opposite direction, there seems no reason why we shouldn't have operators which swing the line, say, only half way round, like this. Call this operator "j".



Why should the symbol "j" have the property of swinging the length through  $90^\circ$ ? Simply because we have decided it should be so. We define j as an operator which would swing a length through  $90^\circ$ .

This method of approaching a problem highlights the fundamental difference between working with things and working with ideas.

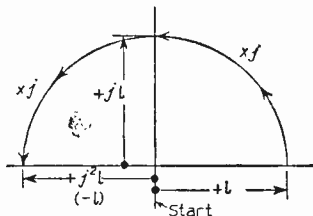
**Black Boxes**

If we are repairing a radio, we don't pick some unidentified "black box" component and say, "This is going to act like a smoothing capacitor" and promptly solder it across the h.t. supply. If we did anything like this it would be likely to have disastrous results, because the thing has physical properties which are quite independent of our wishes.

But when we are dealing with ideas, we do exactly the opposite. We pick up the first "black box" which is handy and say "this has certain properties" and forthwith "solder" it into our general scheme of ideas. Then we try to find out what relationship it has to the rest of the system, and thus get some idea of its other properties.

In the case of j, the only thing we know is that by definition, it swings a length anticlockwise through  $90^\circ$ .

But because this is so, we can immediately see that multiplying again by j must swing our length anticlockwise through another  $90^\circ$  like this.



When we look at the direction of the  $j^2 \times l$ , we find it is identical with  $-l$ . So our definition of j results in the conclusion that multiplying by  $j^2$  has exactly the same effect as multiplying by  $-1$  and therefore  $j^2$  must be equal to  $-1$ . Thus, by simple arithmetic, j must be equal to  $\sqrt{-1}$ . And that is where we come to a full stop, because in the mathematics of things there is "no such animal". But in the mathematics of measurement the limitations don't apply. We have already seen that  $-1$  is not always a quantity, but is sometimes an operator; and exactly the same thing applies to  $\sqrt{-1}$ . It is in fact better to think of it not as  $\sqrt{-1}$  but as "operator j".

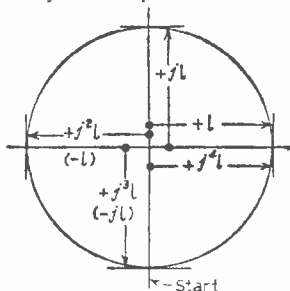
There is, actually, a very good reason why j must have a value like  $\sqrt{-1}$ , something which is not a quantity in any sense of the word. The  $\sqrt{-1}$  acts as a label which prevents us from being able to add quantities at right angles to each other by any simple addition. In the same way, we have to label distances on maps as being 10 miles North by 6 miles East. We can't just add the two, and say that 10 miles North + 6 miles East is 16 miles North-east.

**A Direction Label**

We often hear j referred to as an imaginary quantity. It seems a silly description. One might just as well say that the direction North is an imaginary quantity. The fact is that they aren't "quantities" at all. They are direction labels which give the mathematics of measurement the

ability to work with direction as well as with distance.

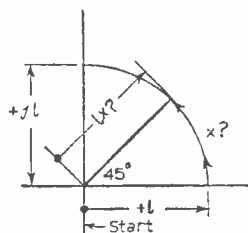
The great advantage of  $j$ , from a mathematical point of view, is that although it is a direction label like North, it can be treated mathematically, as though it were a number. It can be multiplied, divided, squared, and all the rest, and always give a useful and sensible result. Take for instance  $j^2$  and  $j^4$ . The sketch below shows how these values fit into the general scheme of things without conflicting with any of our previous assumptions.



This is where we use the fact that  $j = \sqrt{-1}$  and, therefore that  $j^2 = -1$ . The  $j^2l$  becomes simply  $-l$ , which is the opposite direction to  $+l$ . And the  $j^3l$  becomes  $j^2 \times jl$ , which is simply  $-jl$ . Again,  $-jl$  is the direction opposite to that indicated by  $+jl$ . Finally multiplying four times by  $j$  brings us back to the start and mathematically we have  $j^4l = j^2 \times j^2l = -1 \times -1l = +l$ .

So it all adds up.

Our  $j$  notation will not only define directions at right angles to each other, but, if we wish it, also directions in between. Take for instance the line at  $45^\circ$  in the sketch below.



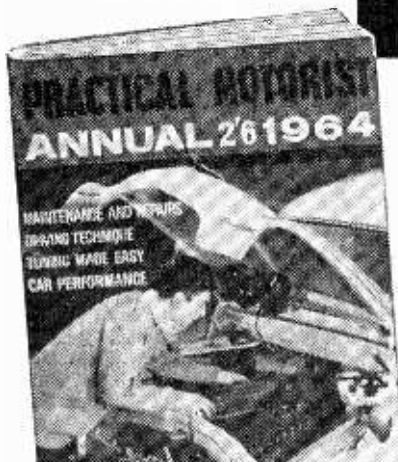
Let us use our previous technique and take a block box "operator C" and say that  $+C$  swings our line through  $45^\circ$ . Then  $C^2$  will be our line. If we multiply by  $C$  again we will bring our line round to  $90^\circ$ , which is  $jl$ . So we see that  $C^2 \times l$  equals  $jl$  and  $C$  is equal to  $\sqrt{j}$ . In this case we can forget about  $C$  because  $\sqrt{j}$  is the same thing and saves up introducing another symbol. Those who are familiar with indices will know that  $\sqrt{j}$  is often written as  $j^{1/2}$ . But that is another story.

In short, by using powers of  $j$  we can specify any distance and direction we like, and swing lines round mathematically in different directions without having to draw complicated graphs and charts.

Next month we shall consider how operator  $j$  can be used to our advantage.

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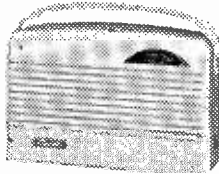
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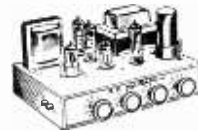
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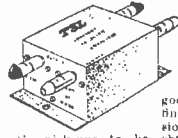
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**CLIFTON AMATEUR RADIO SOCIETY**

Hon. Sec.: J. Rose, G3OGE, 63 Broomfield Road, Beckenham, Kent.

The evening's programme for those members who attended the meeting of February 21st, was provided by a "Voice of America" tape recording.

**DERBY AND DISTRICT AMATEUR RADIO SOCIETY**

Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover, Derby.

Always an enjoyable event for members of this Society, the annual dinner and dance was this year held on February 15th and as usual proved to be a great success.

**LIVERPOOL AND DISTRICT AMATEUR RADIO SOCIETY**

Hon. Sec.: H. James, G3MCN, 448 East Prescott Road, Knotty Ash, Liverpool 14.

On 11th February members had the opportunity to comment on the future plans of the Society. A week later on the 18th, G3PLX and G3PPN delivered a lecture and discussion with "v.h.f." as their subject.

