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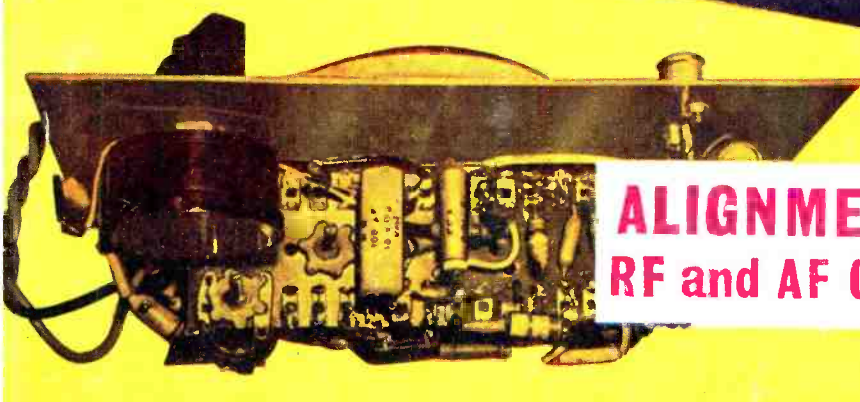

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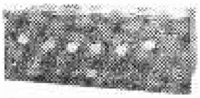
MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT



Designed mainly for Mullard Range of Amplifiers, also suitable for any Amplifiers requiring input up to 250mV Incorporates 5 input Channels, including for Tape and Magnetic Pickups. Separate Bass and Treble controls. High pass filter 20 to 160 c/s, low pass filter 5-9 Kc/s. Totally enclosed in case Size 11½" x 4½" x 4½.

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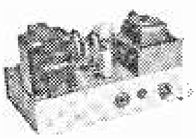
MULLARD "5-10" MAIN AMPLIFIER



For use with MULLARD 2 or 3 valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS and MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer

COMPLETE KIT (Parmeko Output Trans.) **£10.0.0**

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ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.

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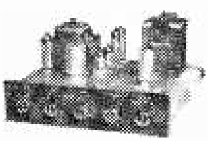
THE MULLARD 5-10RC AMPLIFIER



The popular complete "5-10" incorporating Passive Control Unit providing up to 10 watts high quality reproduction with input of 600 mV. Specified components and new MULLARD VALVES. Includes PARTRIDGE MAINS TRANSFORMERS and choice of PARMEKO or PARTRIDGE Output Transformers. Surplus Power available for Tuner.

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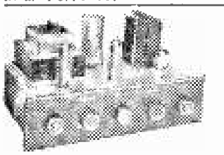

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Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available. (Carr. & Ins. 6/6). Please state L.S. impedance.

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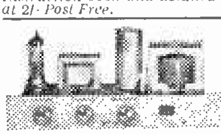
THE "MONO-GRAM"



A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls. PARTRIDGE output Transformer producing up to 3 watts undistorted output. (Carr. & Ins. 3/6).

Kit of Parts **£4.10.0** Assembled and Tested **£6.0.0**

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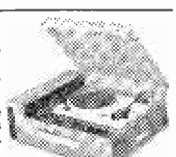

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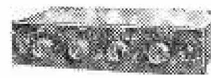
With PARTRIDGE OUTPUT TRANSFORMER **£1.6.0** extra.

MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT



Employing two EF86 valves and designed to operate with the Mullard AMPLIFIERS but also perfectly suitable for other makes with input up to 250 m/V.

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Instruction book and detailed price list (free with kit) available separately at 2/- Post Free.

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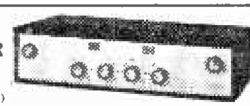

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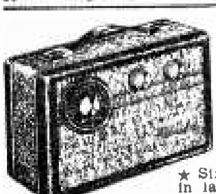

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Our highly successful six-transistor luxury portable with the "SLIM LINE" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as Car Radio, with full MEDIUM wave and LONG wave coverage.

Look at these features: ★ 500 milliwatt output to high flux 7 x 3½in. high fidelity loudspeaker ★ Six selected MULLARD TRANSISTORS in latest supersensitive circuit plus germanium diode. ★ Compact size only 9¼ x 3½ x 6¼in. high. ★ Attractive three-tone cabinet, black, dark grey and silver grey with gilt control knobs and all gilt fittings. ★ Coax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal Ferrite rod aerial. Special inclusive price for all required components. ONLY **£7.19.6** (Plus P. & P. 4/-).

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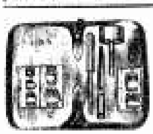

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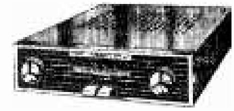
One of the finest general coverage bandspread Receivers available at this price. Covering 550Kc/s—1600Kc/s, 4.8Mc/s—14.5Mc/s, 1.6Mc/s—4.8Mc/s 10.5Mc/s—30Mc/s. Illuminated slide rule dial, calibrated every 5Kc/s on 80 and 40 metres. Edgewise S-meter. 0.100 logging scale, coverage from 0.55—30 Mc/s. 8 valve plus Rectifier super het circuits. RF Stage with an Aerial Trimmer. 2 IF Stages. B.F.O. control Q-multiplier. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier) Frequency (BFO), Band Selector, IF Gain Trimmer, AVC-MVC Switch, Anl Switch, Main Tuning, Bandspread Tuning and Headphone Jack. Selectivity —60dB at 10Kc/s, 0.8Kc/s at 6dB (with Q-Multiplier) IF-455Kc/s. External PM Speaker reqd., 4 or 8 ohms impedance. Output 1.5 watts, 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. Size 15 x 10 x 7½in. Grey crackle finish. 220/240 volt A.C. mains, 50-60 cycle operation. Full instructions and circuit diagram supplied. Send S.A.E. for leaflet. PRICE **40 Gns.** Carriage Paid.

SEND STAMP FOR COPY OF OUR INTERESTING LITTLE BOOKLET "What is High Fidelity?"

SEE PRECEDING PAGE FOR OTHER STERN-CLYNE PRODUCTS

THE "TRAVLER" MkII



Introducing our new ready-built transistorised car radio for ONLY **9½ Gns.** P. & P 5/-. including 7 x 4" speaker fitted to baffle, fixing brackets, filter unit all nuts and bolts with fitting instructions **£2.19.6** (Plus 5/- P. & P.)

H.P. Terms: Dep. and 7 monthly payments of £1.3.6.

Star Features ★ Handsomely Styled. ★ Mullard Valves and Transistors. ★ Push Buttons. ★ 1½ watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily Fitted. ★ Radio Luxembourg (and many other foreign stations) 12 volt Positive Earth Only (applies to 96.8% of the cars on the road). ★ Dimensions 7 x 2 x 7" depth.

Optional extras, 3 section chromium plated weatherproof telescopic aerials type 1 17"/44", 19/6; type 2, 2"/43", 29/6, both plus P. & P. 2/6 if purchased separately.

THE MINICO JUNIOR TRANSISTORISED TAPE RECORDER

Record anywhere any time. A truly portable versatile Recorder with a difference, the highly sensitive Crystal Microphone is built into the Zip Carrying Strap which leaves both hands free to operate your Cine Camera, the Microphone can be removed for office use as a Dictating Machine or for Parties. Outstanding quality of reproduction and tone, up to 45 mins. playing time, twin track and operating on 4-1½ volt Half-Pen Batteries. Robust metal body, size 6½ x 4½ x 2½", weight 33 ozs. Usual price 16 gns. complete with Microphone.

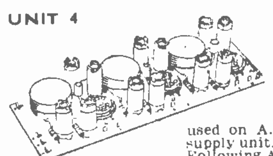
OUR PRICE **£6.19.6** P. & P. Tape and Battery. 4/-.

NOW AVAILABLE!!

MARTIN FULLY TRANSISTORISED AUDIOKITS

These ingeniously designed sub-assembled kits enable you to build a transistorised Hi-Fi system by simply linking together your choice of units. No technical knowledge or special tools are needed to build with complete success. All units are supplied on printed circuit boards ready to mount and connect. Latest type transistors used in conjunction with the specially developed circuits give you superb reproduction. For battery operation or can be used on A.C. mains with Martin power supply unit.

UNIT 4



Following Audiokits available:—

Unit 1.—5-Stage Matching Input Selector Unit. **47/6.**

Unit 2.—Pre-Amplifier with Master Volume Control. **37/6.**

Unit 3.—3-Channel Mixer. **79/6.**

(Plug-in matching adaptors for above. **8/6** each).

Unit 4.—Combined Pre-Amplifier and Tone Control Unit. **62/6.**

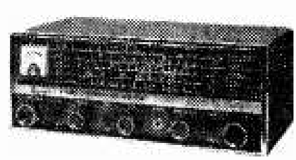
Unit 5.—10 watt Main Amplifier (3 ohm output impedance only at present). **£5.12.6.**

Unit 6.—Power Supply Unit. **£2.12.6.**

P. & P. extra on above items.

Full range of attractive perspex escutcheons available Send S.A.E. for fully descriptive literature.

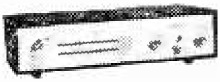
THE HE-40 4-BAND COMMUNICATION RECEIVER



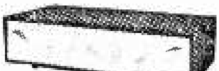
Completely built and ready to go. High sensitivity Superhet receiver covering 550Kc/s—1,500 Kc/s, 1.6 Mc/s—4.4 Mc/s, 4.4 Mc/s—11 Mc/s 11 Mc/s—30 Mc/s. Electrical Bandspread tuning. Slide rule type tuning dial. Internal ferrite rod aerial for medium waveband reception and 1 50in. 10 section chromium plated telescopic whip aerial for the short wave bands. Sockets for optional outdoor aerial. Internal high flux monitor loudspeaker. Latest modern miniature B7G base valves. Headphone socket (may also be used for external loudspeaker). ANL. BFO. built-in "S" meter. 220/240 volt A.C. mains, 50-60 cycle operation. Handsomely styled cabinet with grey crackle finish and handsome front panel, with chrome and satin chrome fittings. Measures 13¾in. x 8½in. x 5¾in. (high) and weighs only 11½ lbs. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and short wave listeners of all ages.

Send S.A.E. for leaflet. PRICE **£24.15.0** Carriage Paid.

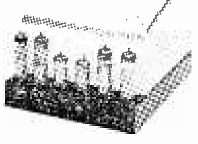
INTRODUCTION OFFER ! ! Available Shortly



FOR ONLY **48 gns.** Plus 15/- Pkg. & Carr.



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 VHF/FM long and medium waveband coverage, frequency range FM 87.5-108.5 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, ECH81, EBF89, EB91, 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 r.m.s. for 14 watts output, frequency response ± 0.5dB 20 c/s. —20 Kc/s. Speaker impedance 4, 8 or 16 ohms, surplus power available for Tape Pre-Amp, mains supply 105/240 v. A.C. Valve line-up, 2—ECC83, 4—EL84, 1—GZ34.

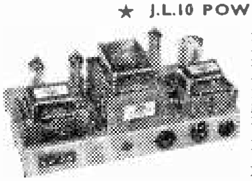


DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

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:

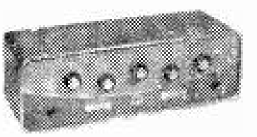
★ J.L.10 POWER AMPLIFIER



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



Inputs for microphone, crystal or magnetic pick-ups, tuner unit. Push-button switching for 3 tape speeds equalised. Tape erase Bias Oscillator circuit incorporating ferrox-cube transformer. Function switch, separate base, treble and volume controls, level control and latest EM87 magic eye level indicator. The pre-amplifier is totally enclosed in a silver hammer finish steel case, and an attractive perspex front panel completes the presentation.

KIT OF PARTS **£17.0.0** READY BUILT **£21.0.0** 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

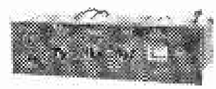
MODEL CR3/S incorporates the HF/TR3 Mk. II Tape Amplifier (described below) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1⅞in., 3¾in., and 7½in. speeds. Complete with microphone and 1,200ft. tape.

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

STEREO TAPE PRE-AMPLIFIER

MODEL STP-1. For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ½ and ¼ track Stereo Decks. Incorporates Ferrox-cube Oscillator, 4-speed Equalisation Signal Level Meter and separate Gain Control. Includes separate Power Unit. KIT OF PARTS **£22.0.0** (Carr. & Ins. 8/6) ASSEMBLED **£28.0.0**
Instruction book and detailed price list (free with kit) available separately at 5/- Post Free.

TAPE PRE-AMPLIFIER MULLARD Type "C"



Suitable for most ½ track. Mono Tape Decks. Incorporates Ferrox-cube Push-Pull Oscillator. Treble Inductor and 3-sp. Equalisation. Includes separate Power Unit.
KIT OF PARTS **£14.0.0** (Carr. & Ins. 7/6). ASSEMBLED **£19.10.0**
Instruction book and detailed price list (free with kit) available separately at 3/6 Post Free.

MULLARD TAPE AMPLIFIER

MODEL HF/TR3/MK.II
Based on Mullard's Type "A" design and suitable for most ½ track Mono Tape Decks. Incorporates Ferrox-cube Treble Inductor, Gilson Output Transformer, and 3-speed Equalisation. Includes separate Power Unit, using PARTRIDGE Mains Transformer.
KIT OF PARTS **£13.13.0** (Carr. & Ins. 7/6) ASSEMBLED **£19.0.0**
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......	£36. 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, ¼ 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.		

Carr. & Ins. 15/- on above units. Send S.A.E. for comprehensive price list.

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ECL86 8/9
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EF9 20/6
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EF40 8/9
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UCH81 6/6
UCL82 7/9
UCL83 8/6
UF41 6/9
UF80 6/3
UF85 7/-
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UL44 28/3
UL46 8/6
UL84 6/-
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UU9 5/3
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OC75 8/-
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XA102 19/6
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METAL RECTIFIERS, DRM1B 13/-, DRM2B and DRM3B 15/6, LW7 21/-, LW15 24/-, RMO 7/11, RM1 5/3, RM2 6/3, RM3 7/9, RM4 12/9, RM5 17/6, 14A86 17/6, 14A97 19/6, 14A100 23/-, 14A124 26/6, 14A163 35/6, 14B130 31/-, 14B261 11/6, FC101 16/9, 16RC.1.1.16.1 8/-, FC31 21/-, 16RD.2.2.8.1 11/-, 16RE.2.1.8.1 8/6, 18RA.1.1.8.1 4/-, 18RA.1.2.8.1 11/-, FC116 6/-, FC124 12/6, SB3 10/6, C2D 9/-, K3 40 9/-, C3D 11/-, C3B 14/8, K3/2D 4/3, Q3/4 3/7, K3/50 10/4.
ELECTROLYTICS, Can types: 32 x 32 450v. 5/9, 50 x 50/350v. 7/-, 64 x 120/350v. 8/3, 60 x 250/275v. 9/6, 100 x 400/275v. 12/6, 100/275v. 3/-, 200/275v. 4/-, 100 x 200/275v. 9/6, Tubular types: 8 450v. 1/9, 16 450v. 2/9, 32/450v 3/9, 8 x 8/450v. 3/-, 16 x 16 450v. 4/-, 32 x 32/350v. 4/-, 8 x 16/450v. 3/9 32/350v. 3/-.
MULLARD Midget silicon rectifiers. Type BY100. Output 250 volts ½ amp. No larger than a shirt button. 7/6 each. Series limiting resistance 1/6.

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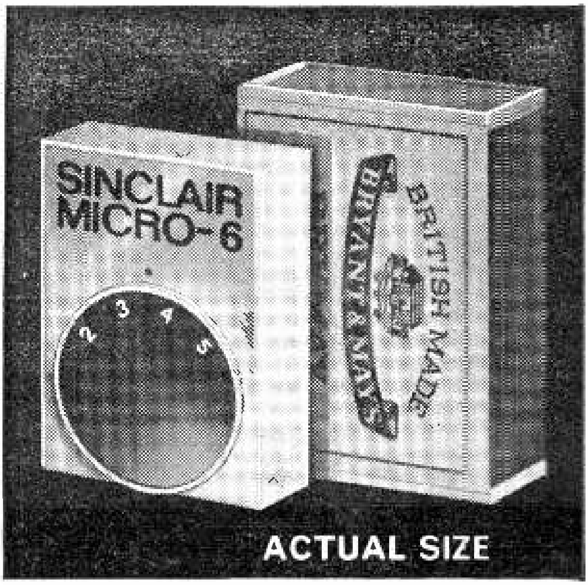
Terms of business:—Cash with order or C.O.D. only. Post 6d. per item. Orders over £3 post free. C.O.D. 3/6 extra. All orders cleared same day as received. Any parcel insured against damage in transit for 6d. extra. We are open for personal shoppers 8.30—5.30 p.m. Sats. 8.30—1 p.m. Complete list of modern and obsolete valves, resistors, condensers transformers potentiometers, microphones etc. with terms of business, 6d. Please enquire for any item not listed with S.A.E.

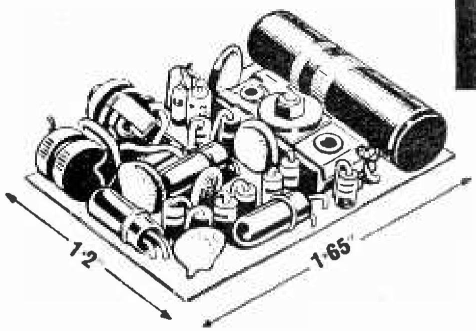
SET IN THE WORLD

- ★ 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.

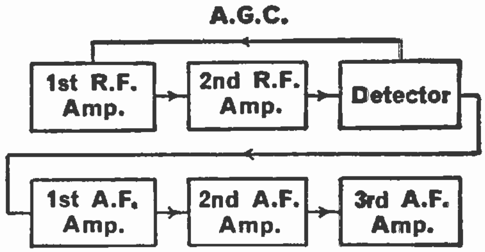


ONLY $1\frac{4}{5}'' \times 1\frac{3}{10}'' \times \frac{1}{2}''$

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—1/11d. each.

MORE SINCLAIR DESIGNS ON NEXT PAGE

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If you are not completely satisfied with your purchase (we are confident that you will be delighted) your full purchase price will be refunded instantly and without question.

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SINCLAIR RADIONICS LTD., 69 Histon Rd., Cambridge

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ADDRESS ....

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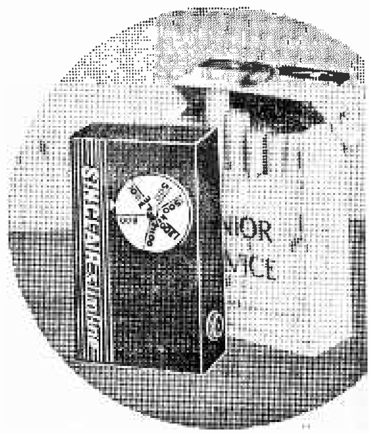
PW4

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

60A Bromley Road,
Catford,
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.

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 $2\frac{11}{16}$in. x $1\frac{11}{16}$in. x $\frac{3}{4}$in.) and lightweight earpiece, to build this set costs

49/6

GUARANTEE

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

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Please send ....

for which I enclose £......:......s......d.

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PW4

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 $1\frac{4}{5}$" x $1\frac{3}{10}$" x $\frac{1}{2}$". Probe—$\frac{3}{8}$". Parts come to **27/6**

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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 $\frac{1}{4}$ watt output (transformerless) into 15 ohms. Sensitivity 0.5mV. Supplied ready built, with instructions. **59/6**

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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 — 16/6.

SINCLAIR RADIONICS LTD.

69, HISTON ROAD, CAMBRIDGE

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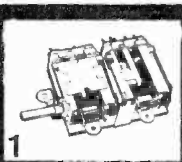
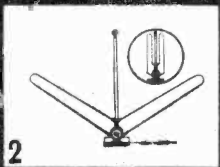
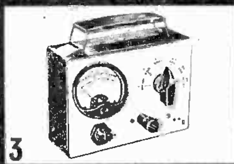
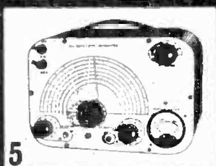
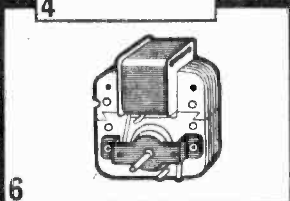


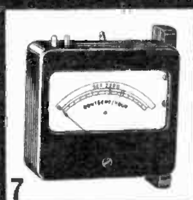
Just a few of our BARGAINS

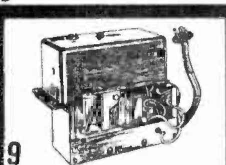


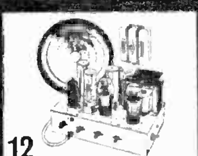


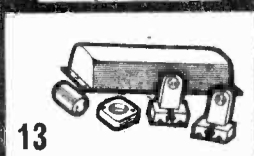












1. **A.M. F.M. PERMEABILITY TUNER FOR ALL TRANSISTOR OPERATION.** Size 2½ x 2¼in. approx. By famous manufacturer. A.M.-I.F. 470 Kc/s. F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1620 Kc/s-525 Kc/s. F.M. coverage 108 Mc/s-88 Mc/s. Circuit diagram **2/6**. FREE with Tuner. **25/-**. 1st. 2nd, 3rd A.M. IF's, **12/6** set. 1st, 2nd, 3rd and 4th F.M. IF's, **12/6** set. V.H.F. Osc. choke, **1/-**. A.M. I.F. trap, **1/6**. A.F. 114 and A.F. 115, **5/-** each. All the above are the RF end of an **AM/FM** receiver car radio, etc. The above six items purchased together, **£2.10.0**

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

10. **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. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour brown. Dimensions: 12½ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Full-Fi turnover crystal head, **£5.19.6.** P. & P. 6/6.