The last meeting of February was held on the 25th which was an open evening.

**MELTON MOWBRAY AMATEUR RADIO SOCIETY**

Hon. Sec.: D. W. Lilley, G3FDF, 23 Melton Road, Asfordby Hill, Melton Mowbray, Leicestershire.

This Society's activities for February included a demonstration of amateur radio on the 5th and listening to an R.S.G.B. recorded lecture on the 20th. At the amateur radio demonstration, the Rev. A. W. Shepherd operated G3NIB/A. The lecture on the 20th was recorded by W. H. Allen under the title of "Two Metres".

**MITCHAM AND DISTRICT AMATEUR RADIO SOCIETY**

Hon. Sec.: A. Thurley, G3SQJ/T, 50 Bruce Road, Mitcham, Surrey.

Proposed alterations to Society rules were among subjects on the agenda of the Annual General Meeting held on Friday 14th February.

**NORTHERN HEIGHTS AMATEUR RADIO SOCIETY**

Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.

This Society is achieving good attendance figures for all its meetings. At a recent meeting on February 19th, Mr. F. C. Luxton gave a talk entitled "Accidents in the Shack" which included mention of electrical faults.

March 4th apart from being a ragchew evening for most members, was also a committee meeting night.

**OXFORD AND DISTRICT AMATEUR RADIO SOCIETY**

Hon. Sec.: B. Green, G3PMI, 3 Barnet Street, Ifley Road, Oxford.

Meetings of this Society are held on the second and fourth Wednesday of each month, beginning at 7.30 p.m. An R.A.E. course is currently being given for unlicensed members, who can also attend a slow morse class which is being run.

**PRESTON AMATEUR RADIO SOCIETY**

Hon. Sec.: W. K. Beazley, G3RTX, 9 Thorngate, Penwortham, Preston, Lancashire.

Prospective members are invited to any of the Club meetings which are held on the second and fourth Tuesdays of each month. A programme of interesting talks has been arranged for these meetings which commence at 7.30 p.m.

**READING AMATEUR RADIO CLUB**

Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook Road, Reading, Berkshire.

Contests were under discussion at the February 29th meeting of this Society, when members met to decide on a programme for Club participation in the competitions of 1964.

**ROTHERHAM AND DISTRICT RADIO CLUB**

Hon. Sec.: J. W. Howe, G3NXZ, 18 Laburnum Grove, Conisbrough, Doncaster, Yorkshire.

New members will be welcomed at Club meetings which are held on alternate Fridays, at the new Club room at the T.A. Centre, Fitzwilliam Road, Rotherham.

**SALOP AMATEUR RADIO SOCIETY**

Hon. Sec.: K. E. Jones, G3RRN, Greystones, Shrewsbury Road, Church Stretton, Shropshire.

This newly-formed Society reports that it has recently been issued with a Club call sign—G3SRT—and that its membership has risen to 40.

Society events during February have included a film show which was given on the 13th.

**SCARBOROUGH AMATEUR RADIO SOCIETY**

Hon. Sec.: P. B. Briscoe, G8KU, "Roseacre", Irton, Scarborough, Yorkshire.

February began with a surplus sale on the 6th. On the 13th members discussed arrangements for the Society's effort in National Field Day this year.

A week later, G3NRI took for the subject of his talk, "Top-band Transmitters" which was followed on the 27th by a more general talk covering transmitters and receivers given by G3FVW.

March 5th was another surplus sale meeting.

**SOUTH BIRMINGHAM RADIO SOCIETY**

Hon. Sec.: T. W. Legg, Flat 3, 80 Alcester Road, Birmingham 23.

A general discussion followed the talk given by G2AGK on 20th February under the title of "30 Years of Amateur Radio".

**SPEN VALLEY AMATEUR RADIO SOCIETY**

Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Leeds.

On February 11th a group of members travelled to Bradford to hear a lecture given by Mr. G. N. Patchett entitled "Colour Television", February 20th was a junk sale.

On March 5th Mr. S. Marsden gave an interesting talk entitled "Moon Bounce".

**STOURBRIDGE AND DISTRICT AMATEUR RADIO SOCIETY**

Hon. Sec.: R. A. G. MacIntosh, 50 Field Lane, Old Swinford, Stourbridge, Worcestershire.

At the only meeting of this Society during February—the 11th—Graham Woolfenden accompanied the second of his talks entitled "Hi-fi Without Tears" with a demonstration.

**WEST KENT AMATEUR RADIO SOCIETY**

R. Trevitt, 28 Dales Avenue, Tunbridge Wells, Kent.

On February 14th members enjoyed a film show evening with films supplied by the Electricity Board. Members who attended the meeting for February 28th heard a talk given by D. Colwell entitled "Beginner's Approach to Hi-fi". Mr. Colwell also gave a demonstration of some equipment.

**P.W. LEADER COMPETITION**

Owing to the unexpectedly large numbers of entries for this competition, it has been considered necessary to hold over publication of the results until the next issue (May).

We would like to thank the very many readers who have sent along entries.

Winners will be notified individually by post.

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# Simple BASS BOOST Circuits

## MODIFICATIONS TO CONVENTIONAL FOUR-VALVE SUPERHETS

By M. L. Michaelis

COMMON tone-control circuits in simple four-valve superhets for medium and long waves are mostly either of the kind shown in Fig. 1a or as in Fig. 1b. Both of these circuits achieve "bass-boost" by reducing treble gain, not by increasing bass gain.

The circuit of Fig. 1a simply reduces treble gain when the tone control slider is at the C1 end, because VR1 and C1 then form a powerful voltage divider for higher frequencies. The available output power of the amplifier is not reduced in this arrangement.

In Fig. 1b full treble is allowed to pass through the amplifier, and develop power in the output valve. Unwanted treble power is then shunted to chassis via C2 and VR2 in the "bass" setting of VR2. This arrangement, as well as reducing treble gain, wastes power, thus reducing the available output power in the speaker in the "bass" setting. Thus the circuit of Fig. 1b, although popular, nevertheless often gives a very weak and muffled effect if any attempt is made to get strong bass in this way.

The circuit of Fig. 1a is also relatively weak, as it gives no increase of true bass gain.

This article now points out a very simple arrangement for tone control which gives true increase of bass gain: if desired, in very considerable amounts! It can easily be incorporated into the audio section of any conventional four valve superhet, the additional components required being merely a small 1.5 intervalve transformer and a few resistors and capacitors. There should be enough room to accommodate these components on the chassis of most existing receivers, in a conveniently close position relative to the valves concerned.

### Auxiliary Transformer Coupling for Bass Boost

Fig. 2 shows a typical example of the suggested modification carried out in a simple receiver in the author's possession. The ECH81 frequency changer stage and EF80 i.f. stage are not shown, as these are perfectly conventional and do not concern the subject of this article.

Before modification of this receiver, a tone control of the kind shown in Fig. 1b was present, which was removed: also R1 was returned directly to chassis and R2 went straight to R3. T1, VR1 (as new tone control) and C1 have been added during the modifications.

R2, C2 and R1 represent conventional resistance-capacity coupling between the two amplifier stages. This has now been augmented by an additional

transformer-coupled path between the two valves, which is operative only for really bass frequencies because of the large capacity of C1 shunting the high impedance secondary winding of the transformer. VR1 allows complete control, right from zero to maximum, of the amount of this additional bass injected into the bottom end of R1 and passed on to the 6V6 output stage. It thus serves as bass tone control.

### Variation of Characteristics

By variation of R2 in relation to the resistance value of VR1 and the step-up ratio of the trans-

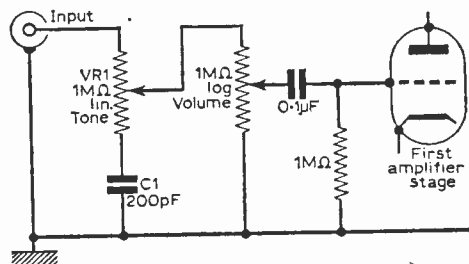


Fig. 1a (above): Simple treble-cut tone control at the input to an amplifier.

Fig. 1b (right): Treble-shunting tone control circuit at anode of an audio output stage.

former T1, the amount of maximum bass boost can be widely influenced.

If the resistance chosen for VR1 is divided by the turns ratio of the transformer and the result again divided by the value chosen for R2, then we get as final result the number of times that the bass across the track of VR1 is greater in amplitude than the pass passed-on via the resistance-capacity coupling.

In the example shown in Fig. 2 this is seen to be three times. R1 and the anode load (total) of the EBC41 valve then act as further voltage divider, to fix the maximum amount of this additional bass actually reaching the grid of the 6V6 output valve. The exact behaviour depends on the relative phasing between the two paths (resistance-capacity



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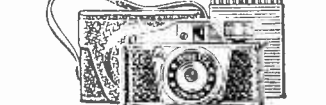
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152/14	Single	25-3500	15	30 or 75	22	14,000	186,000	Copper	15in.	13in.	9lbs.	14 gns.
152/14A	Dual	30-15000	15	30 or 75	22	14,000	186,000	Aluminium	15in.	13in.	9lbs.	15 gns.
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path and transformer path) coupling the valves, so that effects obtained when reversing one winding on the transformer (either one will do) should also be studied when experimenting with this circuit.

In the author's example shown in Fig. 2, conditions were such that about twice the total bass voltage reached the grid of the 6V6 than did without the modification (with VR1 slider at the top). This meant that bass power was increased by a maximum of four times.

**Transformer Resonances**

The behaviour of this circuit, with apparently the same circuit components, may be completely different for two different transformers. This is because C1 can resonate with the inductances involved in T1. If such resonances are present, the bass-boost will be even greater than would be

in the example shown in Fig. 2 (VR2, R4, R5). The overall characteristics can be modified by varying the phasing of the transformer relative to the negative feedback, and by altering the intensity of the negative feedback (e.g. try other values for R4 in Fig. 2).

**Amplitude Modulation Reception Only**

It should be emphasised that this circuit is specifically intended for normal medium and long-wave a.m. reception. It will here probably lead to full success in getting the "vintage model tone" out of modern receivers in this class where the "vintage model" fans felt the tone to be too shrill.

This circuit is unsuitable for good v.h.f. reception, where the full-range treble, absent in medium wave a.m. broadcasts, is transmitted. The circuit here discussed does not pay proper atten-

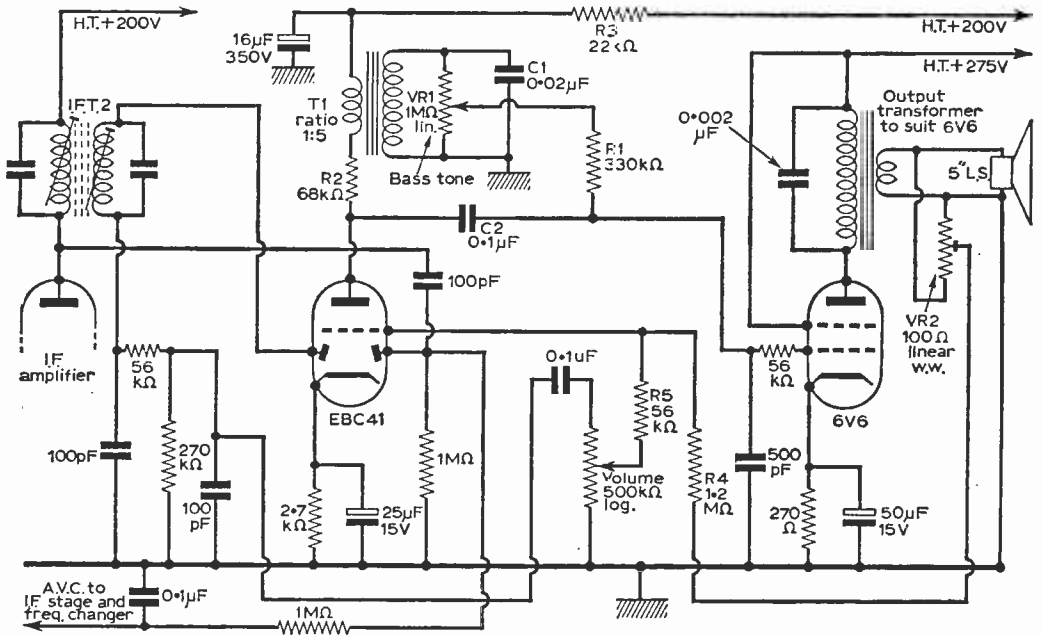


Fig. 2: A typical example of the type of bass-boost tone control discussed in this article.

expected along the lines just discussed.

If one aims to make C1 resonate with the transformer in the middle of the range of bass frequencies one desires to boost, i.e. those between about 50c/s and 200c/s which the straightforward resistance-capacity coupling reproduces "too weakly", and then chooses the resistance of VR1 such that this resonance is sufficiently damped to be effective over this frequency range, one can get a very pleasing effect. The "crossover" between the boosted bass-range and the unaffected middle and treble ranges is then quite sharp and well-defined, giving a sonorous bass without muffling of other frequencies.

Further factors to vary during experiments to get best results arise if the circuit already contained a negative feedback channel, as was the case

tion to such treble—in fact it plays havoc with it. Thus please confine experiments with this circuit to normal a.m. receivers.

The receiver modified in Fig. 2 contained a small Goodmans 5in. round speaker, and was housed in a medium sized wooden cabinet some 9in. x 12in. x 7in. deep. The degree of mellow bass impression obtainable even with this small speaker (after making the modifications discussed) was quite surprising, and even more noticeable on an extension speaker of larger size.