11. **POCKET MULTI-METER.** Size 3¾ x 2½ x 1¾in. Meter size 2¼ x 1¾in. 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. **85/-**. 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 2¼in. 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. 2 dB down to 20 kc/s. Output 8 watts at 5 per cent total distortion. Noise level 40 dB down all hum. Output transformer tapped for 3 and 15 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. **FLUORESCENT LIGHT KIT.** 40 watt fluorescent lighting kit comprising Siemens Choke. 2 Lampholders. starter holder and starter. **11/6**, plus 3/- P. & P.

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Early Closing
WEDNESDAY

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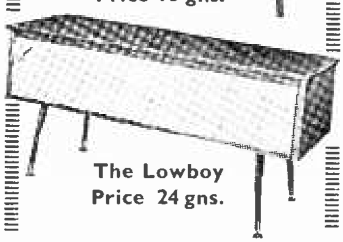

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Glass encapsulated, 2 wire lead out. Size 1¼in. high x ½in. dia. Following frequencies (Kc/s) only available.
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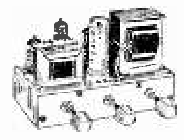
6/- each. P. & P. 1/- per crystal. 3 or more Post Free.

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 7½in. w.x 4in. d. x 4½in. h. Incorporates ECC83, EL84, EZ80 valves, heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs valves, etc., wired and tested for only **£4.5.0** P. & P. 4/-

TWO VALVE AMPLIFIER similar to above but using ECL82 and EZ80 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 **£6.17.6**). Carr. 5/- on each.

NEW CARTRIDGE BARGAINS!

RONETTE STEREO 105 CARTRIDGE. Stereo/LP/78. Complete with two sapphires. Original list price **67/9. OUR PRICE 24/-.** P. & P. 1/-.

COLLARO HI-FI STEREO T/O CARTRIDGE. Type "C". Complete with universal bracket and stylii 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 stylii and mounting bracket. Limited number only at **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	**6/6**	V15/10p	**12/6**

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

EDISWAN MAZDA

R.F.1 Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp.; (Equiv. OC44 and OC45)........**10/6**
R.F. 2 Pack: 2—PXA101 I.F.;—PXA102 Osc.; 1—PXA102 Mixer **12/6**
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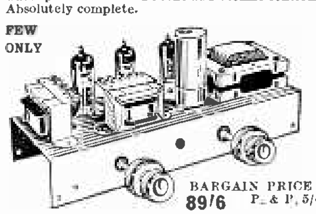
ALL TRANSISTORS POST FREE

STEREO AMPLIFIER

Incorporating 2 ECL82s and 1 EZ80, 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/-

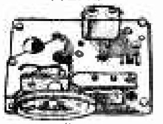
Also available complete with two 8 x 5in. Speakers for only **£5.10.6.** P. & P. 6/6.

SPECIAL PURCHASE! TURRET TUNERS

by famous maker

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

F.M. TUNER HEAD



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

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.

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

Heavy 8¾in. 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 (EZ80, ECL82), A.C. mains, 3 watts output, ready built, tested and complete with valves and output transformer. Size 7in. w. x 2¼in. d. x 5¼in. h. 55/-. P. & P. 3/-. Suitable speakers: 6½in. 15/-. P. & P. 1/6. 10 x 6in., 28/-, P. & P. 1/6.

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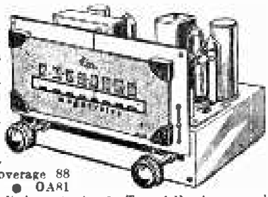
Oatmeal, or Red and Gold Vynair for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard.

OUR PRICE **13/6** per yard length 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. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80's, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5¼in. ● All parts sold separately. Set of parts if purchased at one time £5.19.6. plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye, front panel and brackets. £6.12.6. P. & P. 8/6.

Mark III Version as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6.

Handsome Metal Cabinets. Choice of Grey, Black or Green. To fit Mark I, 25/-. P. & P. 2/6. To fit Mark II, 17/6. P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 wavebands transistor superhet. ● Printed circuit panel (size 8¼ x 2¾in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.

All parts sold separately. Set of parts if purchased at one time.

ONLY **£4.5.0** P. & P. 2/6

35 OHM SPEAKERS

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

Portable CABINET

Size approx. 9¼ x 6¾ x 3½in. Suitable for above using 3½in. speaker, 25/-. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

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

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. Size 7in w. x 2¼in. d. x 5¼in. h. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker.

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

DITTO. Mounted on board with output transformer and 6in. speaker.

Complete at 89/6 P. & P. 4/6.

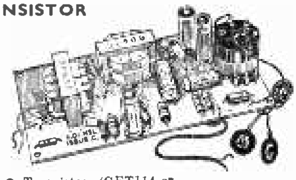
QUALITY PORTABLE RECORD PLAYER CABINET

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.

PRICE £3.9.6 Carr. 5/-

◀ LOOK OPPOSITE FOR MORE BARGAINS

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



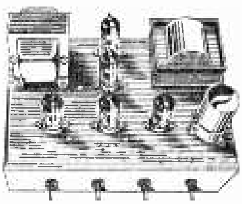
● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p). ●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

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

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

Also available ready built and tested complete with input jack plugs. **£8.15.0** P. & P. 6/6.

BRAND NEW 3 OHM LOUDSPEAKERS

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

E.M.I. 2½in. tweeter .. 10/6

10in. x 6in. 26/-

Also 15 ohm 12 inch, 30/-.

Rola Celestion approx. 9in. x 6in. middle register speaker 10/6

P. & P. up to 6in. 1/6; over 6in. 2/6 per speaker.

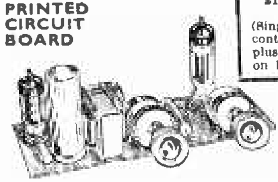
AMPLIFIER CARRYING CASES

BRAND NEW

Strongly made wooden construction, tough vynide covered, complete with carrying handle. Overall size 13¾in. wide x 9in. deep x 8in. high with sloping front panel. Weight only 4½ lbs. Ideal for our 10/14 watt amplifier and many others.

BARGAIN PRICE **28/6** P. & P. 4/-.

AMPLIFIER ON PRINTED CIRCUIT BOARD



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

TAPE DECKS

COLLARO STUDIO DECK £10.10.0 plus 5/6 carr. and ins.

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

Superior CABINET To take 8 x 5in. speaker, with motor board will accommodate BSR UA14 or UA16. £3.9.6. Carr. 5/6. Speaker 10/6 extra. P. & P. 1/6 extra.

LARGE CABINET Similar to above with 3 ohm speaker. £3.9.6 Carr. 5/-.

★ 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.

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

STANDARD COLVERN 50K W/W Pre-set Pots. 2 for 4/-. P. & P. 1/-.

STANDARD 1¼in. FUSEHOLDERS Laminated Twin. 2 for 1/6. P. & P. 9d. Laminated Single. 2 for 1/-. P. & P. 6d. Belling-Lee Panel mounting, single 2/- each. P. & P. 6d.

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

Precision made .0005 2-gang **TUNING CONDENSERS.** Size 2¼ x 2¾ x 1¼in. 4/- each. P. & P. 1/6.

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 3¼ x 2¾ x 1¼in. Weight 4lbs. ONLY 15/-. P. & P. 3/6.

CONDENSERS. 5000 mFd. 12 v. wkg. Size 3 x 1in dia. 3/- each. P. & P. 6d. each.

SPECIAL SPEAKER BARGAINS!

FEW ONLY 6 x 4in. 3 ohm Speakers. Only 9/-. P. & P. 1/6 per speaker.

8 x 5in. 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.

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For the Finest Value and TRANSISTOR RECEIVERS AND

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

THE SKYROVER and SKYROVER DE LUXE

The SKYROVER

Controls: Waveband Selector, Volume Control with on/off Switch, Tuning Control. In plastic cabinet, size 10 x 6½ x 3½ in. with metal trim and carrying handle.

Can be built for

£10.19.6

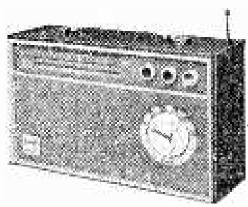
Post and Packing 5/- extra.

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 SKYROVER DE LUXE



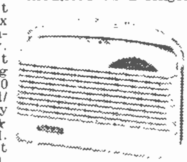
Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11½ x 6½ x 3in., covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

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 "REALISTIC" Seven

★ 7-transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5½ x 5½in. in one complete assembly. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3½in., 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.



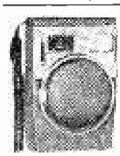
An Outstanding Receiver. **LASKY'S PRICE** for the complete parcel including Transistors, Cabinet, Speaker, etc., and Full Construction Data. Can be built for P. & P. 4/6. **£5.19.6**

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 superchrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. ALL FOR ONLY P. & P. as for Std. model **£1** EXTRA.

THE "SPRITE"



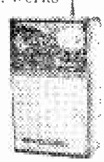
Can be built for

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 2¼ x 2in. ★ Slow Motion Drive. ★ In Plastic Case. Size 4 x 2½ x 1in. 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, can be built for:— **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 2½ x 1in. Fitted with 2¼in. 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 42/- with all accessories Post Free.

ALSO AVAILABLE

6 transistor model, size etc. as above. Supplied complete with personal earpiece and leather case. Post Free **LASKY'S PRICE 79/6**

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.

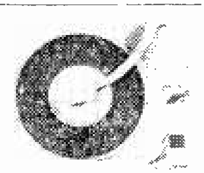
PRIVILEGE PARCELS

A "Privilege Parcel" allows you to purchase the Audio System of your choice at a worth while cash saving. Some examples are listed below, but we shall be pleased to quote our "Privilege Parcel" Prices for any selection of equipment of your own choice. Send us details of your requirements.

Tudor Stereo Amplifier £15. 0.0	Tudor Stereo Amplifier £15. 0.0
Connoisseur Craftsman, 2-speed transcription player £16. 6.6	Braun PC4L Stereo Transcription Unit £12. 9.6
Decca FFSS Stereo Pick-up £18.18.0	2 x Sharon Loudspeaker systems £19.19.0
Total £50. 4.6	Total £47. 8.6
"PRIVILEGE PARCEL" Price: £47.10.0	**"PRIVILEGE PARCEL" Price: £45.0.0**
Collaro Studio Tape Deck, ½-track model £10.10.0	Collaro Studio Tape Deck, ¼-track model £13.19.6
Lasky's Tape Amplifier £8.19.6	Martin Tape Amplifier. ¼-track model £12 12.0
P'table Case £3.15.0	Portable Case with Speaker £5. 5.0
7 x 4in. spkr. 15.6	
Total £24. 0.0	Total £31.16.6
"PRIVILEGE PARCEL" Price: £22.10.0	**"PRIVILEGE PARCEL" Price: £30.0.0**

Carriage and Packing on all the above parcels, 10/6 extra.

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 13¾ x 12½ x 4½in. 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.

LASKY'S PRICE 79/6 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/-.

207 EDGWARE ROAD, LONDON, W.2. Near Praed St. PADDINGTON 3271 2	**33 TOTTENHAM COURT ROAD, W.1.** Nearest Stn., Goodge St. MUSEUM 2605	**152/3 FLEET STREET, LONDON, E.C.4.** *Telephone* Fleet Street 2833.
BOTH OPEN ALL DAY SAT. Early Closing Thurs. Mail Orders to Dept. P.W., Edgware Rd.		Open all day Thursday. Early closing Sat.

◀ See opposite page for addresses

R.S.C. (Manchester) Ltd.

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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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, 6 gns.
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122/17 25watt, £11.17.6 122/17A 25 watt, £12.17.6
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.
"A" indicates dual 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 807 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 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.

11 Gns. Carr. 10/-

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, GOODMANS, 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/Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size approx. 9 x 6 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.

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, **£4.7.6.** 12in. R.A. 3 ohms 10 watts (12,000 lines), **59/9.**

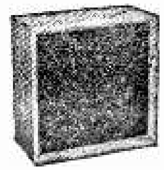
TWEETERS. R.A. 3 ohm, **25/9;** 15 ohm, **25/9**

R.A. 12in. DUAL CONE 3 ohm 8 watt Speakers. Ideal for Stereo. Only **39/9** ea.

Jason FMT1 V.H.F./F.M. Radio Tuner design. Total cost of parts including valves, Tuning dial. Escutcheon, etc., **£6.19.6.**

LINEAR L45 MINIATURE 4-5 WATT QUALITY AMPLIFIER. Suitable for any record playing unit and most microphones. Negative feed-back 12 dB. Separate Bass and Treble Controls. For mains 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Mullard valves EZ80, ECC83, EL84. Size only 7x5x5½in. 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.**

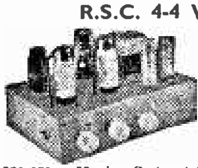
12in. 10 WATT HIGH QUALITY LOUDSPEAKER In walnut veneered cabinet. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only **£4.19.6** Carr. 5/-. Terms: Deposit **11/3** and 9 monthly payments of **11/3.**



12in. 20 WATT HI-FI LOUD-SPEAKERS IN CABINETS. Size 18 x 18 x 10in. Finish as above. Terms: Deposit **17/9** and 9 monthly payments of **17/9.** Only **£7.19.6.** Carr. 8/6.
For larger types see preceding page.

LINEAR LG34 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 available for the supply of a Radio Feeder Unit, or Tape-Deck pre-amplifier. For A.C. mains input of 200-230-250 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, or assembled ready for use 25/- extra. Plus 3/6 carr., or deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

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Three new branches opening in March

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 6½ x 5½in.

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.**

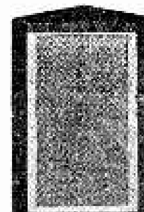
STANDARD MODEL. As above but for 12in speakers. Size 20 x 15 x 13in. For vertical or horizontal use, **£5.19.6.** Set of legs with brass ferrules, **19/6.**

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 18 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 6 watts nominal. Ideal for Stereo.

8 Gns. Carr. 4/6.

MULTI-METER, CABY M1. 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 **£4.17.6. B.20.** 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

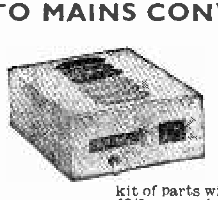


Polished walnut veneer finish. Pleasing design. **JUNIOR MODEL.** Size 20 x 11 x 8in. for 8 x 5in. or 10 x 6in. speakers. **£2.9.9. STANDARD MODEL.** Size 27 x 18 x 12in. for 8 or 10in. speakers, **£4.11.9. SENIOR MODEL** Size 30 x 20 x 15in. for 12in. Speaker. Suitable Speaker systems below. Only **7 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.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

R.S.C. BATTERY TO MAINS Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. 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 5½ x 2½in. 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 L.T. 2 v. accumulators when connected to A.C. mains supply 200/500 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulators. Complete kit of parts with diagrams and instructions, **49/9,** or ready for use, **59/6.**

AUDIOTRINE EQUIPMENT CABINETS. Size 36 x 15 x 18in. Beautiful walnut veneered finish. Elegant contemporary design. Robust construction. Uncut, removable baseboard. Depth above baseboard 5½".

Only **12½ gns.** Carr. 15/-
Terms: Dep. **29/9,** and 9 mthly. pymts. **29/9**

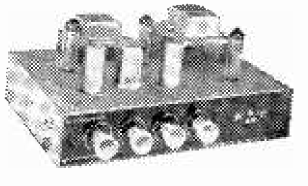
AUDIOTRINE HI-FI TAPE RECORDER KIT 25½ GNS. Carr. 17/6.

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR
Incorporating the latest Collaro Studio Tape Transcriptor. The Audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable Carrying Cabinet with latest attractive two-tone polychrome finish, size 14½ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS. Deposit £2.13.9** and 12 monthly payments of 44/-. Cash price if settled in 3 months.

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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

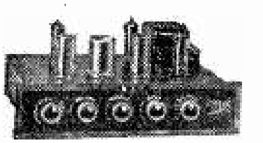


Two input sockets with associated controls allow mixing of "mike" and gram., as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 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 provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-.
(Or factory built 51/- extra.)
If required louvred metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9** and 9 monthly payments of **24/9.** Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Microphones, etc., with cash and credit terms.

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

R.S.C. GRAM. AMPLIFIER KIT. 3 watts o/put. Negative feed back. 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 **39/6.** 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 NP110 **14/9,** R.T.C. **19/9,** Acos Mic 40 **25/9,** Acos Mic 45 **29/9,** Stick type Acos 39-1 **39/9,** BM3 with neck band and heavy table stand **59/9.** Lapel type **29/9.**
COLLARO JUNIOR 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only **£3.19.6.**
B.S.R. UA14 4-sp'd AUTO-CHANGERS with hi-fi turnover head. **£6.19.6.** Carr. 4/6.
GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER with high fidelity pick-up. Latest model. For 200-250 v. A.C. mains. **£7.17.6.** Carr. 4/6.
GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTOCHANGERS. 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 11¾ x 2¼ x 2¼in. Controls: Vol. and Tone with Switch. Only **59/6.**

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



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. Ganged Bass and Treble Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10-watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-.
Kit can be supplied assembled and ready to use for **59/6** extra.

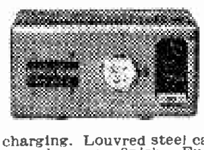
SENSATIONAL STEREO OFFER

A complete set of parts to construct a good 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. **4 Gns.**

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

R.S.C. BATTERY CHARGING EQUIPMENT Guaranteed 12 months.

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



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

ASSEMBLED 6/12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Fused, ready for use with mains and output leads. **39/9** Carr. 3/9.
6/12v. 1 amp. 27/9 Less meter.

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.

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.

6 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. inclusive of Ammeter	35/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector	52/9

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

CHARGER KIT, 12v. 10 Amp. with variable charge rate adjustment and ammeter. **£4.19.6.** Carr. 10/-.

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

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

TOP SHROUDED DROP THROUGH

250-0-250v. 70mA. 6.3v. 2a. 0-5-6.3v. 2a.	17/9
350-0-350v. 80mA. 6.3v. 2a. 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
250-0-250v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	25/9
300-0-300v. 130mA. 6.3v. 4a. 6.3v. 1a. for Mullard 510 Amplifier	29/9
300-0-300v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 100mA. 6.3v. 4a. 0-5-6.3v. 3a	26/9
350-0-350v. 150mA. 6.3v. 4a. 0-5-6.3v. 3a	29/9

FULLY SHROUDED UPRIGHT

250-0-250v. 60mA. 6.3v. 2a. 0-5-6.3v. 2a. Midget type 2½ x 3 x 3in.	17/11
250-0-250v. 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. 130mA. 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

FULLY SHROUDED (continued)—

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

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	4/6
Small Pentode, 5,000Ω to 3Ω	4/6
Small Pentode 7/8,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 7,000Ω to 3Ω	5/9
10,000Ω to 3Ω	5/9
Push-Pull 8 watts, EL84, or 6V6 to 3Ω or matched to 15Ω	9/9
Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 to 15Ω	19/9

Following types for 3 and 15Ω speakers:

Push-Pull 10-12 watts 6V6 or EL84	18/9
Push-Pull 15-18 watts, 6L6, KT66	22/9
Push-Pull Mullard 510 Ultra Linear	29/9
Push-Pull 20 watts, sectionally wound, 6L6, KT66, EL34, etc.	49/9

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

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

Both above size 2⅝ x 2⅝ x 2¼in.

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

SMOOTHING CHOKES

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

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

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

MICROPHONE TRANSFORMERS 120: 1 high grade, clamped. 8/9.

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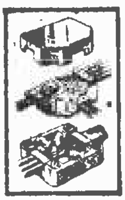

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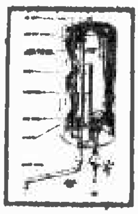

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Practical Wireless

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Contents

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-vise. 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 service-men, 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 Mersey 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.