It must again be stressed that each case of a modification along the lines of this article must be individually trimmed. It is hoped that possible lines of experiment and direction of results produced by the various changes in question have been made sufficiently clear. ■

# T rade N ews

## Amateur Band Receiver

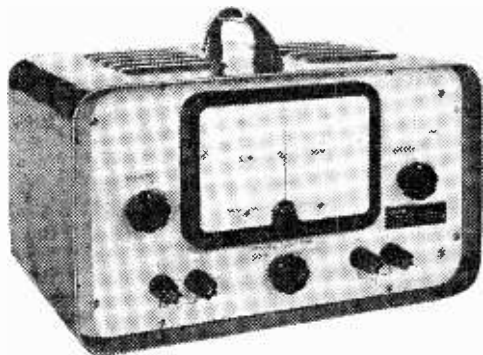
THE American firm of Hammarlund have introduced an improved successor to their well established type HQ-110 amateur receiver. The new receiver—type HQ-110A—incorporates a better degree of stability, both mechanical and electrical, as well as a number of new features.

The dual conversion superhet circuit employs 12 valves giving excellent image response, rejection and selectivity. Hammarlund receivers are marketed in the U.K. by *K. W. Electronics Limited, Vanguard Works, 1 Heath Street, Dartford, Kent.*



One of Hammarlund's latest amateur receivers, the type HQ-110A.

Apart from its primary purpose, the instrument will be found useful for making impedance measurements. The manufacturers are *Aero Electronics Limited, Gatwick House, Horley, Surrey.*



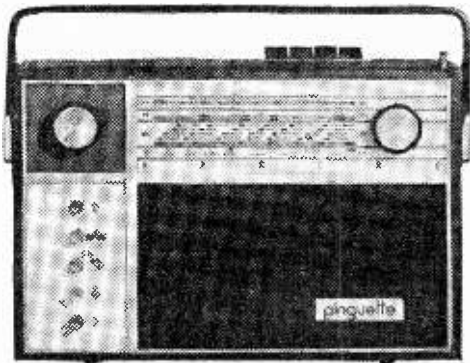
The new Component Comparator made by Aero Electronics Limited.

## V.H.F. Portable Receiver

THE "Pinguette 720" is a four waveband portable receiver made by the German firm Akkord, and is now available in the U.K. Long, medium, short and v.h.f. are the bands covered by the receiver and selection is made by push-button switches.

The 9-transistor circuit provides 1.5W output through a 4in by 7½in. loudspeaker. Included in the design is a telescopic aerial and an illuminated dial. Unusual features in a receiver of this size are the separate bass and treble tone controls.

The Pinguette 720 is available in a choice of cabinet colours at 39 guineas through the U.K. agents *Denham and Morley Limited, Denmore House, 173/175 Cleveland Street, London, W.1.*



This v.h.f. portable is made by Akkord of Germany.

## Component Comparator

AN instrument which will match or grade resistors or capacitors in terms of percentage deviation has been announced by Aero Electronics Limited. Known as the SCOBA R/C Component Comparator, it provides a direct reading from zero to either +20% or -20%.

In essence the instrument is a 50c/s bridge in which the degree of out of balance operates a meter calibrated in per cent. A resistance range between 100Ω to 50MΩ and a capacitance range from 10pF to over 12μF can be accommodated by the comparator.

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—continued on page 1206

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# LETTERS TO THE EDITOR

## GETTING TO THE POINT

**SIR.**—The other day while searching for an obscure component in a forgotten corner of the workshop, I came across a little device of yester-year which I thought some of your younger readers would be interested and amused to hear about.

It consists of a circular metal base about 2½ in. in diameter, to which is fixed a metal bracket. This bracket carries a 2 in. metal shaft which can pivot about its centre and can revolve along its length. At one end of this shaft is a small pulley wheel with a rubber tyre. The bracket carries another shaft, but this one is fixed in a horizontal position and on to it slides a metal "flywheel", which has a knurled knob attached to it so that it may be spun on the shaft. On the opposite face of the flywheel to the knob, is mounted a disc of glass-paper. Now when the flywheel is slid along the fixed shaft so that the glass-paper disc makes contact with the pulley wheel, revolving the flywheel will impart a reciprocal motion to the pulley wheel, which thus causes the free shaft to revolve. Ingenious to say the least, but the most remarkable thing about this device is (or was) its use which is, in fact, to sharpen fibre gramophone needles which were at one time in vogue.

Apparently in those far off days before diamond styli, the demand for gramophone needles was so great that these miracles of engineering were commonplace with audiophiles.

In use, the blunted needle was fixed in the free end of the revolving shaft, there to meet the glass-paper disc 180° away from the contact point of the pulley wheel. And here, as the abrasive disc whirled one way, the needle spun in a counter direction giving the little piece of fibre a new lease of life.

What a shame modern audio practices has made such wonderful inventions redundant. — B. C. BRETTON (Berwick-upon-Tweed).

## NOT SO MUCH PLASTIC PLEASE

**SIR.**—First let me say that no one admires the advanced design of present-day transistor receivers more than I. I do detest, however, the flimsy construction employed for the cabinets of all but the most expensive models. Plastic in all its many forms is a marvellous material, but as used in most portables it often proves to be little more than decorative as it cracks easily when

Whils: 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

dropped and is then practically impossible to repair. Even the chrome plated metal grills and adornments which are at present very popular, are usually only thin additions to a basically plastic case.

When remembering the all-dry portables of several years ago, despite their formidable weight they were always sturdy and able to withstand quite severe knocks. With a modern portable in my pocket I have a tendency to worry the whole time that it will suddenly come to grief against something more solid than its vulnerable cabinet.

Another design improvement I would like to see receiver manufacturers adopt, is the fixing of printed circuit panels by flexible mounts before they are attached to the outer case. This would give a degree of protection for the components even if the case itself suffers from a fall.—A. D. PARKINGSON (Plymouth, Devon).

## TOO MUCH OF A GOOD THING

**SIR.**—We are not all aspiring Beatles you know: though by the contents of recent issues of P.W. it would seem as though half the radio construction enthusiasts in the country are about to forsake their communication receivers and twist and shout their way through twenty watts of guitar amplification. Of course it's good to know that my favourite magazine is keeping its finger on the pulse of things, but with echo chambers, metronomes, guitar pick-ups, tremolo units and guitar amplifiers turning up regularly in the past year or so's issues, I sometimes feel that Liverpudlian readers of P.W. are getting more than their fair share of attention.

Further as a reader who has never been within a hundred miles of Merseyside, I would remind you that there are other musical instruments besides the guitar which can benefit from the application of electronics. How about a bagpipe amplifier, for instance; yeah, yeah, yeah.—J. F. JAMESON (Edinburgh).

## EX-GOVERNMENT COME-BACK

**SIR.**—After the war years I, along with thousands of other kindred spirits, revelled in the flood of service equipment which burst on to the radio construction market. Inevitably however, this flood has lessened to a stream, and seemingly this stream could eventually trickle dry.

There seems to me, however, that there is one

gleam of hope for ex-government fans. We are always being amazed by the statement which usually accompanies the announcement of new acquisitions for one of the three services that the missile, tank, warship, or what have you, is out of date before it is put into service. This is due no doubt to the fantastic speed of development in engineering these days, and it is most often reported when the R.A.F. acquires a squadron or two of new fighters.

Well then, if this becomes the rule throughout all the industries supplying the services I, as an ex-government addict, look forward to the day that sees the radio shops being flooded with surplus equipment only a year or so old yet already outdated. Long live progress. — C. L. HARPER (Oxted, Surrey).

### FILM SHOW APPRECIATION

SIR,—I count myself very fortunate to have been among the audience of this year's PRACTICAL WIRELESS Film Show. The lecture on colour television was most enlightening and interesting. The second half of the programme on ultrasonics, not to mention the tea and sandwiches—helped to make it a very enjoyable evening.

I am already looking forward to next year's show.—S. J. KENT (London, S.E.25).

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

. . . the issues of P.W. concerning the conversion of the No. 19 set.—C. RICHARDSON, 27 Cauldwell Lane, Monk-seaton, Whitley Bay, Northumberland.

. . . the details of converting the R.220 reception set to receive local amateur and BBC transmissions.—P. JACKSON, 36 Ashton Court, Lillington, Leamington Spa, Warwickshire.

. . . the December 1962, January, February, March and April 1963 issues of P.W.—S. H. JONES, Wayside, 23 Holly Road, Uttoxeter, Staffordshire.

. . . service information, circuit diagram, etc., of the Smith's Radiomobile car radio, model 4260 (control unit) and

amplifier and power pack type A, Ref. 46028B.—R. A. C. WARD, 21 Woodfield Drive, East Barnet, Hertfordshire.

. . . the base connections of the war surplus c.r.t. type 10E/759.—K. PARTRIDGE, 73 Cavendish Road, Sunbury-on-Thames, Middlesex.

. . . the circuit diagram of the R.1155 receiver. I would refund postage costs.—G. M. SCHOLLES, P.O. Box 72, Zomba, Nyasaland.

. . . the circuit and any aerial details for the R.220 Mk.II receiver.—C. WARNER, 7 Hester Close, Hightown, Liverpool.

. . . information on the R.3118 receiver.—689040 A/A Strange, M., M.3 Apps. Wing, J. E. Squad, R.A.F., Locking, Weston-Super-Mare, Somerset.

. . . the manual of the Collins radio type R-278B/GR or T.O. 31R2-2GRC-27.—R. V. WRIGHT, 4A Nepal Avenue, Atherton, Manchester.

. . . the circuit or instruction leaflet of the "Costa Brava" three transistor receiver.—S. T. Wood, 259 London Road, South Benfleet, Essex.

. . . the July, August and September 1963 issues of P.W.—M. J. CHELL, 13 Hampden Road, Leicester.

. . . the circuit and any other information on the No. 38 Mk.II set.—D. H. GRAHAM, 20 Harrogate Crescent, Derby.

. . . the circuit and any information on the R.1132A receiver.—B. MILLWARD, 162 Hollydale Road, Erdington, Birmingham, 24.

. . . the handbook and/or circuit of the R.107 receiver.—P. H. PRICKETT, 31 Leopold Street, Loughborough, Leicestershire.

. . . the issues of P.W. giving data on the No. 19 set.—N. A. MORGAN, Heywood House, Denstone College, Uttoxeter, Staffordshire.

. . . all the issues of P.W. dealing with the Malvern tape recorder, except the July 1963.—T. E. SMITH, Lynton Lodge, Goose Lane, Little Hallingsbury, Bishop's Stortford, Hertfordshire.

. . . the issues of *Practical Television* following the July 1959 issue, which contain articles by R. W. Wells entitled "A Closed-circuit Colour TV System."—S. DAVIDSON, School House, School Road, North Berwick, East Lothian.

. . . the circuit and any data on the type 105A transmitter unit.—K. SHEEHAN, 406 Mourn Road, Drimnagh, Dublin 12, Irish Republic.

. . . any information on the wireless set No. 68T.—K. TAYLOR, 5 Park Avenue, Carsbalton, Surrey.

## TRADE NEWS

—continued from page 1202

circuit boards in an entirely new way. The normal process is to apply a large iron to the joint and extract the component while the solder remains a liquid. With such components as i.f. transformers, this process requires a specially designed bit to heat all the pins at once and the excessive heat used during the unsoldering can often cause damage to nearby components and also the printed circuit itself.

The new device—named the "Soldermaster"—consists of a small, high temperature iron with a hollow bit. Through this bit a vacuum (produced by an Austen pump) is applied to the soldered joint. The vacuum draws the solder as it melts through the bit into a "trap" from which the solder may be removed after the operation is completed.

With the vacuum pump turned off, the "Soldermaster" can of course be used as a normal soldering iron. The makers are *Charles Austen Pumps Limited, Petersham Works, High Road, Byfleet, Surrey*.

## SPECIAL PROGRAMME FOR RADIO FANS

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For details of the next programme, please refer to the "Radio Times".



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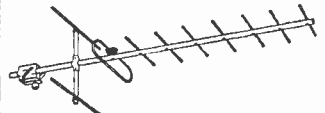
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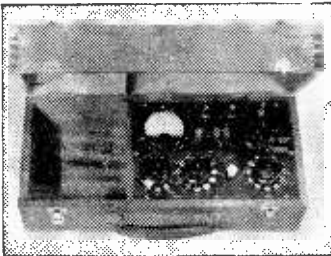
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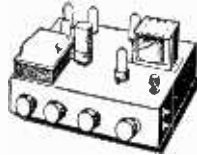
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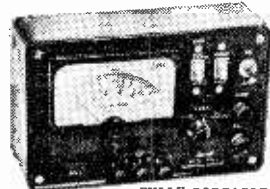
Will cut out mains interference with TV Hi-Fi, stereo, tape recorder or any Laboratory equipment, by providing perfect stabilized voltage supply.

- PERFECT PICTURE & RADIO RECEPTION

- PREVENTS DAMAGE BY POWER SURGES AND CUTS
- JUST PLUG IN
- ATTRACTIVE METAL CASE 8in. HIGH
- CAPACITY 250V.A.
- OUTPUT ACCURACY ± 1%

Ex stock. ONLY **£11.10.0** (Cart. 12/6.)

**TRANSISTOR TESTER**



**FULLY PORTABLE**

Measurement Ranges: Ico (Icbo) and the reverse current of diodes, PNP and NPN—0—50µA (1µA per scale). POWER—0—10mA (20µA per scale). 25-200 (3 per scale). Bias current—1mA on PNP and NPN. (5mA on POWER).

$$\alpha \approx 0.995 \left( \text{from } \beta = \frac{\alpha}{1-\alpha} \right)$$

Terminals: Spring Sockets and Screw Terminals Meter: 4in. 50µA moving coil. Size and Weight: 5in. x 4in. x 3in., 2 1/2lb. Powered by pen-cells.