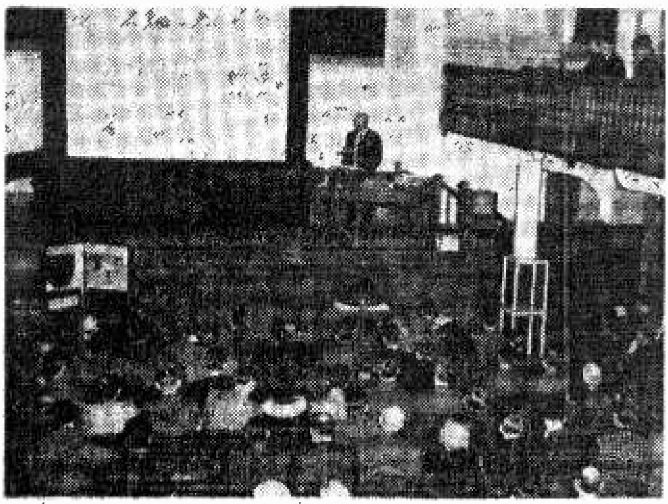
Our next issue dated May will be published on April 7th

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

P.W. FILM SHOW A SELL-OUT

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.



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

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, Warwickshire, 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.

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.

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.

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.

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.

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.

THE PRACTICAL WIRELESS

Trimming Tool Set

A USEFUL AID FOR THE AMATEUR CONSTRUCTOR

TRIMMING 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 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 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.

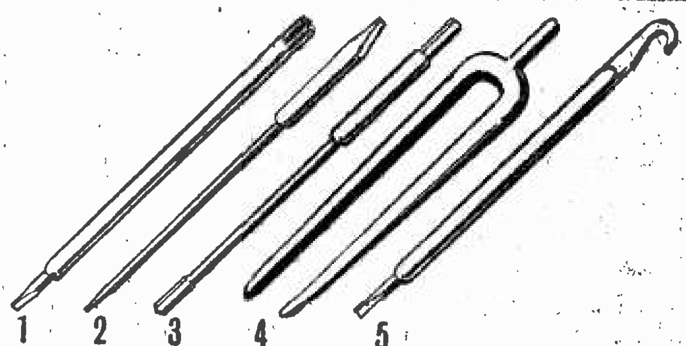
The wide blade of No. 2 fits mica and ceramic trimmers, ferrite pot-cores and slotted hex-nut compression trimmers. It should not be used as a screw-driver, for obvious reasons.

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.



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

BY H. W. HELLYER

THE 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 0·1μF.

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 of a direct short-circuit: suggested value 0·1μF.

Remove the damping from the i.f. transformer, 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.

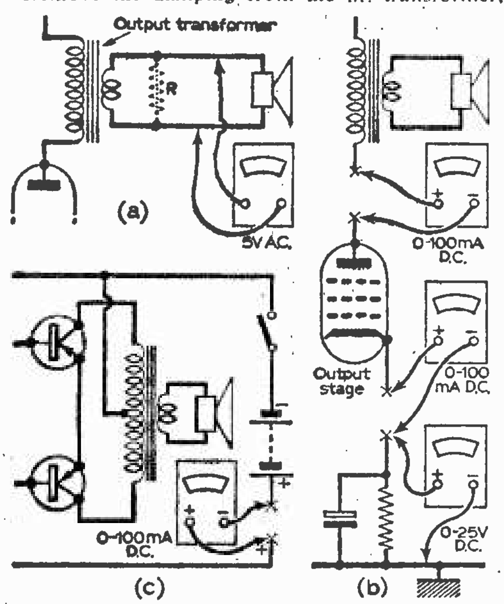


Fig. 1: Indication of audio output level. (a) across secondary of output transformer. (b) Measuring anode current, directly and indirectly. (c) Measuring current consumption of a transistorised radio.

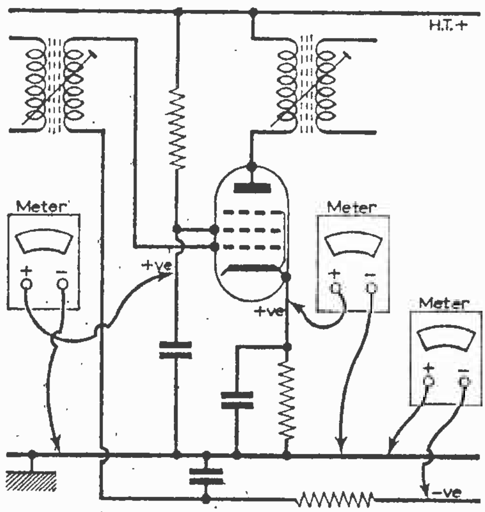


Fig. 2: Signal level in a controlled i.f. stage. Using a c.w. input, measuring anode and screen grid current, test for dip. Using modulated signal at higher level, a.v.c. voltage becomes more positive.

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 t.r.f. alignment is as for r.f. alignment of a superhet (see below). The tuned circuits of the demodulator stage are 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).

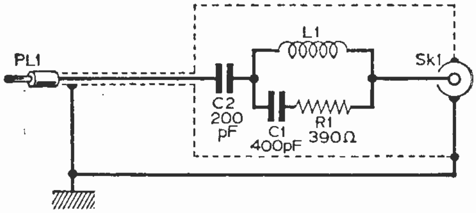


Fig. 3: A dummy aerial unit. The coil L1 consists of 40 turns of 28s.w.g. enamelled wire wound over 1in. of a ¼in. diameter plastic rod. The unit should be enclosed in a metal can.

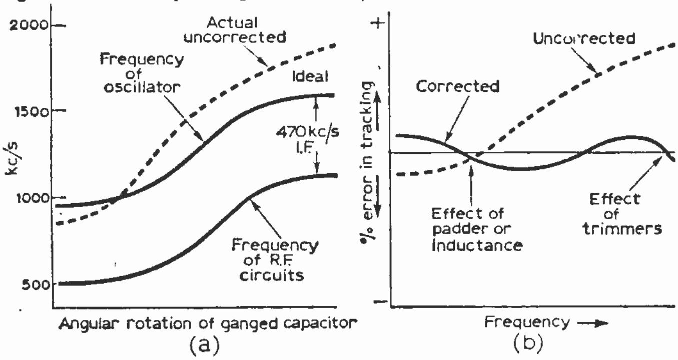


Fig. 4: Necessity for padding and trimming. (a) Rate of change of frequency and of angle of rotor of tuning capacitor is not equal for both r.f. and oscillator circuits. (b) Adding parallel and series capacitance modifies the tracking error. Alternative method consists of forming blades of oscillator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

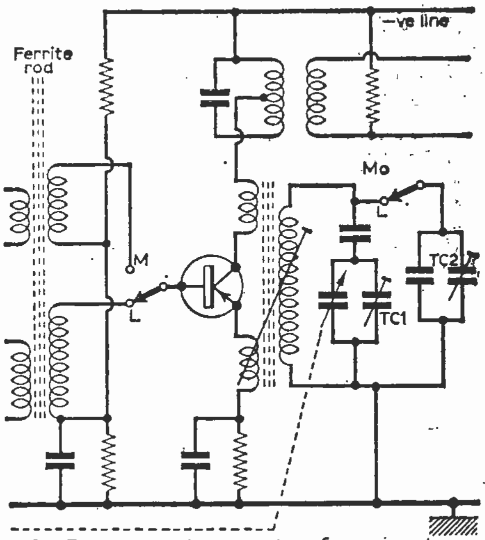


Fig. 5: Typical transistor receiver frequency changer. TC1 is a common trimmer, across the oscillator section of the ganged capacitor. TC2, plus a fixed capacitor, is switched across the circuit for l.w. reception. The coil is tuned by a common core.

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.

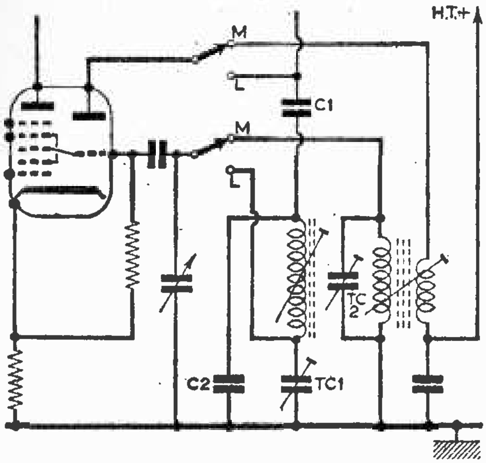


Fig. 6: Typical valve frequency changer. Separate bottom-coupled coils are used and the capacitors C1, C2 provide effective series capacitance for long-wave tuning.

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. wavetrap 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)=260kc/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 cricuit, 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

EFFICIENT 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,

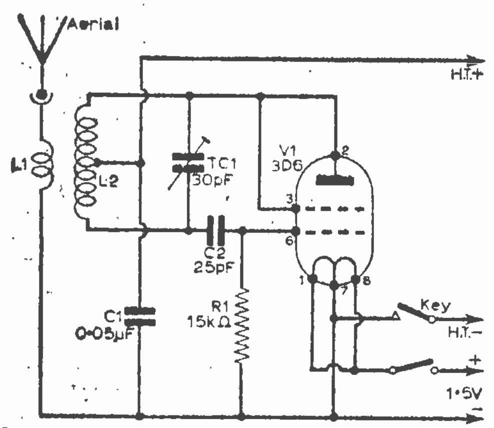


Fig. 1: The circuit of a one-valve model control transmitter.

the drain is 0·22A from a 1½V 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 loctal 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.

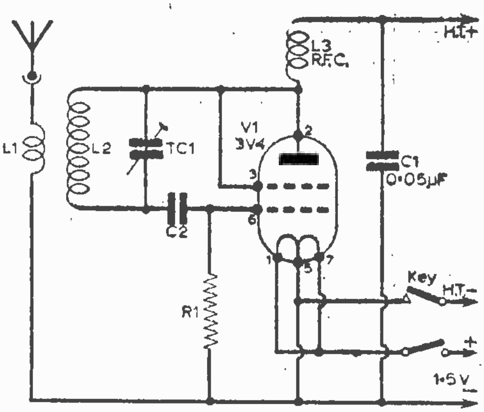


Fig. 2: Including an r.f. choke avoids the need for a tapped coil.

The transmitter can be tested, 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 ⅜in. 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 ⅞in. 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 centre-tap is required this is made by soldering a lead on the centre turn of the coil.

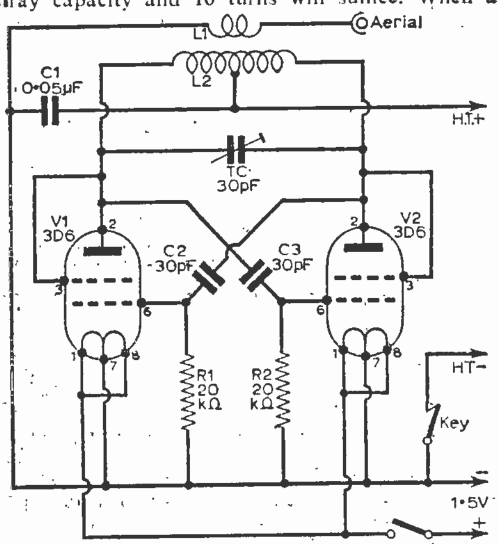


Fig. 3: A two-valve circuit for greater power.

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 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 over-wound on L1 but situated about ¼in. from one end of L1.

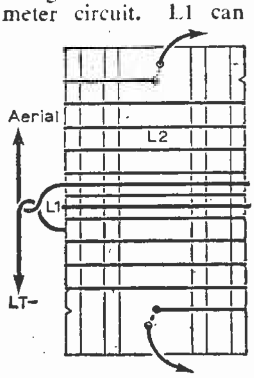


Fig. 4: Winding details for a suitable tuning coil.

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

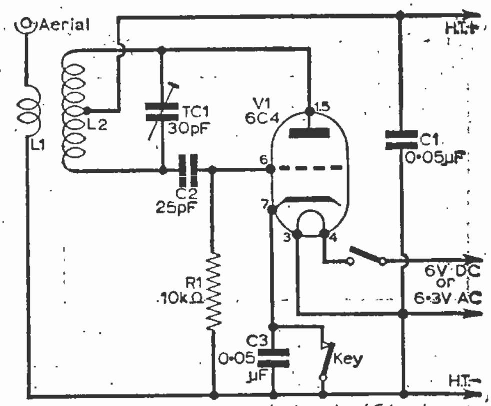


Fig. 5: A transmitter employing the 6C4 valve.

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 VC1 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 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 8ft 6in. long. For average purposes some change in the aerial length will not be important.

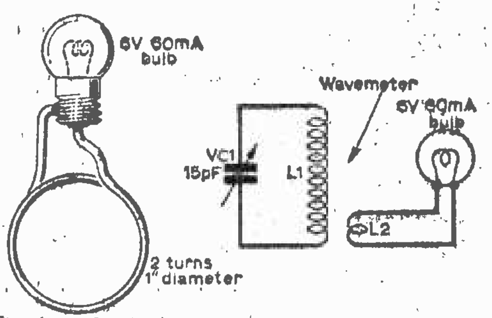


Fig. 6: Left: the lamp loop; right: a simple absorption wavemeter.

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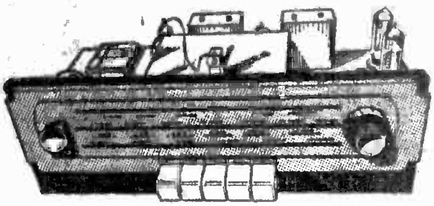

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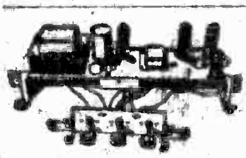

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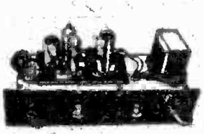

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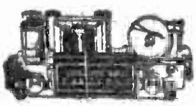

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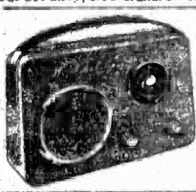

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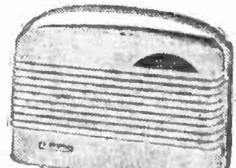

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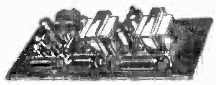
4 TRANSISTOR MINIATURE PUSH-PULL AUDIO AMPLIFIER



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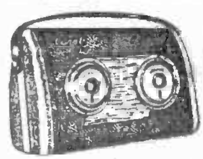

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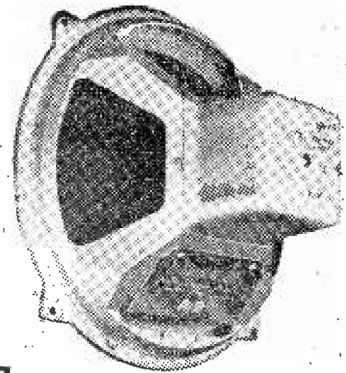

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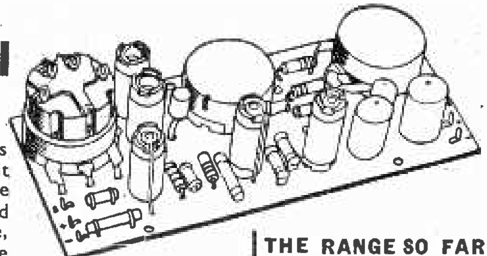

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Kits complete with knobs, instructions, etc. Escutcheons available to requirement at 10/6 each.

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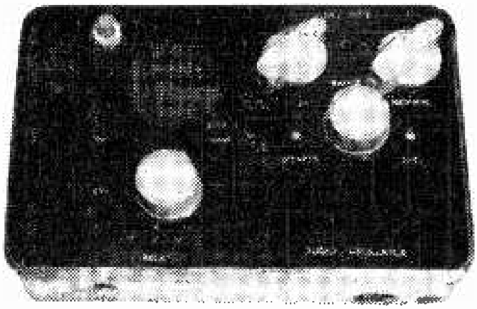


The MULTITONE

AN AUDIO OSCILLATOR ● A SQUARE-WAVE AND SAW-TOOTH GENERATOR ● A METRONOME ● A SWITCHING UNIT ● A SIMPLE ELECTRONIC ORGAN

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.

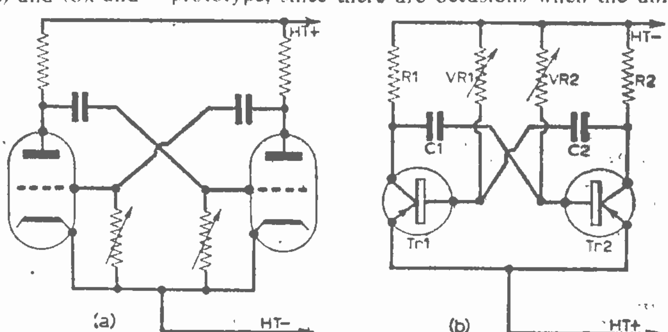


Fig. 1: Basic multivibrator circuits for (a) valves, (b) transistors.

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 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

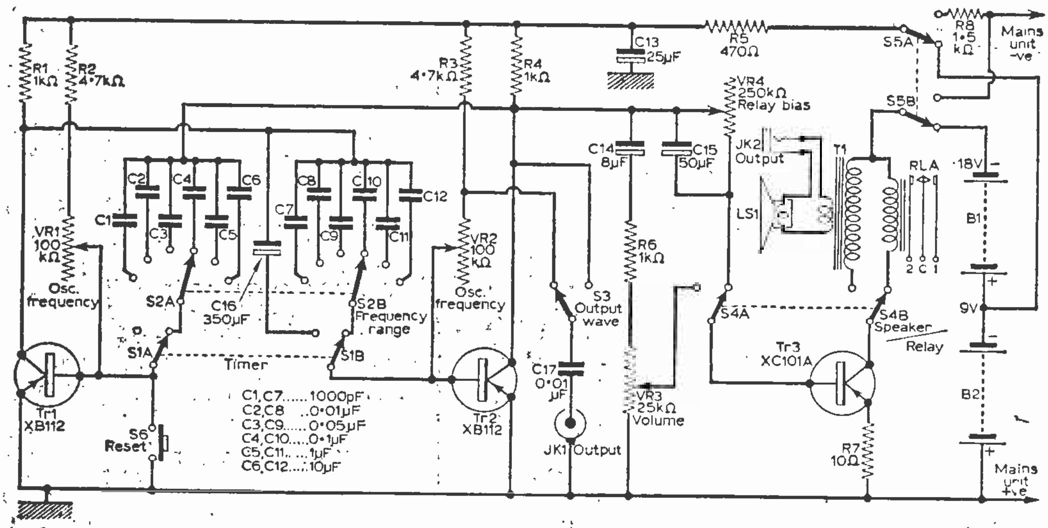


Fig. 2: The fully developed circuit of the instrument.

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 distor-

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

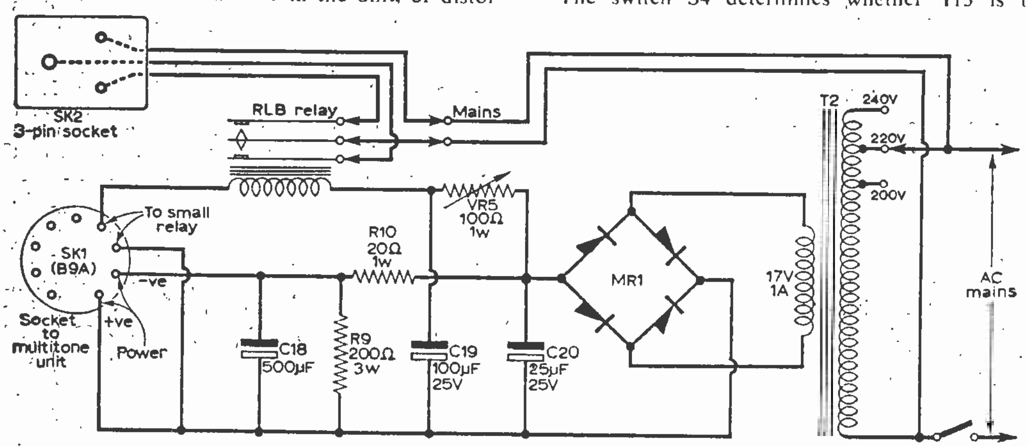


Fig. 3: A mains supply unit for the Multitone.

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

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 ¼W, 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 electroyltic 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)

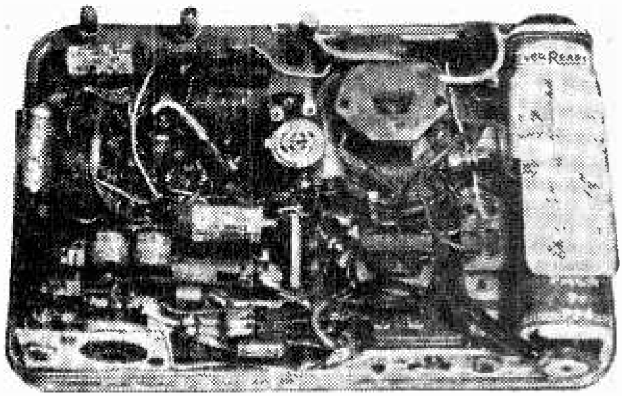
Miscellaneous:
RLA High speed relay, 1,000Ω + 1,000Ω
T1 Output transformer
LS1 Small speaker unit (see text)
JK1, 2 Miniature jack sockets
B1, 2 9 volt battery (PP4)

Switches:
S1 Slide switch, d.p.d.t.
S2 Rotary switch, 6 way
S3 Slide switch, s.p.d.t.
S4, S5 Slide switch, d.p.d.t.
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 6¾in. x 4½in. x 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.



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:
MR1 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

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.

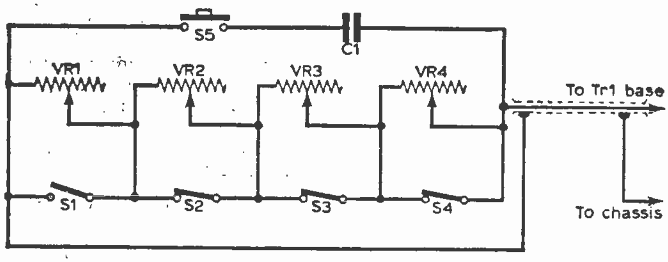


Fig. 4: The electronic organ keyboard circuit.

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 l.t. 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

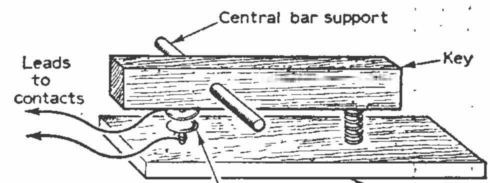


Fig. 5: The basic construction required in an organ keyboard.

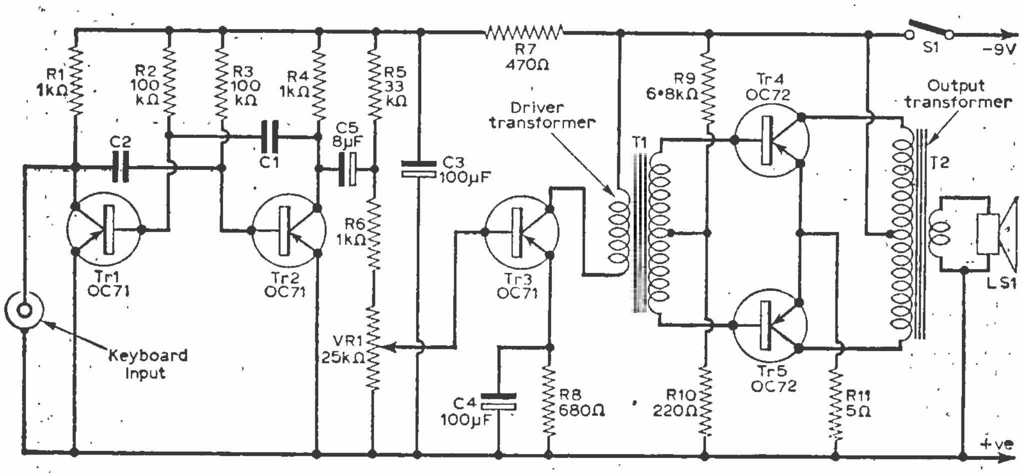
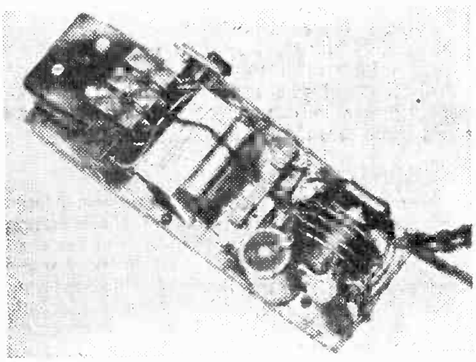


Fig. 6: The circuit of a monotone organ.

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.



A view of the mains power pack.

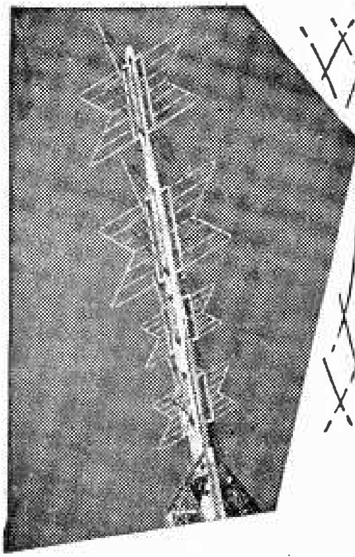
The basic idea of how a keyboard can be adapted or built is shown in Fig. 5. Contacts consisting of drawing pins are held together by pressure from a light spring embedded in small indents drilled in the key and baseboard at the front end. The keys are supported by a central bar passing through the keys.

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 500kΩ are employed. In large keyboards not all these potentiometers should be as high as 500kΩ 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 0.01μF is switched in with a press-button switch (C1 and S5 in Fig. 4) any note emitted will be dropped by a half-tone. ■



On Your Wavelength

By THERMION

THE 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 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 enthralment 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.

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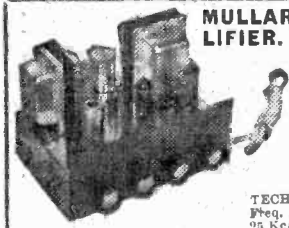
COMPLETE KIT comprising items above	15 gns.	+ 10/- Carr.

Leaflet, circuits, instructions, 2/- post free.

MULLARD "3-3" HI-FI AMPLIFIER. 3 VALVES 3 WATT



3 ohm and 15 ohm Output. A really first-class Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86, EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

TECHNICAL SPECIFICATION—Freq. Response: + or — 1 dB 40 c/s-25 Kc/s. Tone controls: Max. Treble Cut 12 dB at 10 Kc/s. Max. Bass Boost 14 dB at 80 c/s. Sensitivity: 100 Mv for 3 w. output. Output Power (at 400 c/s): 3 w. at 1% total harmonic distortion. Hum and Noise Level: At least 70 dB below 3 w.

COMPLETE KIT (incl. valves, all components wiring diagram and special quality sectional Output Trans.). Bgn. Price £6.19.6. Carr. 4/6. Complete wired and tested, 8 gns. Wired power O/P socket and additional smoothing for Tuner Unit, 10/6 extra.

Bronze Escutcheon, Printed Vol. Treble, Bass, On-Off, supplied with each Kit.

Recommended Speakers—WB, HF 1012, £4.7.6. Goodmans AXIOM 10, £6.5.0. 8in. AXIETTE £5.5.0 or AUDIOM 51, £8.10.0.

NEW BRITISH RECORDING TAPE

Famous Manufacturer. Bulk purchase, genuine recommended Tape Bargain. Unconditional Guarantee. Fitted Leader & Stop Foils (except 3in.).

	Standard (PVC base)		Long Play (P.V.C. base)		D'ble Play (Mylar base)	
3in.	150ft.	3/9	225ft.	4/9	300ft.	6/6
5in.	600ft.	11/6	900ft.	15/-	1200ft.	25/-
5¾in.	850ft.	14/6	1200ft.	17/6	1800ft.	32/6
7in.	1200ft.	17/6	1800ft.	22/6	2400ft.	42/6

Post and Packing—3in. Reels, 6d. Each additional Reel, 3d. 4in. to 7in. Reels 1/-. Each additional Reel, 6d.

EMPTY TAPE REELS (Plastic): 3in. 1/3, 4in. 2/-, 5in. 2/-, 5¾in. 2/-, 7in. 2/3.
PLASTIC REEL CONTAINERS (Casettes): 3in. 1/3, 5in. 1/9, 5¾in. 2/-, 7in. 2/3.

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

Volume Controls—5K-2 Meg. ohms, 3in. Spindles. Morganite Midget Type 1⅛in. diam. Guar. 1 years LOG or LIN ratios less Sw. 3/-. DP. Sw. 4/6. Twin Stereo less Sw. 6/6. DP. Sw. 8/-. Specials to order.

SPECIAL BARGAIN

½ Meg. VOL. Controls DP. Sw. ¼" flatted spindle. Famous Mfrs. 4 for 10/-, post free.

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

TRIMMERS. Ceramic (Compression Type)—30pF, 50pF, 70pF, 9d; 100pF, 150pF 1/3; 250pF, 1/6; 600pF, 1/9.

PHILIPS. Bee Hive Type (conc. air spaced)—2-8pF, 1/-; 3-30pF, 1/-.

KNOBS—Modern Continental types. Brown or Ivory with Gold Ring; 1" dia., 9d. each; 1⅛", 1/- each; Brown or Ivory with Gold Centre, 1" dia., 10d. each; 1½", 1/3 each. LARGE SELECTION AVAILABLE.

METAL RECTIFIERS. STC Types—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

TUB-ELECTROLYTICS-CAN

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

DE-LUXE RECORD PLAYER KIT

Incorporating 4 Sp. Garrard Auto-Slim unit and Mullard latest 3 w. amplifier (ECL 86 and EZ 80), vol., bass and treble controls, with 8" x 5" 10,000 line speaker.
Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue relief. Size 17½" x 15" x 8".

COMPLETE KIT £13.19.6
Carr. and Ins. 10s.
Cat. & Const. details 2/6 (free with kit).

BARGAINS — 4-SP. PLAYER UNITS

Single Players	carr. 3/6
E.M.I. Stereo/Mono	£5.10.0
E.M.I. Junior "985"	£3.7.6
Auto-changers	carr. 5/-
BSR UA16	£6.19.6
BSR UA14	£6.10.0

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s ⁹⁄₁₆in. diam.	5/3
Osc. Coil M. & L.W.	5/9
Midget Driver Trans. 3.5:1	6/9
Midget Output Trans. Push-Pull—3 ohms	6/9

Elect. Condensers—Midget Type 1 mfd.-50 mfd. ea. 1/9, 100 mfd. 2/-. 12V.
Condensers 150 v. working: .01 mfd., .02 mfd, .03 mfd., .04 mfd. 9d.; .05 mfd., .1 mfd., 1/-. .25 mfd., 1/3; .5 mfd., 1/6, etc.
Midget Tuning Condensers. J.B. "OO" 208 pF and 176 pF, 8/6. ditto with trimmers, 9/6. J.B. 220pF and 105pF conc. slow motion 10/6. 365pF single 7/6. Sub. Min. ¾in. Dilemin 100 pF, 300pF, 500pF, 7/- each.
FERRITE AERIALS. M. & L.W. car aerial coil 9/3.
Midget Vol. Control with edge control knob, 5 K/ohms, with switch 4/9; Ditto less switch 3/9.
Speakers: P.M.: 2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms, 13/6. 7 x 4in. Plessey 35 ohms, 23/6.
Ear Plug Phones—Min. Continental type 3ft. lead, jack plug and socket. High Imp., 8/-. Low Imp., 7/6.
Brand New, Mfrs. 1st grade. 1 OC44 & 2 OC45, 15/6. 1 OC81D & 2 OC81, 15/6. All above and OA81, 32/6. Post Free.

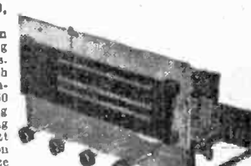
RECORD PLAYER CABINETS 59/6 Carr. & Ins 5/-.

Contemporary style, rexine covered cabinet in two-tone maroon and cream. Size 15½" x 14¾" x 8½", fitted with all accessories including baffle board and Vinair fret. Space available for all modern amplifiers and auto-changers etc. Uncut record player mounting board 14¾" x 13¾" supplied.

2-VALVE 2 WATT AMPLIFIER. EZ80 and Twin stage ECL82 with vol. and neg. feedback tone control. A.C. 200/250V with knobs, etc., ready wired to fit above cabinet. £2.17.6. P. & P. 1/6. 7" x 4" Speaker and trans., 23/-. P. & P. 2/-.

COMPLETE R/PLAYER KIT. As ill. inc. BSR UA14 Unit. New Bargain Price Now Only £11.10.0. 7/6 carr. Double wound mains Tfr no live chassis!

7 VALVE AM/FM RADIOGRAM CHASSIS



Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.
Three Waveband and Switched Gram positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Philips Continental Tuning Insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ x 6½in. Height 7½in. Edge illuminated glass dial 11½ x 3½in.
Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250v. operation. Magic-eye tuning. Cct. diagram now available.

Aligned and tested ready for use **£13.10.0** *Carr. & Ins. 7/6*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra. 3 ohm P.M. Speaker only required. Recommended Quality Speakers 10in. Elac H/D, 30/-; 13½ x 8in. E.M.I. "Fidelity", 35/-; 12in. B.A. with cone Tweeter, 42/6. Carr. 2/6.

TYGAN FRET (Contam. pat.), 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/- etc.

EXPANDED ANODISED METAL. Attractive gilt finish ¼ in. x ¼ in. diamond mesh 4/6 sq.ft. Multiples of 6in. cut. Max. size 4 ft. x 3ft., 47/6 plus carr.

ENAMELLED COPPER WIRE—¼lb. reels 14g-20g. 2/6; 22g-28g, 3/-; 30g-34g. 3/9; 36g-38g, 4/3; 39g-40g 4/6, etc.

BONDACOUST Speaker Cabinet Acoustic Wadding (1in. thick approx.) 12in. wide, any length cut, 1/6 ft., 4/- yd. **TINNED COPPER WIRE.** 16-22g. 2/6 ¼lb. **ERSIN MULTICORE SOLDER.** 60/40 4d. per yard. Cartons 2/6 etc.

TRS Est. 1949

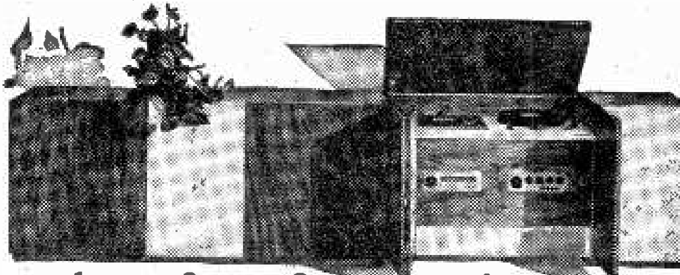
We manufacture all types Radio Mains Transf.. Chokes, Quality O/P Trans., etc. Enquiries invited for Specials. Prototypes for small production runs. Quotations by return. Send for detailed bargain lists, 3d. stamp.

RADIO COMPONENT SPECIALISTS

70 Brigstock Rd., Thornton Heath, Surrey. *Hours: 9 a.m.-6 p.m., 1 p.m. Wed.*
THO 2188. *Terms C.W.O. or C.O.D. Post and Packing up to ½ lb. 9d.; 1 lb. 1/3; 3 lb. 2/3; 5 lb. 2/9; 8 lb. 3/6.*

Easy-to-make cabinets to house your hi-fi

1 Tape deck/record storage
2 & 5 Loudspeaker
3 Record storage
4 Radio/record player



These easy-to-make sectional units are part of an outstanding new range of designer-styled cabinets for high fidelity sound equipment. They are the direct result of a close collaboration between well-known Industrial designer Frank Guille Des RCA FSIA and Percy Wilson MA, technical editor of *"The Gramophone"* and prominent authority on acoustical engineering.

The cabinets which will house almost any combination of Hi-Fi equipment have been especially designed for making in Vipboard. Vipboard is a fine quality board with superior screw-holding qualities; specifically made for easy and economical furniture-making within the home. It comes in 20 standard sizes, fully veneered on all surfaces and ready to polish. No special skills are required, and you need only basic household tools. Total cost of Vipboard for the cabinets shown above is £27.0.4. The individual cabinets cost from £2.8.11 (units 2 and 5).

Vipboard fully veneered chipboard with the natural wood finish

Find out how you can choose and build the units best suited to your Hi-Fi requirements—*at a fraction of their "shop price"*. Ask for **Free Instruction Leaflets** and the **Vipboard Furniture Brochure** at your local Vipboard stockist, or write to: Vipboard Division, G.W.E. Boards Limited, 6 John Street, London WC1. Holborn 8421

VALVES FOR RADIO, TV AND AUDIO APPLICATIONS

All valves sold by us are first quality, unused and guaranteed for three months.

WHEN ORDERING BY MAIL, PLEASE ADD 2/6 IN THE £ FOR HANDLING. MINIMUM CHARGE 1/6

Please send 6d. stamp for new valve price list.

OA2	4/-	6AV6	5/-	787	16/-	83	8/-	ECC40	9/-
OA81	2/-	6B7	5/-	9BW6	7/-	85A2	8/6	ECC81	3/-
OB2	6/-	6B8G	2/-	10D1	7/-	90AV	15/-	ECC84	6/6
OC3	5/6	6BA6	4/9	10P14	12/-	90C1	8/-	ECC85	6/6
OD3	5/-	6BE6	5/-	11D3	7/-	807	9/-	ECC88	9/-
1A5	4/6	6BG6G	12/-	11D5	7/-	832	20/-	ECF80	7/6
1A7GT	7/-	6BH6	7/-	12AC6	8/-	866A	14/-	ECF82	7/-
1D5	7/6	6BJ6	8/-	12AH8	11/-	884	10/-	ECH21	9/-
1H5GT	7/-	6BQ7A	7/-	12AT6	4/-	954	5/-	ECH35	10/-
1R5	5/-	6BR7	11/6	12AT7	3/-	955	3/-	ECH42	7/-
1S4	4/6	6BR8	5/-	12AU6	5/6	957	5/-	ECH81	6/-
1S5	4/6	6BW6	9/-	12AU7	5/-	958A	4/-	ECH83	7/6
1T4	3/-	6BW7	9/-	12AV7	8/-	959	8/-	ECL80	6/-
1U4	5/-	6C5GT	6/-	12AX7	6/-	5670	10/-	ECL82	6/6
1U5	5/-	6C8G	7/-	12AY7	10/-	5673	10/-	ECL83	9/-
1X2A	7/-	6CB6	5/-	12B4A	9/-	5965	5/-	ECL86	8/-
1X2B	7/-	6CD6G	17/-	12BA6	6/-	6146	27/6	EF6	7/-
2CW4	14/-	6CL6	10/-	12BE6	4/6	AC/TH1	14/-	EF9	12/-
2D21	6/-	6CW4	14/-	12BH7	6/-	AC6/PEN	6/-	EF37A	6/-
3A4	3/6	6D3	7/6	12E1	20/-	AZ1	5/6	EF39	5/-
3A5	7/-	6D4	15/-	12K8	10/-	AZ31	8/-	EF40	9/-
3B7	4/6	6D8	15/-	12SC7	3/6	AZ41	6/-	EF41	6/9
3D6	3/-	6F7	4/6	12SG7	3/-	CIC	5/-	EF42	6/-
3E29	50/-	6F17	6/-	12SJ7	5/-	CL33	9/-	EF80	5/-
3Q4	6/6	6F23	8/6	12SQ7	10/-	CY31	5/6	EF83	9/6
3Q5GT	6/6	6J4	9/-	19AQ5	5/-	DAF96	5/6	EF85	6/-
3S4	5/-	6J5	5/-	19BG6G	7/-	DD41	7/-	EF86	5/6
3V4	5/6	6J7G	4/-	20L1	12/-	DF66	6/-	EF89	4/6
5R4GY	9/-	6K6GT	6/-	20P1	14/-	DF96	5/6	EF95	5/-
5U4G	5/-	6K7	5/-	25A6G	5/-	DK40	11/-	EF98	9/-
5U4GB	6/-	6K8G	4/-	25L6GT	8/-	DK92	6/6	EF183	7/-
5V4G	8/-	6L6	9/-	25Z4G	6/6	DK96	6/6	EF184	7/-
5Y3G	4/-	6L6G	6/-	25Z5	7/-	DL68	10/-	EH90	7/3
5Y3GT	5/-	6L18	8/-	25Z6GT	8/6	DL96	6/-	EL34	10/-
5Z4	9/-	6N7	6/-	28D7	6/-	DM70	5/-	EL36	9/-
5Z4GT	8/-	6Q7G	6/-	30C15	8/6	DY86	7/-	EL37	17/6
6A8G	6/-	6SG7	5/-	30F5	8/6	E88CC	15/-	EL38	17/6
6AB4	6/-	6SL7GT	4/6	30FL1	9/-	E180F	15/-	EL41	7/3
6AF4	11/-	6SN7GT	4/6	30PL1	10/6	EABC80	6/-	EL42	7/-
6AG7	5/-	6SQ7GT	5/-	35L6GT	6/6	EAF42	8/6	EL81	8/6
6AH6	11/-	6U4GT	9/6	35W4	4/6	EBC3	13/-	EL83	7/-
6AK5	5/-	6U7G	10/-	35Z3	7/-	EBC41	6/9	EL84	5/-
6AK6	7/-	6V6	9/-	35Z4GT	5/-	EBC81	6/6	EL85	7/-
6AM6	4/-	6V6G	3/6	35Z5GT	5/-	EBF80	6/6	EL86	7/6
6AQ5	6/-	6V6GT	5/-	50B5	8/-	EBF83	7/-	EL360	12/6
6AS6	5/-	6X4	4/-	50C5	6/-	EBF89	6/-	EL821	6/-
6AS7G	22/6	6X5G	4/9	50CD6G	25/-	EBL1	11/-	EL822	8/-
6AT6	4/-	6X5GT	5/6	50L6GT	6/-	EBL21	11/-	EM34	9/6
6AU6	5/-	7C6	6/-	53KU	9/-	EC92	6/-	EM80	6/6

Z & I AERO SERVICES LTD.,

Retail Shop: **85, TOTTENHAM COURT ROAD, W.1**
Tel. LANgham 8403

Head Office and Warehouse now in new premises at: **44A WESTBOURNE GROVE, W.2.**
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Please send ALL correspondence and Mail Orders to the Head Office.