MODEL AT-1 ONLY **£9.17.6** (Cart. 3/6)

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**MULTIMETERS**

Fully Guaranteed, brand new, boxed with test leads, batteries, instructions.

**LOWEST PRICES IN THE COUNTRY**

1,000 o.p.v. 0-15-150-1,000 v. D.C. and A.C. 0-150mA. D.C. Resistance 0-100K., 35/-, Post 1/6.

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Illustrated leaflet on request.

18,000 o.p.v. 25 range Multimeter kit, with Weston 0-50µA meter now reduced to 65/- post paid. Circuit etc. free for stamp.

**PLANET INSTRUMENT CO.,** 25, DOMINION AVENUE, LEEDS 7



EKCO L.O.P.T. Unused replacements for Perspex cased 1954 7 models, complete with E.H.T. rect., 39/-, unrepeatable.

CO-AX. low loss, 8d. 30ft., 25 vds., 11ft., 30 vds., 92ft., 100 vds., MW 3624 ditto, 39/-. P.P. 126f. The above are guaranteed for 6 months.

SPECIAL C.R.T. OFFER Due to huge Bulk Special Purchase we are offering MW 3174 Tubes at the unrepeatable price of 29/-. MW 3624 ditto, 39/-. P.P. 126f. The above are guaranteed for 6 months.

LOUDSPEAKERS. 3 1/2" Top Makers. 4in. 7/6 3 1/2" 8/6

CONNECTING WIRE P.V.C. Bright colours. Five 25ft. coils only 4/-

3 VALVE AMPLIFIERS Kit of new parts, consisting chassis, name and output transformers, valves (P1 6X500, 6X500) and all components. With full instructions for making high gain amplifier with separate bias and treble control, negative feedback, etc. Truly unusual value at 29/-

MAINS TRANSFORMERS Excellent Quality Guaranteed. 1 bright mounting, 100-0-250V 50mA, 5.5V 3.0 (800mA) 12/6. Ditto semi-shaded 9/6

13 CHANNEL T.V.s Table Models. Famous Sets. Absolutely Complete. These sets are un-rivalled in value due to huge purchase direct from source. They are untested and not guaranteed to be in working order. (Carr. etc. 13/-) £2.19.0 14in. £4.19.0

LEAK AMPLIFIER SNIPS Due to a fortunate Purchase we are able to make the following unrepeatable offers. All Amplifiers have fine matching Output Transformers (Transformers to match these Amplifiers to 15Ω Speakers can be supplied at 28/6 each.). TL12 WATT (slightly used) £15 TL25 WATT (new) £21 TL50 WATT (slightly used) £18 Pamphion 60 watt Amplifier, complete with pre-amp £29 (Note—These Leak Amplifiers all have the added facility of volume and tone controls so that they can be used without a pre-amp, if very high gain is not required.)

BULK BARGAINS ★ 12 POIS. Popular valves, 3K to 2 Meg. Unused, nice, present, long sp. switched, etc. 4/6 CONDENSERS. 25 Mixed. Electrolytic. Many popular sizes. 1st Value £5. Our Price 10/-

100 RESISTORS 6 6 Excellent. Sizes 1-3 watt.

100 CONDENSERS 9 6 Miniature Ceramic and silver Mica Condensers. 3 pF to 5,000 pF. 1.8V VALUE OVER £5.

25 TAG STRIPS 4/- 2, 3, 4, 8 way etc. Unused.

100 HI STABS 9 6 1% to 9%, 100Ω to 5MΩ.

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TRANSISTORS GUARANTEED TOP QUALITY Huge reduction. Red Spot standard L.F. type now only White Spot R.F. 2/- Mullard Matched Output Kits (OC81D and 2-OC81s) 12/6 R.F. Kits (OC44, OC45 etc.) 3 transistors. 12/6

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SILICON RECTIFIERS Guaranteed performance. Top Mkr. Tested 250V working. 100mA 250mA (3 for 9/6) 3/9 (3 for 19/6) 7/6

NEW SHOP SOUTHAMPTON Now Open in Large Premises WE LOOK FORWARD TO OFFERING YOU A FIRST CLASS SERVICE. Please note the address. 72 EAST STREET (Tel. 25851) With widest Stocks Kneest Prices: T.V.s. Radios. Valves. Transistors. Hi-Fi Equipment. Loudspeakers, Autochangers. Cables. Components, etc. 4/-

4 watt AMPLIFIER excellent amplifier with high gain preamp stage. 10F3 driving 10P14 output stage, complete with 8in. speaker. In attractive 2-tone case. Tone control negative feedback ready for immediate use. Individually tested. Amazing volume and clarity ideal for guitars, record players, p.s. in small halls, baby alarms, etc. Easily worth £5. Our price whilst stocks last. 47/6 Carr. Packings, etc. 4/-

ENQUIRIES WELCOMED Quantity Prices or Quotes for Items not listed, particularly rare valves. TELEPHONE C.O.D. ORDERS DISPATCHED THE SAME DAY.

★ GUARANTEED VALVES ★ by return of post THE MOST ATTRACTIVE COMPETITIVE VALVE LIST IN THE COUNTRY All valves are new and unused unless otherwise advised

POST 3 MONTHS FREE TRANSIT INSURANCE, Satisfaction or Money back Guarantee on Goods if returned within 14 days. 1 Valve 6d., 2-11 1/- FREE for 12 or more valves. In writing with order every valve.

Table listing various vacuum tube types and their prices. Columns include tube type, price, and other specifications. Includes types like 6X4, 6X5, 6X50, 6X500, 6X6, etc.

We supply from stock most of the components and items specified or circuits published in this and other magazines and radio books. Let us quote for your circuit, first grade components at realistic prices.

# MINIATURE 'SCOPE

MODEL CT84

Features 2½ in. DG7/5 Tube. Level 2dB, 50 c/s to 2 Mc/s. 3½ Sec. to 80½ Sec. Sweep. High sensitivity. Fully portable scopes. Ideal for all transistor and valve design or servicing. 22 to 30 volt D.C. operated.

**£16-10-0**  
CARRIAGE 7/6

### DEAC RECHARGEABLE BATTERIES

18 volt 100mA/H 4 x lin. diameter. Brand new sleeved, 30½. 3.9 volt 450mA/H, 12½. All types easily split into any multiple of 1.2 volt. Brand new.



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Multi-range test meters featuring easy to read scales and provided with full operating instructions, lead and batteries. Suitable for amateur, designers, repair shops, all domestic uses. Full details and specification in our catalogue.