EM81	7/6	PEN45	6/6	U50	5/-
EM84	8/-	PEN45DD		U76	5/-
EM85	9/-		11/-	U191	9/-
EM87	8/6	PEN383	10/-	U251	12/6
EN31	10/-	PEN453DD		U281	13/-
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EY84	7/6	PL36	8/-	U801	20/-
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GZ32	10/-	PM84	9/-	UBF89	7/-
GZ34	10/-	PY33	10/-	UBL21	11/-
GZ37	9/-	PY80	4/9	UCC84	8/-
HVR2	7/-	PY81	5/6	UCC85	6/-
KT66	15/-	PY82	5/-	UCF80	9/6
KT88	20/-	PY83	6/-	UCH21	8/-
ME41	7/6	PY88	7/6	UCH42	7/-
MHLD6	11/-	PY801	6/6	UCH81	7/-
MU14	4/-	QQV02-6		UCL82	7/6
N78	15/-		45/-	UCL83	8/-
PABC80	7/-	QQV03-10		UF41	7/6
PC86	12/-		35/-	UF42	7/-
PC97	8/6	R10	15/-	UF80	6/6
PCC84	5/6	R18	7/6	UF85	6/6
PCC85	7/-	R19	6/-	UF86	8/6
PCC88	10/-	RL18	12/6	UF89	6/-
PCC89	10/-	SU25	12/6	UL41	7/6
PCC189	10/-	TH41	10/-	UL84	6/-
PCF80	5/6	TH233	6/-	UM80	7/-
PCF82	6/6	TH2321	10/-	UU10	8/-
PCF84	10/-	TP22	4/6	UY21	8/-
PCF86	8/-	TP25	4/-	UY41	5/6
PCF801	10/-	TP2620	7/6	UY85	4/9
PCF802	10/-	TT15	35/-	VCR139A	
PCL81	9/-	TT21	32/-		25/-
PCL82	6/6	U12/14	7/-	VP4	12/-
PCL83	7/6	U22	5/-	W81M	5/3
PCL84	6/9	U24	12/-	X65	5/-
PCL85	7/6	U25	11/-	X79	15/-
PCL86	8/-	U31	6/-	Z66	7/-

C.R.T. INDICATORS TYPE 103

Triggered Oscilloscope using a VCR139A 3-in. tube. Switchable Time Base giving 6 speeds from 10 to 20,000 μ sec. "Y" Amplifier with gain of 1,5 and 20. Calibrated "X" shift. "Y" shift voltmeter. Power supplies required can be provided by Power Unit type 917 described below. In perfect condition, complete with description and circuit diagram £7.10.0. Packing and carriage (UK only) 20/-.

'SCOPE POWER UNIT TYPE 917

Mains operated 230V A.C., providing 600 and 450V D.C. at 300mA, 2x6.3V at 3.6A6. .3V at 2.15A, and negative EHT of 2200V at 6mA. Price, in perfect condition £5. Packing and carriage (U.K. only) 20/-.

PRICE for Indicator complete with Power Unit and set of interconnecting cables £11. Packing and carriage (U.K. only) 25/-.

POST OFFICE COUNTERS

Four-digit, non cancelling type, counting from 0 to 9999, 500 Ω Coil 6/6
Ditto 2300 Ω Coil 5/-
The dimensions of the above two types are 1¼in. x 1¼in. x 5in. long.
Four-digit as above, but miniature high speed type, counting speed 600 per minute, 500 Ω Coil, 1in. x 1in. x 3¼in. 7/6
P.P. 1/- each.

MULLARD TRANSISTORS

OC28	17/6	OC71	5/-	OC78D	7/-
OC35	15/-	OC72	8/-	OC81	7/-
OC44	6/-	OC75	6/-	OC81D	7/-
OC45	6/-	OC76	6/-	OC139	12/-
OC70	5/-	OC78	7/-	OC170	8/-

MATCHED PAIRS OF OC81 WITH OC81D 13/- per set

Alignment Aid

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

ALTHOUGH 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 600μA (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.

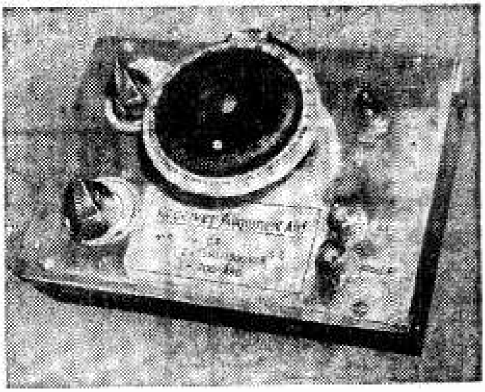
Audio Oscillator

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 = ·01μF (10,000pF) the operating frequency approximates to 3kc/s. Putting instead C8 = C7 × 10 = 0·1μF 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

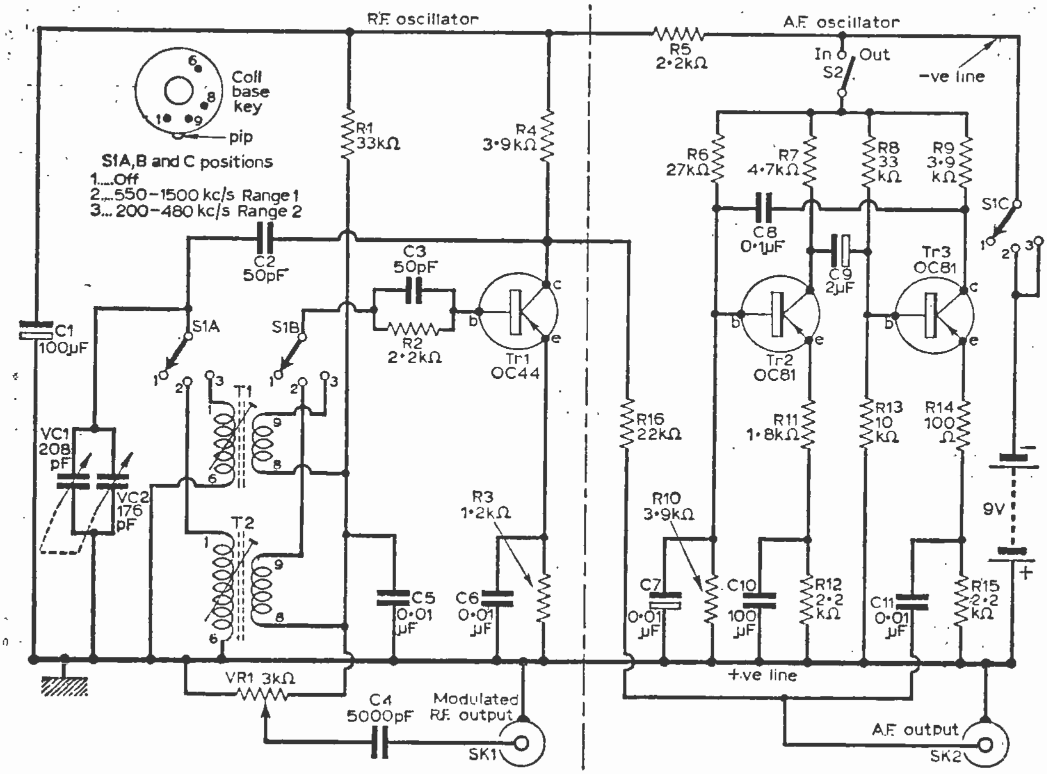


Fig. 1: The complete circuit of the unit.

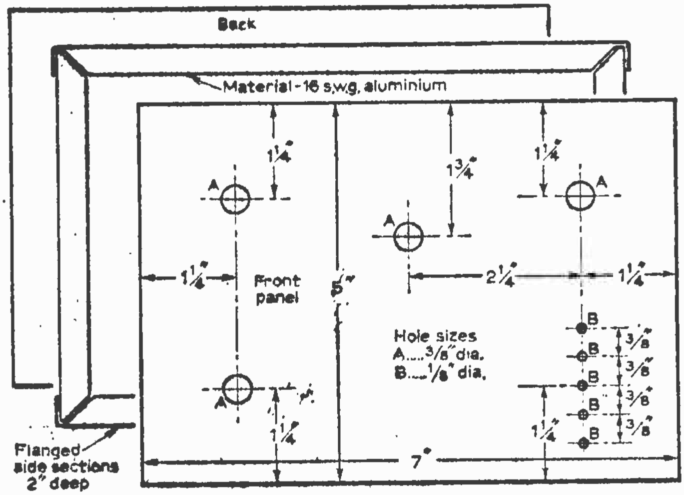


Fig. 2: Details of the instrument's case.

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

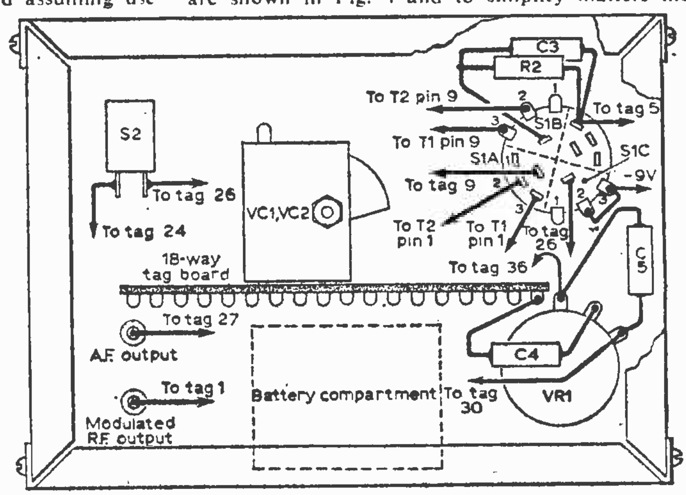


Fig. 3: Layout of major components and S1 connections as viewed from the rear.

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 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 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.

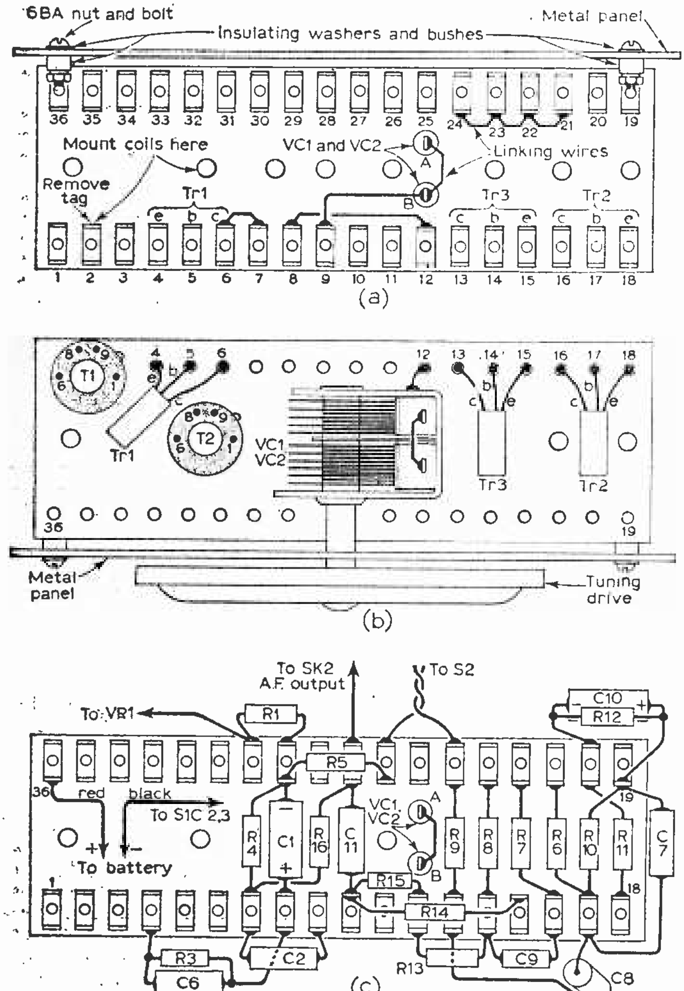


Fig. 4: (a) Tag board numbering and mounting arrangement; (b) top view of tag board; (c) tag board wiring.

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.

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, TR2 OC81, TR3 OC81 — Mullard

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.

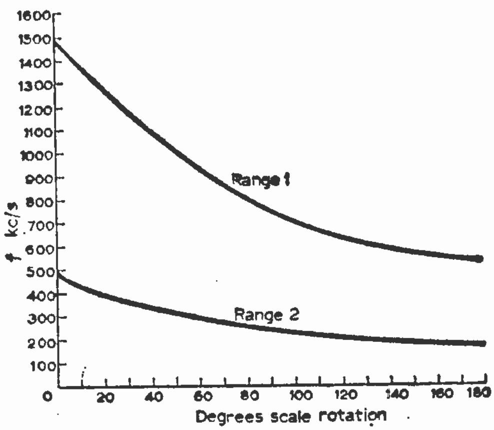
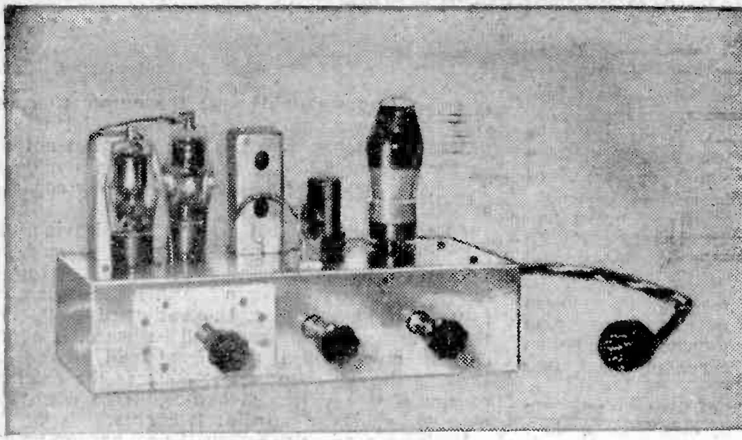


Fig. 5: A frequency/degrees of rotation graph.

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 (881kc/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. ■



THIS 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 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.

chassis via the aerial tuning coils.

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

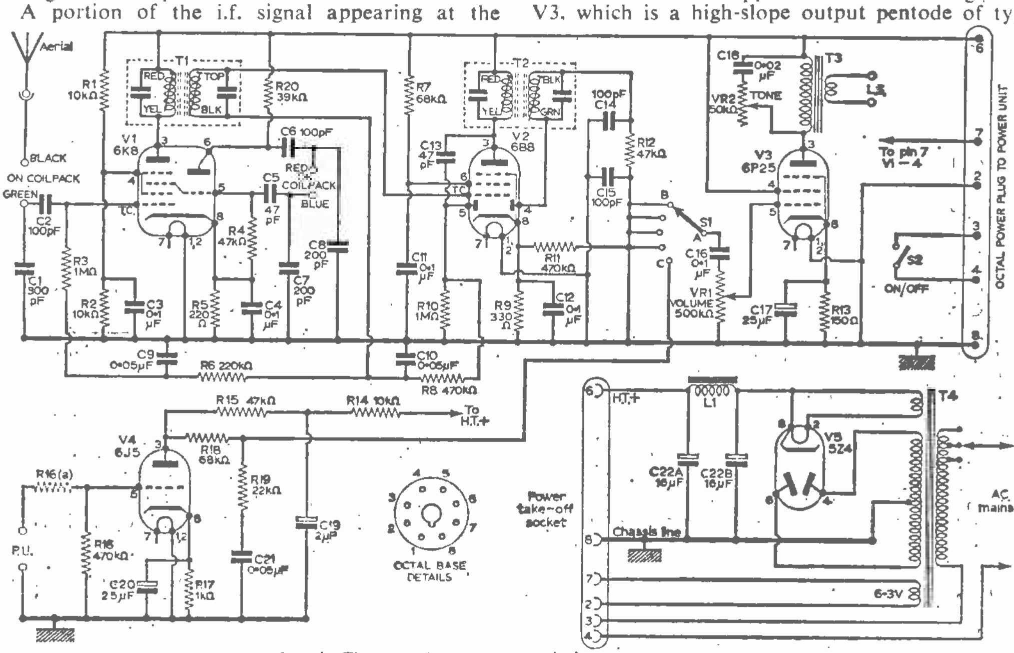


Fig. 1: The complete circuit including the power pack.

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 l.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 ±10%, ½W 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 I.F. transformer, 465kc/s (Denco IFT6B/465)
T2 I.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
LS1 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 ⅜in. 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.

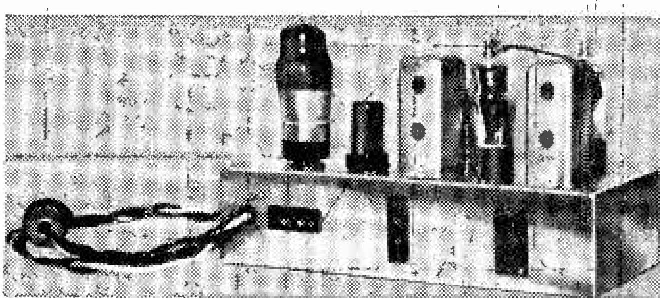
The oft-repeated warning against using ex-equipment capacitors of doubtful origin is again emphasised as these can lead to disappointing results and tedious efforts to trace the cause of unsatisfactory or erratic operation.

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 octal-sized valves. The colour coding of their leads may not necessarily agree with that shown in the 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 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.

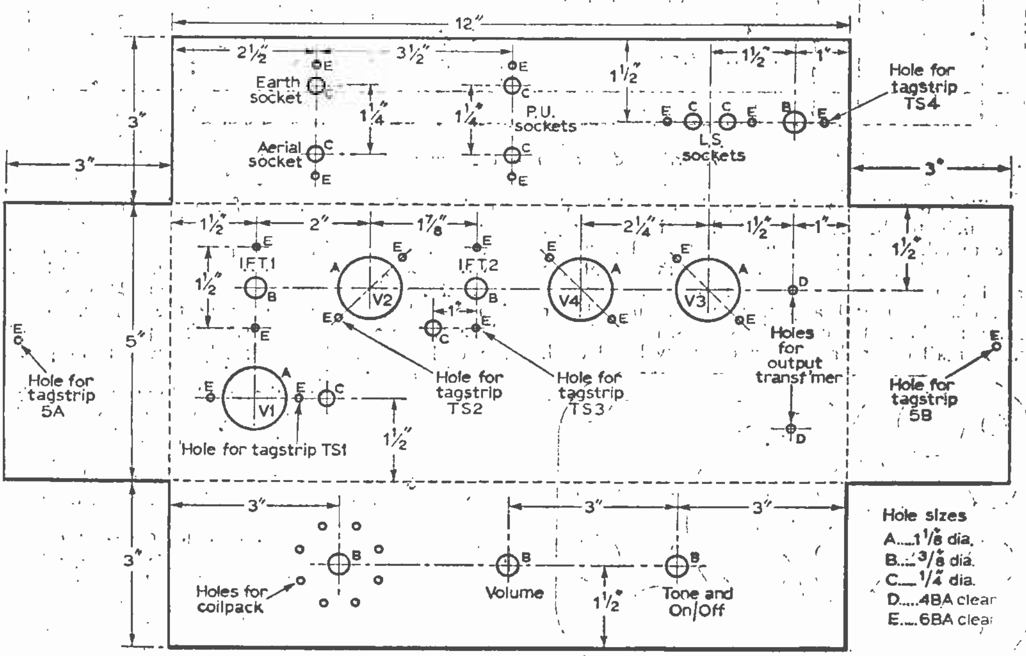


Fig. 2: The main chassis drilling details.

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

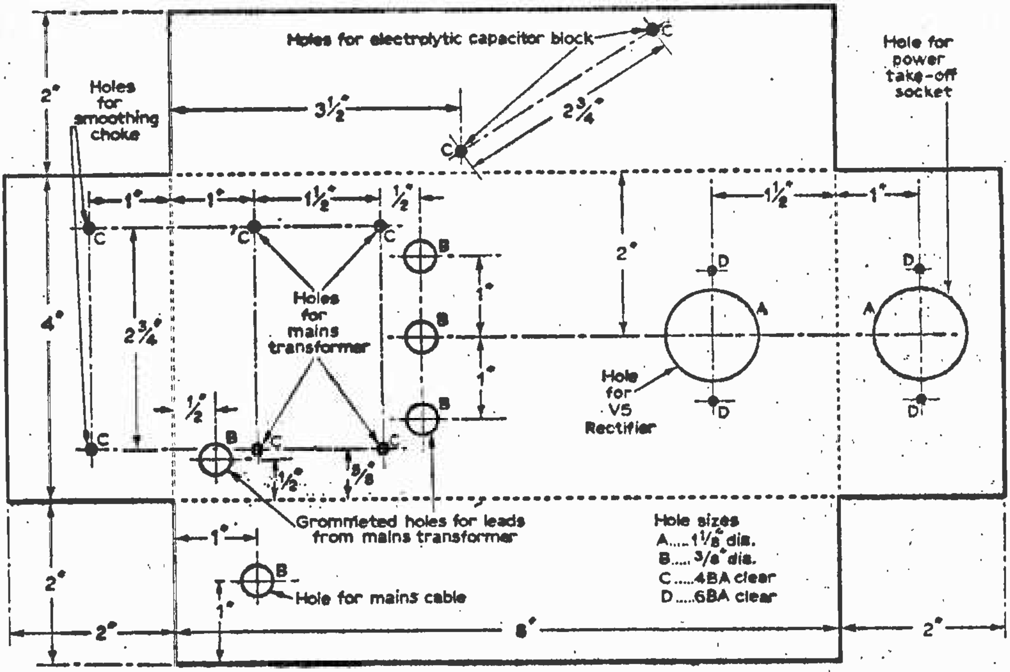


Fig. 3: Drilling dimensions of the power pack chassis.

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 (1⅛in. diameter) and a ⅜in. punch is useful for making the holes for control spindles, mains leads, etc. For all other drilling an ordinary hand drill,

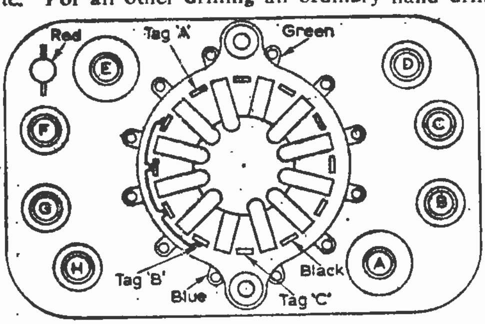


Fig. 4: Coil pack layout.

with bits to provide holes of ⅛in., 4B.A. or 6B.A. clearance, will be adequate.

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.

The group of ¼in. diameter holes shown around the hole which accommodates the control spindle of the coil pack selector switch is to provide access 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. 3¼in. x 2½in. Make a ⅜in. 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.

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 ¼in. holes at each of these positions.

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 ¼in. holes through the marker holes in the card.

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.

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

NO 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 3½in. by 6½in. 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 G7 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 } (Dublier type Q)
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.

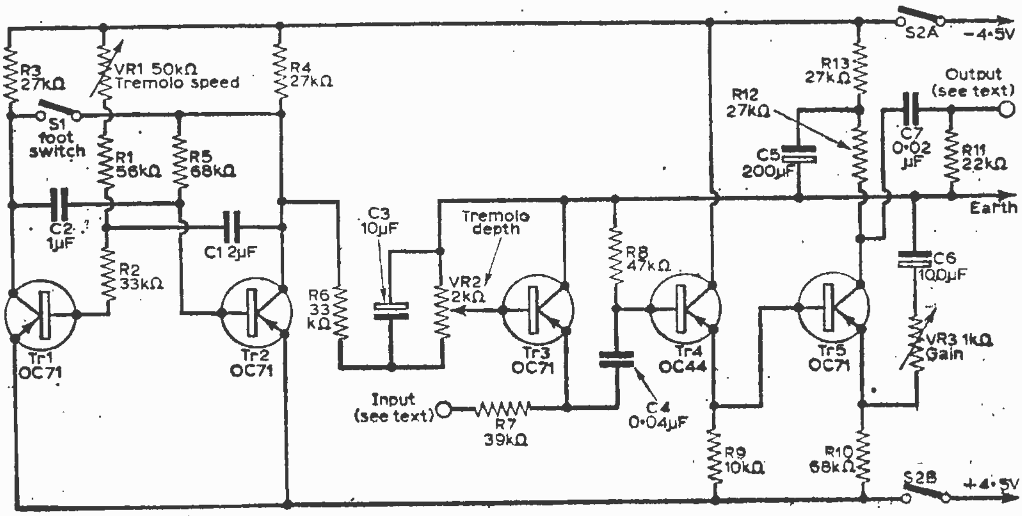


Fig. 1: The tremolo unit circuit.

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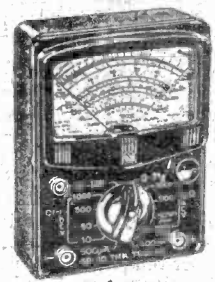

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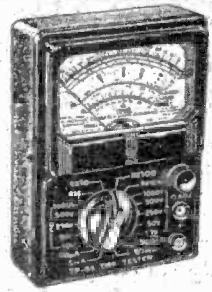

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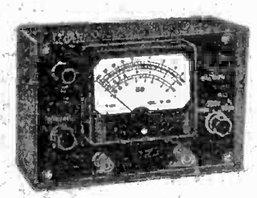

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Construction

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.

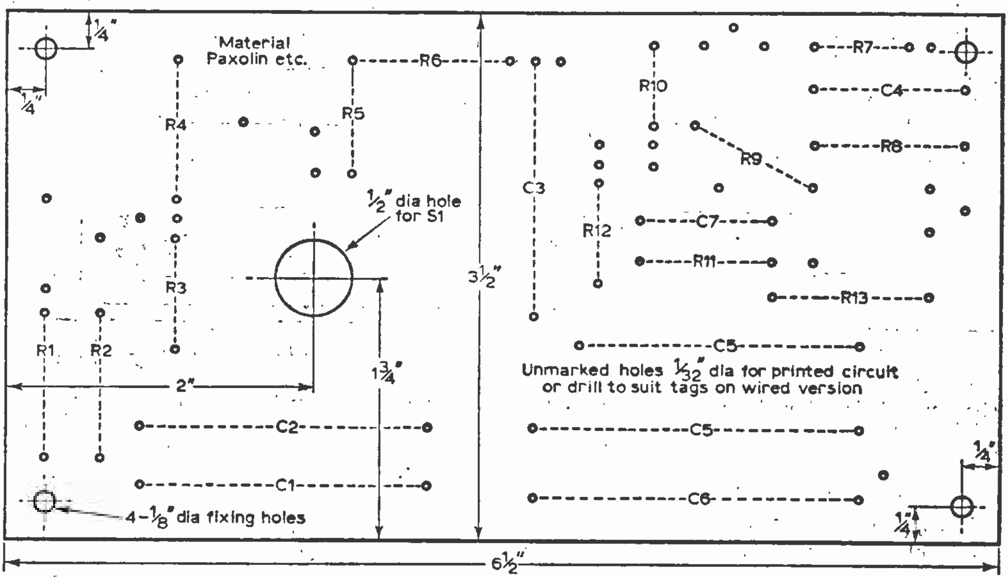

Fig. 2: The drilling dimensions of the panel.

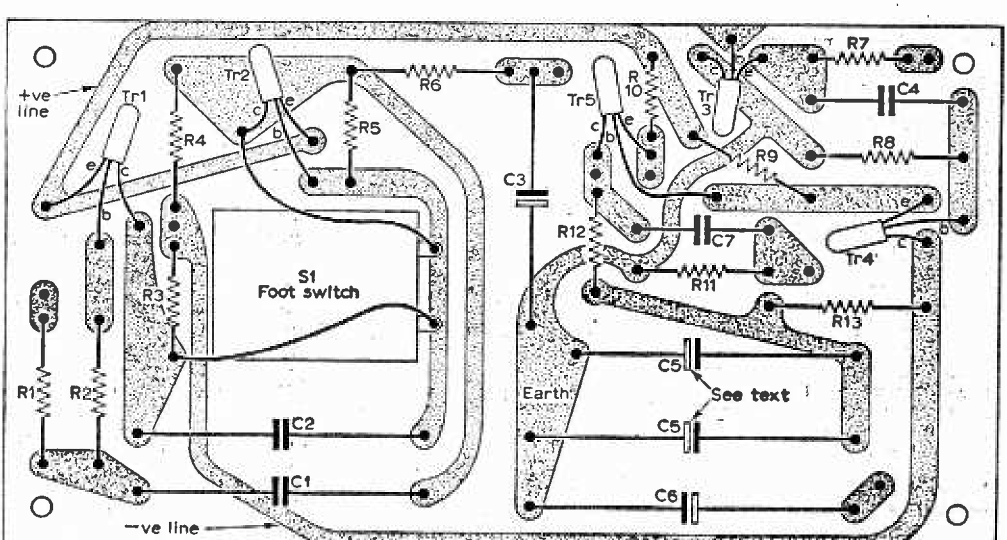

Fig. 3: The printed circuitry and component layout and wiring.

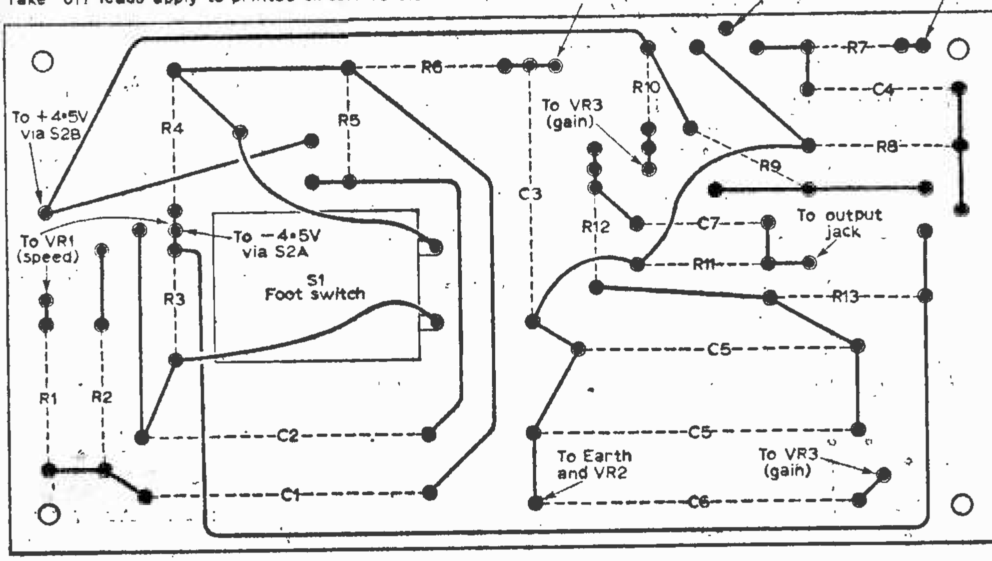

Fig. 4: Point-to-point wiring for a component board using tags fixed into a plain sheet.

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 6¼in. 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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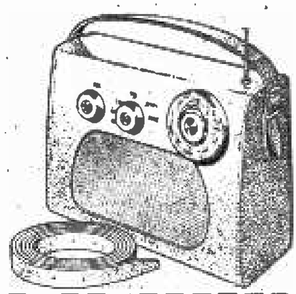

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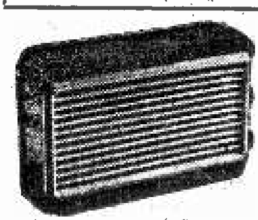

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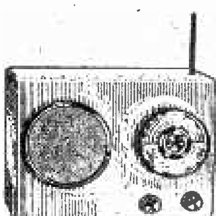

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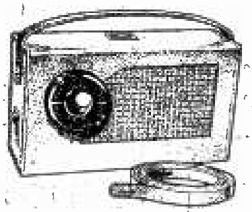

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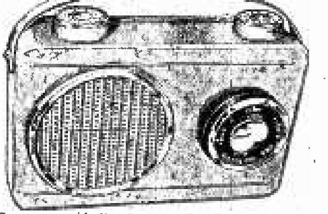

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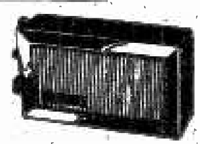

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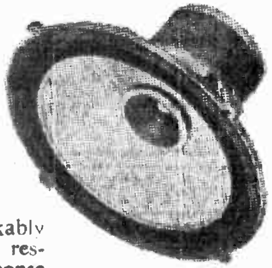

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The treble response is a delight to hear and even my poor quality records sound better, no doubt due to the absence of peaks in the middle and upper register. My pressure unit tweeter has now been dispensed with as it certainly cannot compete with the treble in your unit.

Being lucky enough to live within good range of Wrotham, I was able to put it through tests with various transmissions including the Proms, and we all have been most impressed—the bass improvement is also exceptionally good.

Yours sincerely,
Geo. H. Hunter.

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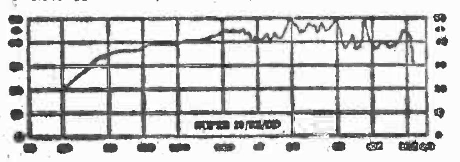

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The text is written for the young beginner and naturally more advanced readers will find some of the information superfluous. The author is sure that any beginner will be able to make this radio as a result of this article.

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

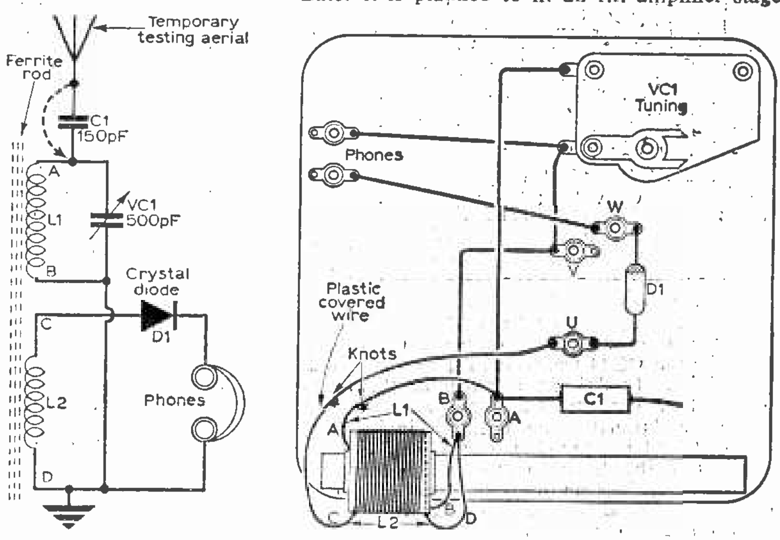


Fig. 7a (left): Crystal detector with aerial transformer consisting of L1 and L2; b (right): the new wiring.

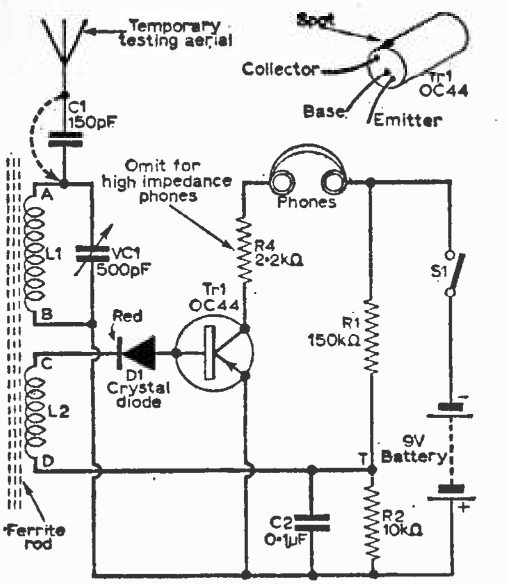
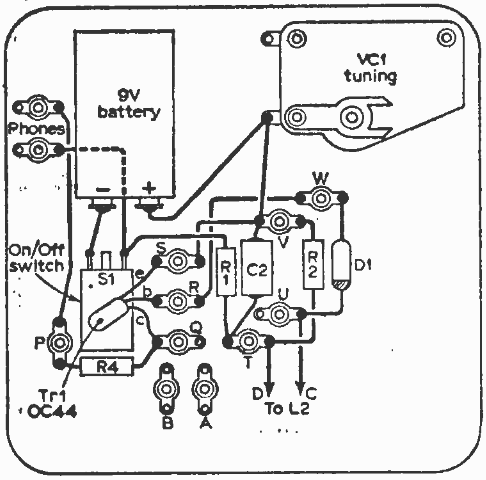


Fig. 8a (above): Incorporating a simple transistor amplifier into the circuit; b (below): the wiring of the amplified set.



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 234. Intended for the receiver type 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 milliamps and A.C. heater supply of 6.3 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 39/-. Carriage 10/-.

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.3 amp. Dropper—tappings marked 200/220/250, 3/6.

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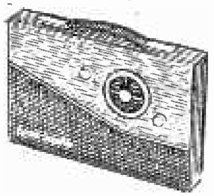

The 6 transistor set with the 8 transistor performance. Incorporating all the latest requirements. Anyone who can solder can make it. Many thousands already in use all over the country. Full coverage of Long and Medium wavebands. Fine looking cabinet, size 11" x 8" x 3". Q.P.P. Output approx. 750 mW. Excellent reception of difficult stations like 208. Variable feed back gives excellent tone. ONLY **£5.19.6**

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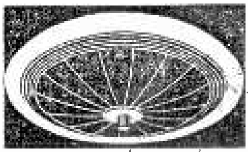

They are ideal in living rooms, shops and offices, in fact anywhere and being plug-in they can be fitted in a jiffy, at no extra expense. Whole shops and offices can be re-lit in minutes and at something like three times the light quantity for the same current i achieved: additional wiring is not necessary to create a tremendous light increase. 40 watt circular fitting. Complete requiring only tube 22/6 plus 2/6 post and packing.

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Chrome ornaments to hold shade. 6/6 per set.

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THE TWIN 20 (Batten model): Similar to above but intended for mounting directly to ceiling or hanging by chains. 18/6, plus 3/6 post.

THE FOUR FOOT 40. A white enamelled batten type fitting, extremely popular as a kitchen light but equally suitable for bedroom or office, etc. Complete ready to work when standard bi-pin tube is fitted. 14/6, plus 4/6 carr. and insurance.

THE FIVE FOOT 80. Similar to above but for 5 foot 80 watt tube. 27/6, plus 7/6 carr. and insurance.

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Made for a famous company intending to make a Battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a Cosmocord pick-up with crystal cartridge and sapphire stylus. Both items new and perfect. Only 19/6 plus 4/6 post and insurance.

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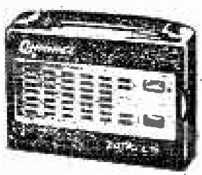

Constructor's parcel: comprises modified two-tone cabinet as illustrated tuning dial, two gang tuning condenser, printed circuit. Costing value 57/6—offered while supplies last at only 19/6 plus 2/6 post. Suitable for your own circuit or to build original circuit. All parts available at highly competitive prices. Do not miss this tremendous bargain.

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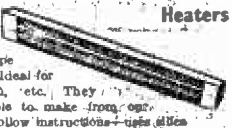

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated 19/6, plus 2/6 post and insurance.

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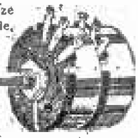

Single and 2-gang types available, standard size with good length spindle, all new. Single type, 1/- each. values available 5K, 25K, 50K, 100K, 250K, 1, 2 meg. Gang type 3/- each—values available 5K + 5K 100K + 100K, 1 meg. + 1 meg.

Copper Clad Element

Mount this under a reflector to make ideal infra red heater, also suitable for building into convector, Blower Heater, drier cabinet, etc., etc., 230/40 v. 1250 watts 12in. long, but can be bent to almost any shape, 7/6 each plus packing and insurance 2/6 extra.

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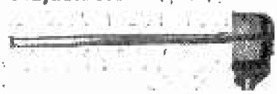

Suitable for Industrial or domestic purposes, such as controlling furnace oven, immersion heater, etc. Can also be used as a flamestat or fire alarm. Made by Sunvic these are approximately 17in. long and adjustable over a range 0 to 550°F. The contacts are rated at 15 amps., 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at £3 or £4 each, these are offered at only 8/6, plus 2/6 postage and insurance.

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Suitable to control elements, heater, soldering irons and boiling rings up to 2,500 watts. Complete adjustable, normal price 55/- each, special snip price 12/6, plus 1/6 postage and insurance.