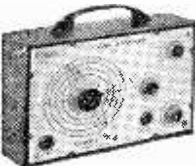
- ★ PT34 1 Kohm/volt ..... £2 5 0
- ★ MI 2 " " ..... £2 9 6
- ★ THL33 2 " " (illus.) £3 15 0
- ★ EP10K 10 " " ..... £4 9 6
- ★ ITI-2 20 " " ..... £5 5 0
- ★ TP55 20 " " ..... £5 19 6
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- Capacitor Box. Provides 9 standard values from 0.001 to 0.22 mfd at 600 volt working. 29½.
- Resistor Box. Provides 24 standard values at 1 watt, 15 ohms to 10 meg., 37½.

Each box fully calibrated with insulated leads. Invaluable for service and design.

### NOMBREX TEST EQUIPMENT



All transistor portable units supplied with full instructions.

LEAFLETS ON REQUEST

- ★ 150 Kc/s to 350 Mc/s generator. RF, Mod., AF, 8 ranges. Leads, batt., instructions, £9.10.0, P.P. 2/6.
- ★ Resistance/Capacitance Bridge. 1 pF to 100mF and 1 ohm to 100meg. leakage. PF Tests, with batt. and instructions, £8.5.0, P.P. 2/6.
- ★ Transistorised Power Supply. Gives any voltage 1 to 15 D.C. up to 0.1 amp. From Mains. £6.10.0, P.P. 2/6.
- ★ Audio Generator, 10 c/s to 100,000 c/s. Sine and square wave. With batt. and instructions. £16.15.0, P.P. 2/6.

### HI-FI SPEAKERS

- CX300 12 inch 25 watt ... 12 Gns.
- CR12AE 12 inch 20 watt ... 8 Gns.
- CR30AE 12 inch 20 watt triple range ... 10 Gns.
- BA7 8 inch 6 watt ... 79½
- 10 watt Horn Tweeter ... 29½

**TEST LEAD KIT** supplied in Pocket Pouch. Contains probes, leads, clips, etc. 8/6, P.P. 9d.

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Sin. 600ft. 12½; Sin. 900ft., 15½; 7in. 1,200ft. 18½; 7in. 1,800ft., 25½; 7in. 2,400ft. 27½. Excellent quality.

### 100 Kc/s QUARTZ CRYSTALS

- 2 Pin: Octal or 3 Pin.....15/- ea.
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  - 455 Kc/s (AR88).....12/6
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- (Over 600 Frequencies in Stock for all purposes. Catalogue on request.)

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- All Decks Complete with Cartridges**
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  - ★ Garrard Autoclim ..... £6 10 0
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  - ★ SRP10 4-speed or GU7..... £5 5 0
  - ★ Garrard AT6 with Stereo Cartridge ..... £10 19 6
  - ★ Collaro 2-track Studio Deck £10 10 0
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  - ★ Garrard 9V, 2-speed, 2-track Tape Deck ..... £11 15 0
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- Mini Ranger Personal Radio.....49½
  - Ranger-3 Personal Radio.....49½
  - Sinclair Slimline Personal Radio.....49½
  - Sinclair Micro-6 .....59½
  - Sinclair Micro Injector .....27½
  - Quintet M/LW-5.....79½, P.P. 2/6
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  - PW Shortwave 2 .....99½, P.P. 2/6
- Leaflet and details on request

**ALL PARTS IN STOCK FOR PW SHORTWAVE TRANSISTOR CONVERTER. As per Feb. Edition 1964.**

### CRYSTAL MICROPHONES

- Acos 39-1 Stick Microphone.....32½
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- Lapel/Hand Microphone.....12½
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- BM3 Stick with Stand.....49½
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- \*0.50µA (D.C.) 39½ \*0.5mA (D.C.) 27½
- \*0.500µA (D.C.) 32½ \*0.300V (D.C.) 27½
- \*0.1µA (D.C.) 27½ "5" Meter 35½
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- 1 mA D.C. Edge meter .....59½
- 3½ x 1 inch Front Panel.

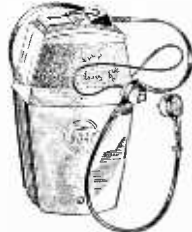
**POCKET SOLDERING IRON.** 30 watts. 220/250 volts A.C. Complete with pointed bit, mains plug, carry pouch. 14½. P.P. 1/6.

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- 2000 ohms 12½. 4000 ohms 14½.

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- Mono Stethoscope Types. Crystal 10½. Magnetic 12½.
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- Crystal Contact Microphone .....12½ P.P. 9d.
- 2K, ½-track Tape Head .....15½ P.P. 9d.
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- 4-Channel Transistor Mixer Unit .....59½ P.P. 1½
- Tape Jack Radio Tuner .....29½ P.P. 1½.

### BOAC VHF POCKET RECEIVERS



● Complete units with CS 5A VHF Detector, 5—V6/8R (OC44) Transistors, 3.9V, 450 mA rechargeable Deac battery 200—OA91, OA 10 rectifiers, 1Kohmstethoscope headset, moulded casing, etc.

- Complete Unit with Full Circuit 35½ P.P. 2/-
- OR DEAC BATTERY OR HEADSET 15½, P.P. 1/-
- Unit less DEAC & HEADSET 12½, P.P. 1½

### FIELD STRENGTH METER

Five channels cover 1 Mc to 200 Mc/s. Fitted 200 microamp meter for CW or RF. Indication and Earphone for A.F. Monitoring. Designed for checking all types of transmitters. Size 4 x 2½ x 2½ in. Complete. Ready to Use, with instruction and telescopic aerial, 69½. Post Free.

### RUN YOUR RADIO OR AMPLIFIER FROM MAINS BATTERY ELIMINATORS AND CHARGERS

1. For PP3 or equivalent 9 volt Pocket Radio Battery, 18½, P.P. 1½.
2. For PP4, PP7, PP9, 9 volt Portable Radio and Equipment. Supplies up to 300mA, 49½, P.P. 2/-.
3. De Luxe version of No. 1 also charges PP3 type batteries. 24½, P.P. 1½.

- Full range of Goodmans, WB and Eagle Speakers and Tweeters in stock.
- Stereo Hi-Fi Headphones, lightweight.....62½

## Henry's Radio Ltd.

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Open Monday to Sat. 9-6. Thurs. 1 o'clock.

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# Practical Wireless

# BLUEPRINT SERVICE

ALL of these blueprints are drawn full-size and although the issues containing descriptions of these sets are now out of print, constructional details are available free with each blueprint except for those marked thus (\*).

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London W.C.2.

## DOUBLE-SIDED BLUEPRINTS

Each blueprint in this series contains details of two separate instruments or items of equipment.

The Strand Amplifier ... ..	}	*	5/-
The PW Signal Generator ... ..			
The Savoy VHF Tuner ... ..	}	*	5/-
The Mayfair Pre-amplifier ... ..			
The Berkeley Loudspeaker Enclosure ... ..	}	*	5/-
The Luxembourg Tuner ... ..			
The PW Troubadour ... ..	}		7/6
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All-dry Three ... ..	PW97 3/6
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The PT Band III TV converter ... ..	1/6
The Mini-amp * ... ..	5/-
The PT Olympic * ... ..	7/6
The PT Multimeter * ... ..	5/-

## SOME EARLIER DESIGNS

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. The majority of the components for these receivers are no longer stocked by retailers.