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2in. Moving Coil 500 micro-amp. f.s. Brand new, 17/6, plus 1/- Packing and Insurance.

Cabinet Snip

This fine cabinet as illustrated but less control knobs is available this month at a special snip price of 12/6, plus 4/6 post and insurance. Size is 13¼in. x 9in. x 4in. and it is nicely covered in two tone I.C.I. fabric.

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A Medium Wave T.R.F. Receiver

A THREE-VALVE DESIGN FOR THE BEGINNER

By M. H. Thomas

THIS 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

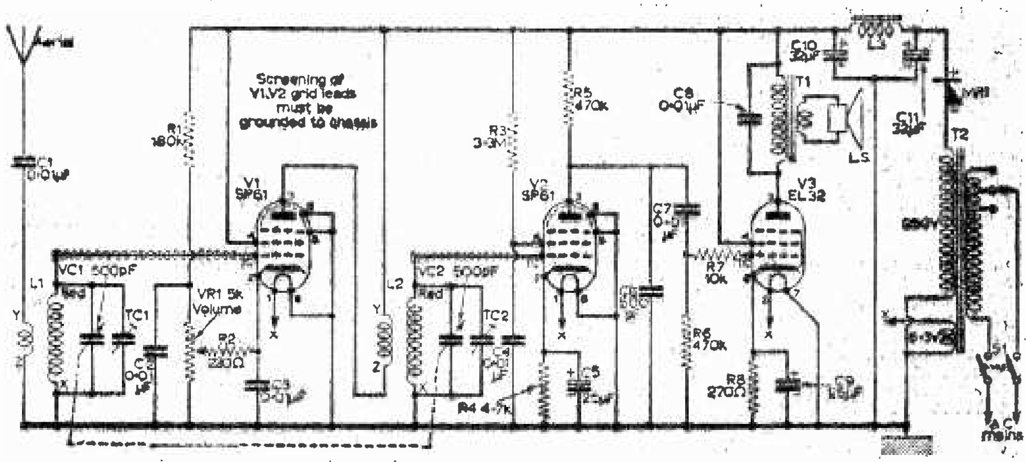

Fig. 1: The simple circuit of the receiver.

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 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.

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 V2 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

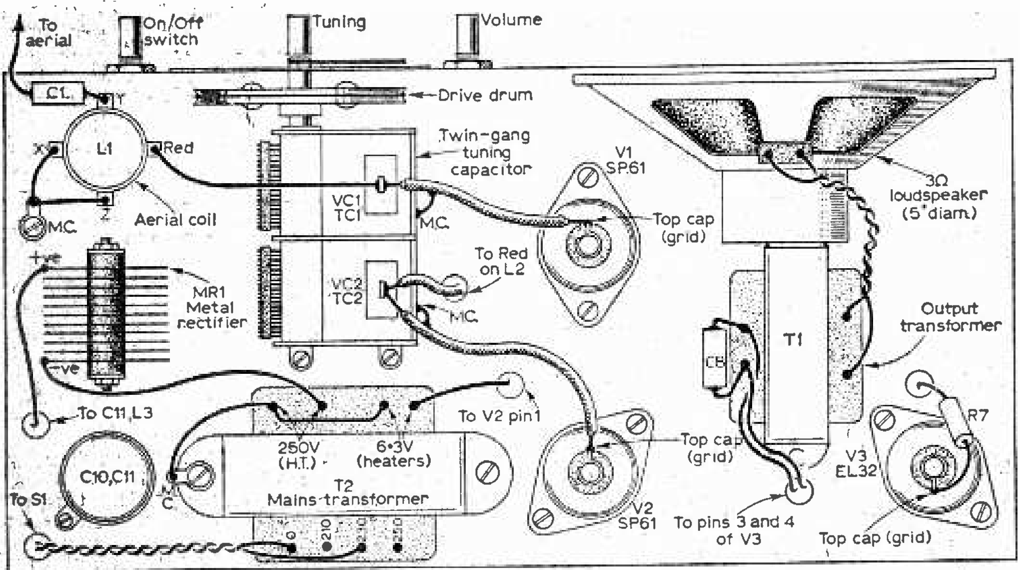

Fig. 2: The layout of the larger components, most of which are mounted on the top side of the chassis.

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.

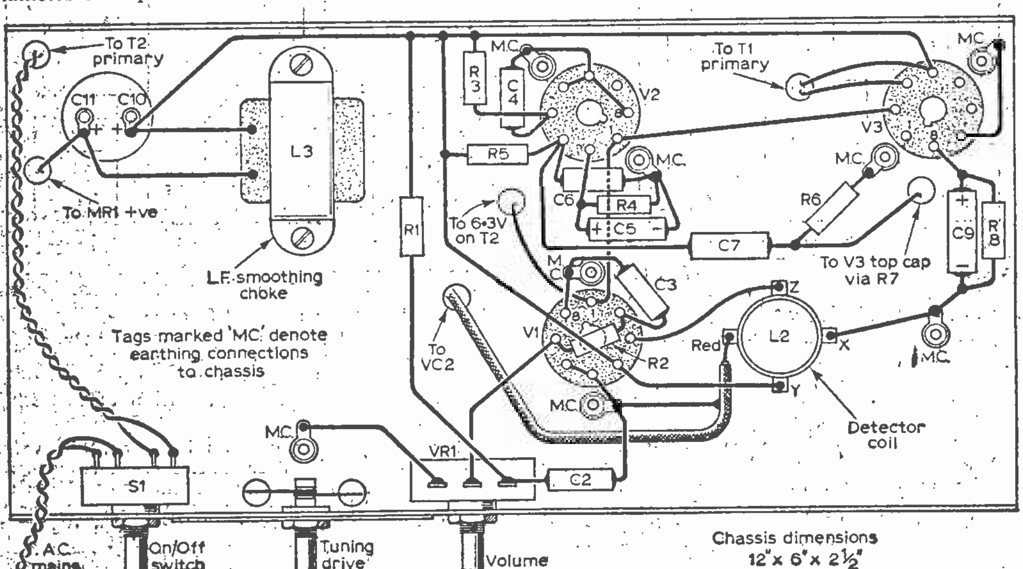

Fig. 3: The underchassis wiring.

● **SCOOP! Hi-Fi 10 watt Amplifier £7.10.0** complete. Carr. 5/6. Branded manufacturer's model (cartoned). Very latest high efficiency valves. Push-pull output. Separate bass-treble controls, dual input for "mike". 3 or 15 ohm speakers. Separate pre-amp. High sensitivity. Fully guaranteed. Please send for our complete Amplifier Lists—no charge.

● **SCOOP! Baby Alarm or Intercomm. Kit.** Complete set of parts with diagram, etc. Housed in two beautiful moulded plastic cabinets of pleasing design. High sensitivity. Fully Controllable. Only 4 gns., carr. 5/-, or Assembled Ready for Use, £4.10.0.

● **SCOOP! Set of 6 Transistors and Diode.** Brand new. Beautifully Boxed. Complete with Circuit, 15/-. P.P. 1/-.

● **SCOOP! Record Player Amplifier.** 2 valve, A.C. mains. Output 3 watts. Ready built, tested, guaranteed. Complete with valves, output transformer and speaker. **OUR** price 50/- only. Product of national manufacturer. P.P. 1/6.

● **SCOOP! B.S.R. U.A.14 Auto-changers.** Brand new and wired for stereo. Note **OUR** price **£5.10.0** only. **P.P. 5/6.**

● **SCOOP! Garrard Autoslim Auto-changers.** Brand new and wired for stereo. Note **OUR** price **£6.10.0** only. **P.P. 4/6**

DO IT YOURSELF

Build a Record Player and save Pounds

The Cheapest — The L.K. Way

Famous Autochanger or Single Player Units supplied with brand new, two-tone, de-luxe portable cabinets, 17 x 15 x 8½in. Strong carrying handle, gilt finish clips and hinges as used by famous make for 22 gn. model. Ready cut out motor board, 14 x 13in. Front baffle 7 x 4in. 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.

L.K. PRICES FOR COMPLETE KITS:

Autochanger Kits as above		
B.S.R. U.A.14	£11. 0.0	P.P. 5/6
Garrard Autoslim	£11.10.0	P.P. 5/6
Single Player Kits as above		
Garrard S.R.P.10	£10.15.0	P.P. 5/6
E.M.I. Autostop	£11. 0.0	P.P. 5/6
Individual Prices for those who wish to purchase separately.		
Record Player Cabinet with Cut-out Board	£2.15.0	P.P. 3/6
Amplifier with 7 x 4in. speaker	£3.10.0	P.P. 2/6
Auto-changers		
B.S.R. U.A.14	£5.10.0	P.P. 5/6
Garrard Autoslim	£6.10.0	P.P. 4/6
Single Players		
E.M.I. Autostop	£5. 7.6	P.P. 4/6
Garrard S.R.P.10	£5. 7.6	P.P. 4/6
E.M.I. Separate Pick-up	£3. 5.0	P.P. 3/6
Transcription Units—Stereo—Mono		
Garrard 4 H.F.	£16. 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. **OUR** price 3 ohm **42/-**, 15 ohm **45/-**. P. & P. 1/10. Please send for our complete Speaker List. Our prices the most competitive in the trade.

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● **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.P.	900ft.	10/-	5¾in. D.P.	1800ft.	22/6
5¾in. L.P.	1200ft.	12/6	7in. D.P.	2400ft.	25/-
7in. L.P.	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. **OUR** 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. 2/6.

● **SCOOP! The Famous Bandbox** 2 waveband (L.M.) transistor Car or Caravan Radio. Brand new in maker's carton with maker's guarantee. Size 8 x 5 x 2in. Large speaker. S/M tuning. In beautiful pastel colours. Uses PP6 battery. List price £8.15.0. **OUR** price **£4.10.0.** While stocks last. This is a winner. P.P. 2/6.

● **SCOOP! The Wiltonia—Pre-assembled for only 75/-** P.P. 2/6 extra. Real calf 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 2¼ x 2in. Slow motion drive. In beautiful plastic case, size 4 x 2½ x 1in. 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 3 ohm speaker. All parts available separately. Size 7 x 5 x 1½in. Building plans 2/6 (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 £6.15.0 complete. P.P 2/-.

● **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 1½in. Normal output 9 v. 100mA. Full mains transformer. Full wave germanium diodes. Cartridge fuse. Runs radio direct from mains.
Complete kit with plans, 33/-. P.P. 1/6.
Ready Assembled 42/-. P.P. 1/6.

● **SCOOP! Transistor Tape Recorder.** The best obtainable, by very famous manufacturer. Brand new, boxed and guaranteed. Reduced from 12 gns. Now **£7.10.0**, complete with microphone, tape, batteries and operational booklet. P.P. 3/6. 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 wording. Size 13 x 4in. Aligned and calibrated. Isolated chassis size 13½in. x 9in. high x 5½in. 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/-.

● **SCOOP! Car Aerials.** Window fitting, easily detachable. Complete with leads. **OUR** price 12/6 only. List price 25/-.

● **SCOOP! 17in., £11; 14in., £7.** 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 Brittamer 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

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	180kΩ	R5	470kΩ
R2	220Ω	R6	470kΩ
R3	3·3MΩ	R7	10kΩ
R4	4·7kΩ	R8	270Ω ½W

All ±10%, ¼W, except where otherwise stated.
VR1 5kΩ wire-wound potentiometer.

Capacitors:
C1 0·01µF paper 750V
C2 0·01µF paper 350V
C3 0·01µF paper 350V
C4 0·01µF paper 350V
C5 25µF electrolytic 25V
C6 500pF mica or ceramic
C7 0·01µF paper 350V
C8 0·01µF paper 450V
C9 25µF electrolytic 25V
C10 32µF, C11 32µF } dual electrolytic 350V
VC1 500pF, VC2 500pF } twin gang, with trimmers TC1, TC2.

Valves:
V1, V2, SP61, 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 3Ω loudspeaker
T2 Mains transformer with tapped primary. Secondaries: 0—250V 50mA; 6·3V 1·5A

Other Circuit Components:
MR1 Metal rectifier, 250V 50mA
S1 Double-pole, on/off switch
LS1 Loudspeaker, 5in. diameter, 3Ω 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 MR1 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 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.

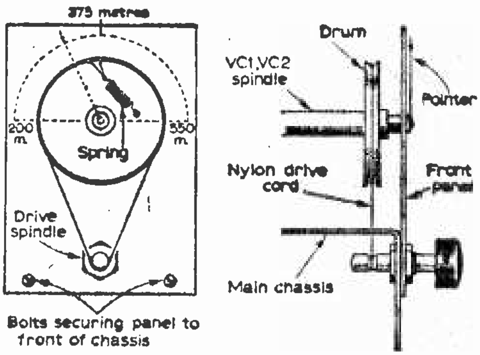


Fig. 4: A suitable dial for the receiver, with details of the tuning drive.

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 ¼in. 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 + 1

—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 2·2kΩ 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 carcase 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.

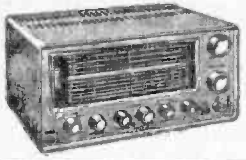
What *is* stereo? Is it just a gimmick, is it worth while in a small room, does the end effect justify the additional cost? These are the kind of questions likely to perplex many who enjoy and appreciate good music and drama but who have little or no knowledge of the technicalities involved in the reproduction 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 edgewise "S" meter. Output for phones or STD speaker. Supplied brand new and guaranteed with manual. £42 carriage paid. S.A.E. for full details. Part exchanges welcome.

HE-40 4-WAVEBAND COMMUNICATIONS RECEIVER

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

LAFAYETTE BRAND RECORDING TAPES

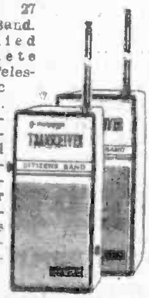
First grade quality American tapes. Brand new and guaranteed. Discounts for quantities.

5in.	600ft.	std.	plastic	8/6
5in.	900ft.	L.P.	acetate	10/-
5in.	1200ft.	D.P.	mylar	15/-
5¾in.	1200ft.	L.P.	acetate	12/6
5¾in.	1800ft.	D.P.	mylar	22/6
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.

9 TRANSISTOR TRANSRECEIVER TWO-WAY RADIO

Average range up to 1.5 miles frequency 27 Mc/s Band. Supplied complete with Telescopic Aerials, Batteries, Personal Earpieces, Leather carryingcases and instructions.



Brand new guaranteed £25 pair. S.A.E. for details.

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/-.

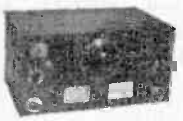
CV2193/89D. DOUBLE-BEAM C.R.T.

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

COSSOR DOUBLE-BEAM OSCILLOSCOPE 1035

4in. tube. Calibrated Y1 amplifier from 50mV to 50V. Bandwidth 10Mc/s. Calibrated Y2 amplifier from 5V to 500V 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

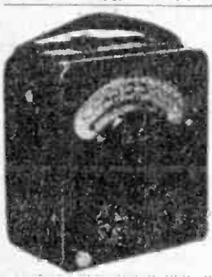


SENIOR MODEL. Supplied complete with full set of nine coils covering 50Kc/s to 30Mc/s. Each receiver thoroughly checked before despatch and available as follows:

Table Model. Good used cond. .. £19.19.0
Rack Model. As new cond. £22.10.0
Rack Model. Good used cond. .. £18.18.0

N.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.



UNIVERSAL AVOMETER MODEL "7"

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

MINE DETECTOR No. 4A

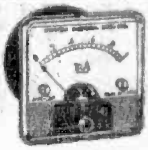
Will detect all types of metals. Fully portable. Complete with instructions. 39/6 each. Carr. 10/-. Battery 8/6 extra.

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

OA202 miniature silicon rectifiers, 1/- each.
Discounts for quantities.
Please add postage.

CLEAR PLASTIC PANEL METERS



D'Arsonval Movement . Jewelled Movements. 1¹¹/₃₂in. Square Fronts. 1¼in. Overall Behind Panel. 1¼in. 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:

150µA	32/6	10mA	22/6	50V. DC	22/6
100µA	29/6	50mA	22/6	100V. DC	22/6
200µA	27/6	100mA	22/6	150V. DC	22/6
500µA	25/-	150mA	22/6	300V. DC	22/6
50-0-50µA	29/6	200mA	22/6	500V. DC	22/6
100-0-100µA	27/6	500mA	22/6	750V. DC	22/6
300mA	22/6	750mA	22/6	15V. AC	22/6
1mA	22/6	1A. DC	22/6	50V. AC	22/6
		5A. DC	22/6	150V. AC	22/6
		3V. DC	22/6	300V. AC	22/6
		10V. DC	22/6	500V. AC	22/6

Calibrated "S" meters 35/-. **A full range of larger clear plastic and Bakelite panel meters are available. Send for illustrated leaflet. Trade terms available.**

FIELD TELEPHONES

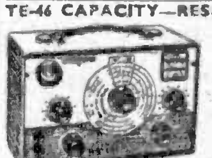
Type "L". Two line connection, generator bell ringing. Complete telephone intercom. Supplied in excellent condition, fully tested and complete with batteries. Only 69/6 per pair. Carr. 5/-.
Type "F". As above but moulded bakelite case (as illustrated). Supplied complete with wooden transit case for field use. £4.19.6 per pair. Carr. 5/-.

Semi Automatic "Bug"
Super speed key. 7 speed adjustments, 10 WPM to as high as desired weight scale for reproducible settings. Precision tooled anti rust nickel plated brass and stainless steel operating parts. Size 6¾ x 3 x 2¼in. Brand new. £4.12.6. Post paid.

MARCONI TF144G/4 STANDARD SIGNAL GENERATORS

First release of this famous mark. 85Kc/s to 25Mc/s ±1%. Output variable from 1µV to 1 volt. Internal sine wave modulation 400c/s up to 75% depth. Operation 200/250 volt A.C. Offered in really excellent condition, like new fully tested and guaranteed. £25. Carr. 30/-.

TE-46 CAPACITY—RESISTANCE ANALYSER



- ★ Factory wired and tested.
- ★ Capacitance bridge circuit.
- ★ Direct reading scales for capacitance and resistance.
- ★ Magic eye null indicator and meter.
- ★ Checks opens, shorts, leakage and intermittents.
- ★ Determines power factor of electrolytics.
- ★ 2 Turns ratio scales.
- ★ Measures impedance.

Capacity 4 ranges 2PF—2,000 MFD. Resistance 4 ranges 2 ohms—200 meg. ohm. Turns, ratio and impedance ranges. Read insulation resistance direct on meter to 200 meg. Size 10½ x 7 x 5½in. Operation 200/240 v. A.C. Supplied brand new with instructions. £15. Carr. 7/6.

TE-20 RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120kc—260Mc/s on 6 bands. Directly calibrated. Variable RF attenuator. Operation 200/240 v. A.C. similar in appearance to TE-46 CR Bridge. Brand new with instructions, £12. Carr. 5/-. S.A.E. for details.

P.C.R.2 COMMUNICATION RECEIVERS

Excellent 6 valve receiver. Frequency coverage on 3 bands, 800-2,000 metres, 190-550 metres and 6-22Mc/s. Output for phone or speaker. Supplied in perfect condition, £5.19.6 each. Carr. 10/-. The receiver can be supplied with an internal power supply to operate on 200/250 volt A.C. at 39/6 extra, or plug in external power supplies are 35/- extra. Full circuit supplied.

AVO WIDE RANGE SIGNAL GENERATORS

Frequency coverage 50Kc/s to 80Mc/s in six turret operated ranges. For use on standard A.C. mains. Packed in original transit cases with accessories. Supplied in as new condition, fully checked before despatch. £15. Carr. 10/-.

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60Kc/s to 30Mc/s on 6 bands. 200/250 volt A.C. operation. Supplied in perfect working condition. £21 each. Carr. 30/-.

MICROAMMETERS

0-500 microamp. 2½in. circular flush panel mounting. Dials engraved 0-15, 0-600volts. Brand new boxed, 15/-. P. & P. 1/6.

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0/115/230 volts step up or step down. Brand new boxed, ex-U.S.A. 3,000 w. £7.10.0. carr. 10/-; 7,500 w £15, carr £1

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Set of three, record, playback, erase. Only 29/6 set. P. & P. 9d.

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Frequency coverage 1-250Mc/s. Fitted with 200 microamp meter. Supplied with telescopic aerial, earpiece and instructions 69/6 post paid.

LARGEST STOCK OF COMPONENTS IN THE COUNTRY.
OPEN 9 a.m.-6 p.m. EVERY DAY—MONDAY to SATURDAY.

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TEST GEAR accessories

Part 3

BY C. MACKAY

CONTINUED FROM PAGE 1085 OF THE MARCH ISSUE

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

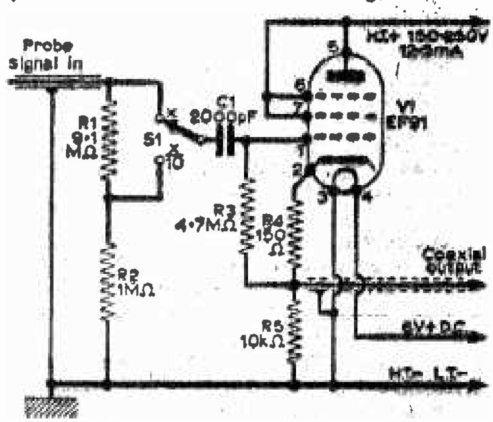


Fig. 9: The circuit of the cathode follower probe unit.

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.

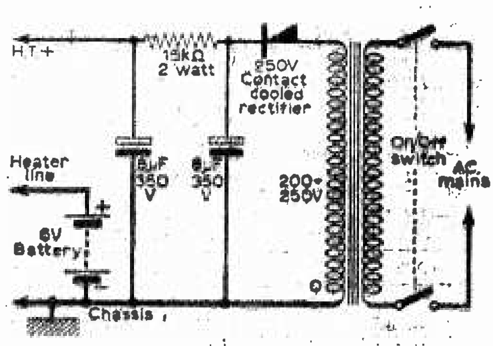


Fig. 10: A suitable power supply circuit for the probe unit.

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 2¼in. in diameter and 3¾in. high with a twist-on base. Inside, a circular piece of paxolin, 2in. in diameter was mounted about 1in. above the base on pillars. A ¼in. hole and other smaller holes were drilled in the centre of the 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.

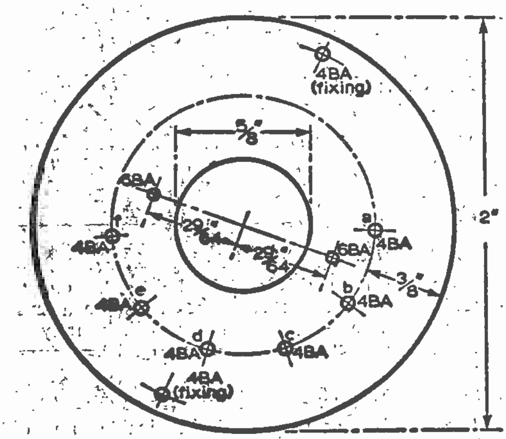


Fig. 11a (above) Drilling details of the paxolin panel; 11b (right) complete wiring diagram of the probe.

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 wavechange switch, although only one pole was 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.

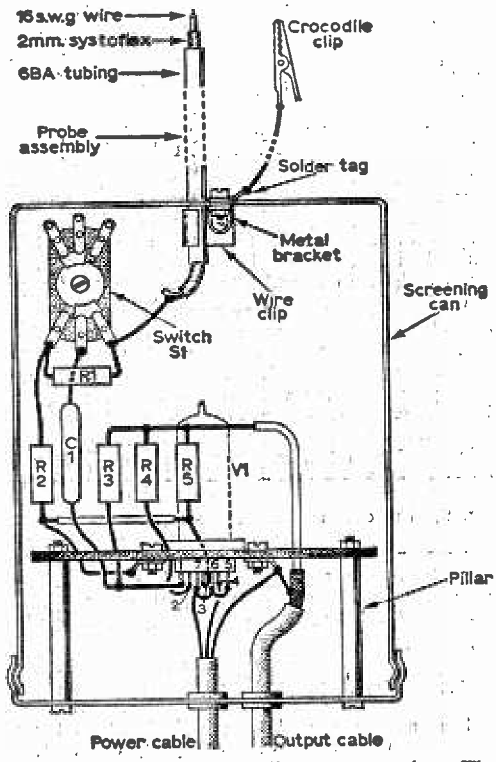
COMPONENTS LIST FOR CATHODE FOLLOWER PROBE UNIT

- R1 9·1MΩ (or 4·7MΩ + 4·3MΩ in series)
- R2 1MΩ
- R3 4·7MΩ
- R4 150Ω
- R5 10kΩ
- C1 2,000pF 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.

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 10Mc/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

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

MOST 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 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!

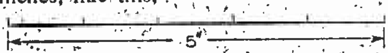
When we come to subtraction, and minus quantities, the differences between the mathematics of things and the mathematics of measurement really begin to show up. Suppose we have five radio sets and take three away. Three from five leaves two. Suppose we have a length of five inches and take three inches 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.

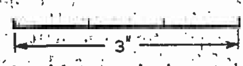
Negative Quantities

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.

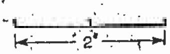
Although we can't make sense of subtracting six radio sets from five, we can make very real sense of subtracting six inches from five inches. The best way to explain this is to begin by drawing a diagram of what happened when we subtracted three inches from five inches. We began with five inches, like this,



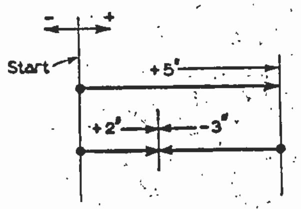
Then we subtracted three inches, which looked like this,



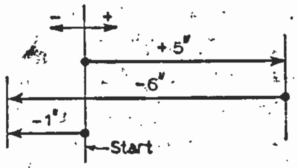
and we finished with two inches, which looked like this.



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.

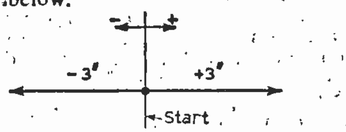


And now, when we try to subtract six inches from five inches we don't have the slightest trouble. We finish up with minus one inch and our diagram looks like this.



The minus one inch simply means that we have 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*.

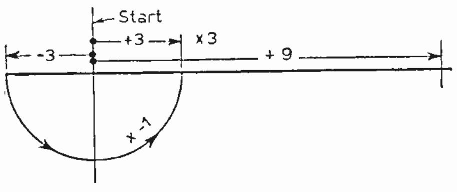
An Operator

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

until it would more accurate to call it an "operator", that is, a symbol which "operates" on a quantity to change it.

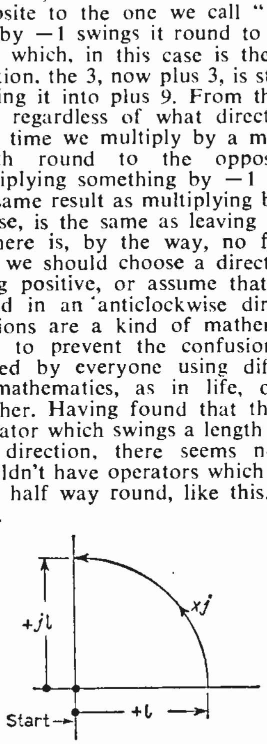
This, of course, doesn't apply to length alone. It applies to any measurement we like to think of. A negative electric current, for instance, doesn't mean a kind of ghostly counterpart of a "real" current. It simply means a current flowing in the opposite direction to the direction which we have chosen 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×-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×-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°? Simply because we have decided it should be so. We define j as an operator which would swing a length through 90°.

This method of approaching a problem highlights the fundamental difference between working with things and working with ideas.

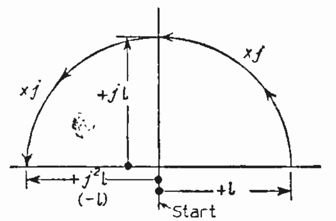
Black Boxes

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°.

But because this is so, we can immediately see that multiplying again by j must swing our length anticlockwise through another 90° like this.



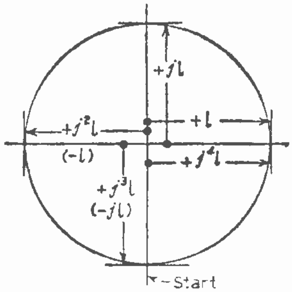
When we look at the direction of the $j^2 \times l$, we find it is identical with $-l$. So our definition of j results in the conclusion that multiplying by j^2 has exactly the same effect as multiplying by -1 and therefore j^2 must be equal to -1. Thus, by simple arithmetic, j must be equal to $\sqrt{-1}$. 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^3 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.

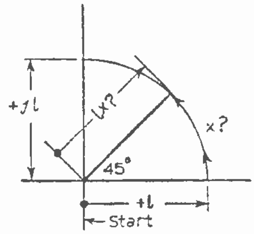


This is where we use the fact that $j=\sqrt{-1}$ and, therefore that $j^2=-1$. The j^2l becomes simply $-l$, which is the opposite direction to $+l$. And the j^3l becomes $j^2 \times jl$, which is simply $-jl$. Again, $-jl$ is the direction opposite to that indicated by $+jl$. Finally multiplying four 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° 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°. Then Cl will be our line. If we multiply by C again we will bring our line round to 90°, 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 $j^{\frac{1}{2}}$. 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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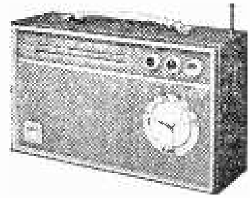

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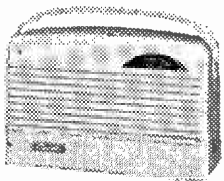

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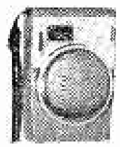

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CLUB NEWS

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 Prescot 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, Iffley 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 callsign—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. Briscombe, 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.

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-

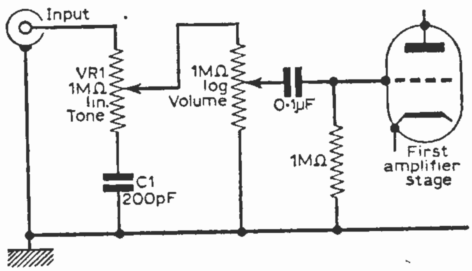

Fig. 1a (above): Simple treble-cut tone control at the input to an amplifier.

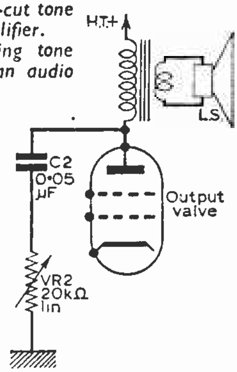

Fig. 1b (right): Treble-shunting tone control circuit at anode of an audio output stage.

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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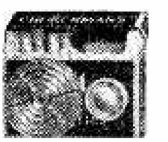

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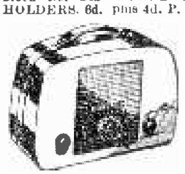

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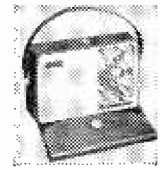

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path and transformer path) coupling the valves, so that effects obtained when reversing one winding on the transformer (either one will do) should also be studied when experimenting with this circuit.

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 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 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 attention to such treble—in fact it plays havoc with it. Thus please confine experiments with this circuit to normal a.m. receivers.

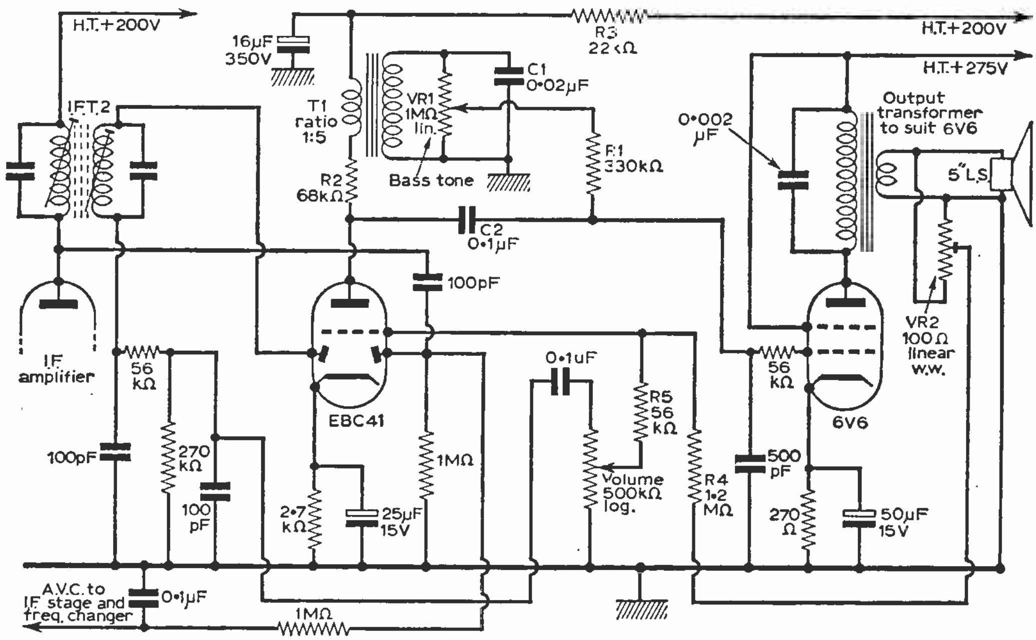


Fig. 2: A typical example of the type of bass-boost tone control discussed in this article.

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.

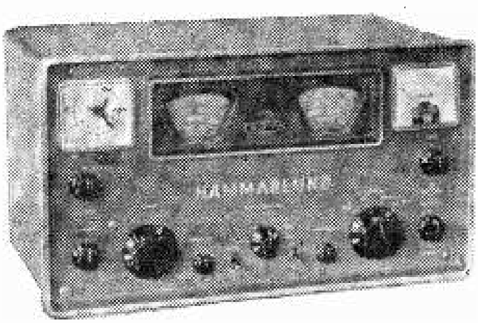
It must again be stressed that each case of a modification along the lines of this article must be individually trimmed. It is hoped that possible lines of experiment and direction of results produced by the various changes in question have been made sufficiently clear. ■

Trade News

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.*



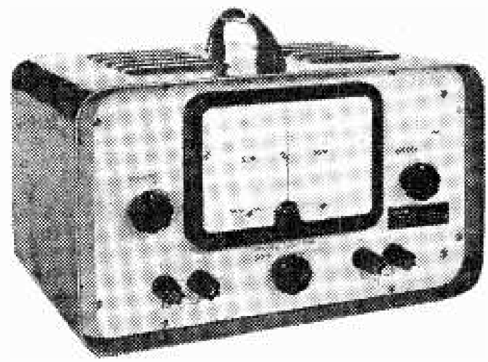
One of Hammarlund's latest amateur receivers, the type HQ-110A.

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.

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.*



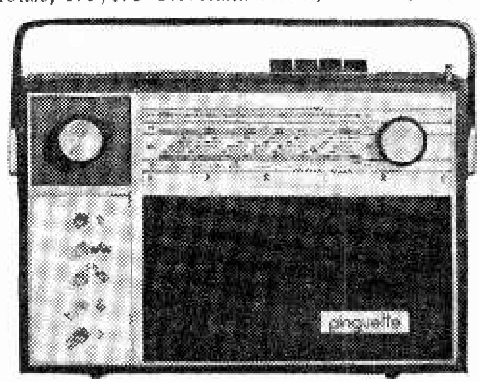
The new Component Comparator made by Aero Electronics Limited.

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.

Vacuum Soldering Iron

THE firm of Charles Austen Pumps Limited have attacked the problem of unsoldering components (especially multi-pin types) from printed

—continued on page 1206

LETTERS TO THE EDITOR

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of the cover.

The Editor does not necessarily agree with the opinions expressed by his correspondents

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 $2\frac{1}{2}$in. in diameter, to which is fixed a metal bracket. This bracket carries a 2in. 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 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, Monkseaton, 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. SCHOLES, 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 Mourne Road, Drimnagh, Dublin 12, Irish Republic.

. . . any information on the wireless set No. 68T.—K. TAYLOR, 5 Park Avenue, Carshalton, 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

READERS not already aware of its existence will be interested to learn of the special magazine programme for radio and recording enthusiasts which is broadcast every fortnight on Network Three, Sundays 2.30p.m.

We can highly recommend this programme which includes talks by leading personalities in radio, tape recording and hi-fi. It also features discussions and other items of interest to all readers of PRACTICAL WIRELESS. Recent programmes have included a History of the R.S.G.B. and a talk on tape recording clubs by PRACTICAL WIRELESS contributor F. C. Judd.

For details of the next programme, please refer to the "Radio Times".

SERVICE SHEETS

SERVICE SHEETS, Radio and Television, 3/6, post paid. VEST AND EMERY, 17 Hallgarth St, Durham.

SERVICE SHEETS: Radio, TV. 5,000 models. List 1/-. S.A.E. inquiries TELRAY, 11 Maudland Bank, Preston.

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SERVICE SHEETS for all makes of Radio and TV, 1925-1963. Prices from 1/- with free fault-finding guide. S.A.E. inquiries. Catalogue of 6,000 models. 1/6. 125 Radio/TV Sheets covering many popular models, 21/-. Valves, modern and obsolete. Radio/TV Books. S.A.E. lists. HAMILTON RADIO, Western Road, St. Leonards, Sussex.

SERVICE SHEETS also Current and Obsolete Valves for sale. JOHN GILBERT TELEVISION, 1b Shepherd's Bush Road, London, W.12. Phone: SHE 8441.

BC-620-A, -B, -F, -G, -H, -J, circuits. 5/-. Add inf. extra. EDDY, 13 Lindfield Gardens, London, N.W.3.

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1T4	2/6	25L6GT	4/6	EZ41	5/6
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1S5	3/11	CY31	5/-	PCL85	7/6
6K7G	1/3	ECC85	5/-	PENA4	5/-
6BW7	4/6	PEN46	2/6	R19	7/-
6X4	3/6			TY86F	6/-

Cash with order only. Postage 6d. per valve. Any parcel insured against damage in transit 6d. extra.

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RECEIVERS & COMPONENTS
(continued)

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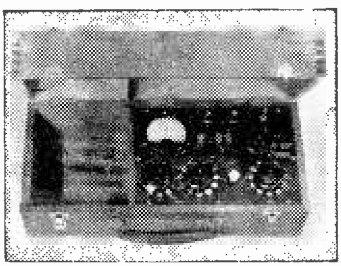
Wheatstone Bridge



Centre Zero Galvanometer scaled 20-0-20 2½in. movement 2.5mA FSD, 3 stud switch controls 0-10, 0-100 ohms and 0-Inf. Complete in carrying case with instructions, 45/-. Post 5/-.

MARCONI CANADIAN No. 52. As previously advertised, still a number left. Used less case, complete for 115/240 A.C. mains and 12v D.C. Fully tested. Only £8.10.0. Carr. £1.

POWER UNIT, Type ZE12. Designed for the above receiver, 52/6, carr. 5/-. Moving Coil Headphones, chamois padded with lead and plug, 15/-. Post 2/6.

WS. NO19 Mk3 TXRC 2-8 Mc/s with economy power pack, 12/24v D.C., 80/-. Carr. 25/-. Set only 55/-. Carr 15/-. All parts available.

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RECEIVERS & COMPONENTS
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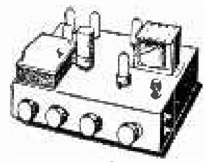

15 watt Valves ECC83, ECC83, EL84, EL84, EZ81. 30 watt Valves ECC83, ECC83, EL34, EL34, GZ34. Four jack inputs. Nine controls: four volume, master volume, bass, treble tremolo speed, depth. Remote plug. 3 and 15 ohms outputs.

15 watt tremolo kit, £9.10.0; Factory built £12.10.0. 30 watt tremolo kit £12.10.0; Factory built £15.10.0.

LESS TREMOLO:

15 watt 2 input kit £8; Factory built (illus.) £10.10.0. 15 watt 4 input kit £8.10.0; Factory built £11. 30 watt 4 input kit £11.10.0; Factory built £14.

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6 Wander plug sockets—sorry no plugs
6 Miscellaneous items.
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20ft. Steel Telescopic Mast, **50/-**.
High Stab Resistors, **6d.** each.

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Assorted Resistors, 50 carbon plus 50 high stab. My choice **7/6**.

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Speakers. 3 ohm P.M. 5in. **5/-**, 6in. **6/-**, 7 x 4in. **7/-**, 8in. **8/-**, 10in. **12/6**.

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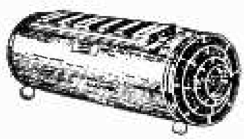

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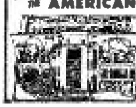

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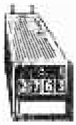

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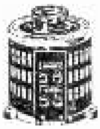

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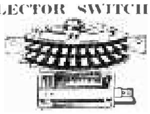

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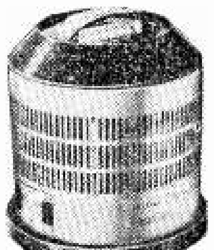

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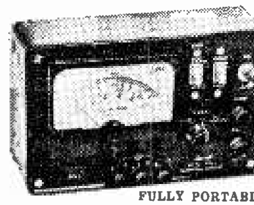

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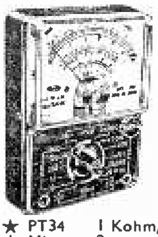

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PRACTICAL WIRELESS, APRIL, 1964.

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