Experimenter's Short Wave ... ..	PW30a	2/6
Midget Short Wave Two ... ..	PW38a	2/6
Simple S.W. One-valver ... ..	PW88	2/6
Pyramid One-valver ... ..	PW93	2/6
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A One-valver for America ... ..	AW429	2/6
Short-Wave World Beater ... ..	AW436	3/6
Standard Four Valve S.W. ... ..	WM383	3/6
Enthusiast's Power Amplifier ... ..	WM387	3/6
Standard Four Valve ... ..	WM391	3/6
Listener's 5-Watt Amplifier ... ..	WM392	3/6

## QUERY COUPON

This coupon is available until 7th April, 1964, and must accompany all queries in accordance with the notice on our "Letters to the Editor" page.

PRACTICAL WIRELESS, APRIL, 1964.

LATEST FULLY DETAILED AND ILLUSTRATED CATALOGUE COMPONENTS AND EQUIPMENT 2/- POST FREE.

NEW 8 PAGE VALVE TRANSISTOR CRYSTAL AND RECTIFIER CATALOGUE. 1/- POST FREE.

LOW PRICES—NEW TYPES OF TRANSISTORS AND SILICON RECTIFIERS—ALL TYPES FOR ALL PURPOSES.

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RESULTS WILL AMAZE YOU!



● **PREAMPLIFIER AND CONTROL UNIT.** For use with either of above amplifiers or valve amplifiers — Hum Free — High Sensitivity — 8 Inputs between 1.5mV and 300mV. For all pick-ups — Microphones, Tuners — Tape Replay. Separate treble and bass with cut and boost — 4 position Low Pass Filter — Volume etc. Panel size 9 x 2 1/2 in. Battery operated or from power supply.

● **CALL IN FOR DEMONSTRATION** ●

● **POWER AMPLIFIERS.** Two versions.  $\pm 1$ dB 40 c/s to 20 kc/s. 60dB Feedback. 100mV input and less than 0.25% distortion for 10 watts output. 3 and 15 ohm versions. Very low current. 6-Transistors and Rectifier.

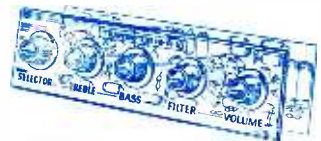
★ 3 ohm 10 Watt. **BUILT £5.10.0** P.P. 2/6.  
★ 15 ohm 10 Watt. **BUILT £5.19.6** P.P. 2/6.

★ **MAINS UNIT**—will run 2-amplifiers for 3 ohm and 15 ohm. 69/6, P.P. 2/6. Each type.

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COMPLETE CIRCUITS WITH FULL DETAILS ON REQUEST

PERFORMANCE EQUAL TO VALVE UNITS OF FOUR TIMES THE PRICE AND VERY MUCH LARGER.



★ Low Distortion.  
★ High Performance.  
★ Mains or Battery.  
★ Low Noise Design.  
★ Mono or Stereo.

Dark Brown and Gold Panel Plate. 8/6.

GUARANTEED HIGH PERFORMANCE UNITS.

● Generous Trade Discount. Send For Details.

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● Made by well known British manufacturer. Features ready built 4-transistor printed circuit 1 watt amplifier, elliptical speaker and volume control. Low current Star, constant speed 45 r.p.m. turntable with crystal pick-up. Strong moulded two colour cabinet with handle. Plays anywhere on long life 9 volt battery. Requires less than half an hour's work to connect up using ready built units and easy instructions.

**TOTAL COST 79/6** P.P. 3/6. (Battery 3/9).

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Complete in every detail. ● Pre-built units—Collaro Studio Decks—Portable Cabinets with speakers. 6 valve designs.

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**Total Cost £26** P.P. 8/6.

### FOUR TRACK

**Total Cost £30** P.P. 8/6.  
ALL AUDIOKITS IN STOCK

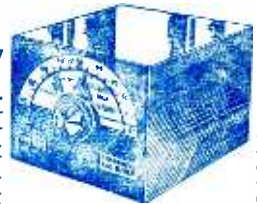
★ Leaflets on Request ★

## VHF FM TRANSISTOR TUNER

(As described in December 1963 Edition of "Radio Constructor").

★ 5-Transistor.  
★ 4 Diodes.  
★ Full coverage 87 to 105 Mc/s.

★ **AFC and AVC.** Printed circuit design of high sensitivity and quality. Output for valve or transistor amplifiers. Size 3 1/2 x 2 1/4 x 4 in. Simplified building instructions. All parts sold separately.



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## "THE CONTESSA"

★ **COMBINED PORTABLE AND CAR RADIO** ★ **AMAZING SENSITIVITY AND SELECTIVITY ON MEDIUM AND LONG WAVEBANDS**

★ The easiest Superhet Radio to build on the market. Features clearly-marked printed circuit and packaged components with full illustrated building instructions. Full tuning of medium and long wave bands with unbeatable sensitivity and selectivity. Excellent tone and volume with over 600mW push-pull output.

★ Clearly marked horizontal station dial with slow motion tuning. Two colour Blue or Beige cabinets with Gold handles, grilles and fittings. Size 10 1/2 x 7 1/2 x 5 1/2 in., includes car aerial sockets, recording sockets.

★ 6 Mullard Transistors and 2 Diodes.

**TOTAL COST OF ALL PARTS £9.19.6** P.P. 3/6

Fully Detailed and Illustrated Leaflet on request. All parts sold separately. Guaranteed the Best Obtainable. Attractive Appearance. Reliable Design. Quality Performance.

UNBEATABLE FOR QUALITY AND VALUE

## 7-TRANSISTOR RECORD/PLAYER/RADIOGRAM AMPLIFIER

● 4 watt peak output.  
● Full Treble and Bass boost and cut.  
● 40 c/s to 20 kc/s  $\pm 3$  dB.  
● Inputs for Pick-ups, Radio Tuners, Microphones, mixers.



● **TWO VERSIONS AVAILABLE**  
12/18 volt for 15 ohm speakers. (mains unit now 60/- extra).  
9/12 volt for 3 ohm speakers (mains unit 49/6 extra).  
● Size only 6 x 2 1/2 x 2 in. Ideal for mains or battery, portable or domestic record player, grams, etc. Or car.  
● **Built Ready To Use** **£5.19.6** P.P. 2/6.

## 4-WAVEBAND COMMUNICATIONS RECEIVER

● 550 kc/s to 30 Mc/s.—5FO — AVC — Noise Limiter — Band spread — "S" Meter — Telescopic Aerial — Full World Wide Coverage. 4 valve. **PRICE £24.15.0** With Full Instructions. **BRAND NEW IN CARTONS.** Detailed Leaflets on request.  
● 9 valve version of above 40 gns. Details on request.

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