PRACTICAL WIRELESS

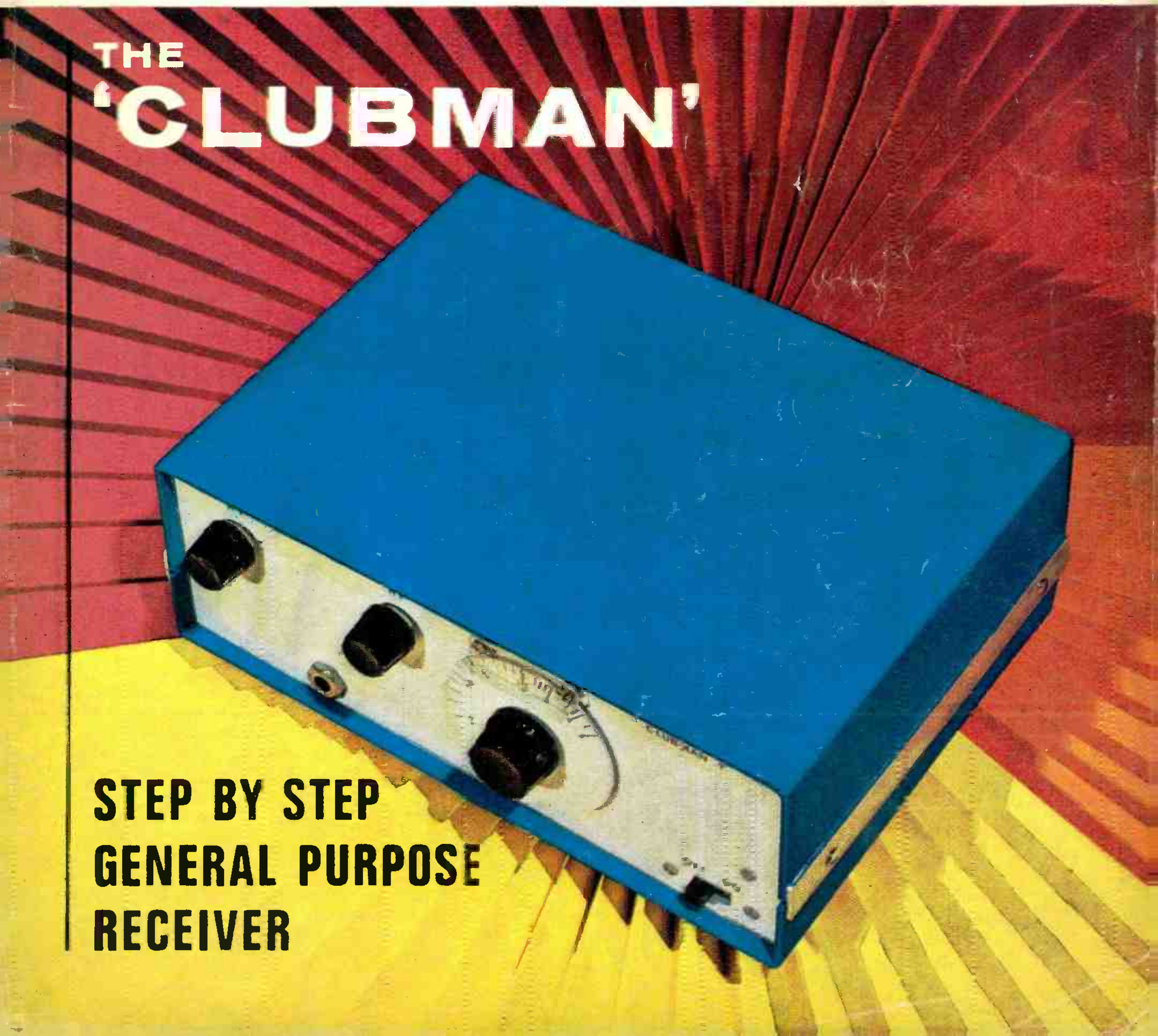
JANUARY 1968

2'6

Special IN THIS ISSUE

- INTERMITTENT FAULT LOCATOR
- LEARNING MORSE
- SIMPLE SUBSTITUTION BOX
- LOW COST HI-FI SYSTEM—PART 2
- CRYSTAL TUNER FOR THE NOVICE

THE 'CLUBMAN'



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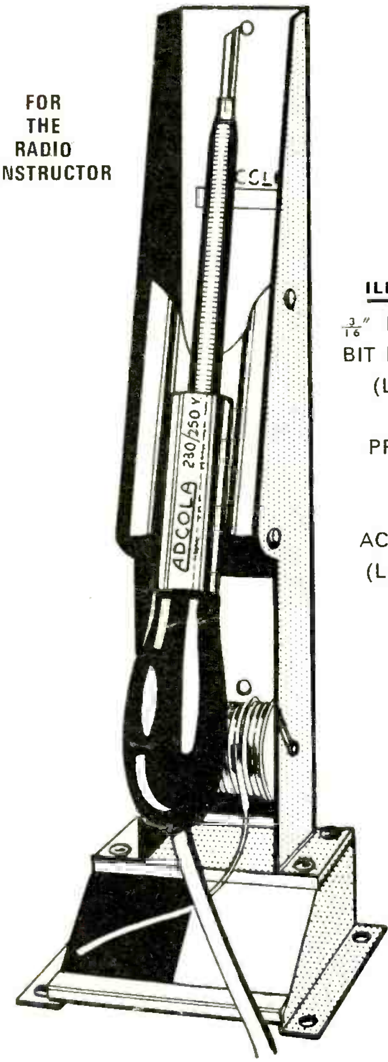
ADCOLA

PRODUCTS LIMITED

(Regd Trade Mark)

SOLDERING EQUIPMENT

FOR THE RADIO CONSTRUCTOR



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WIDE RANGE OF MODELS SIZES AND PRICES
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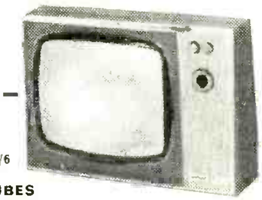

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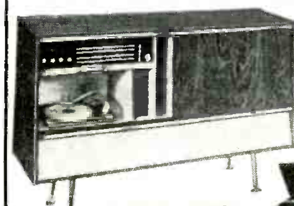
EXCHANGE BOWLS. Carr. 10/6
EX MAINTENANCE TESTED TUBES
17in.—35/- 14in.—15/- Carr. 5/- (not slimline)

COCKTAIL/STEREOGRAM CABINET £25



Polished walnut veneer with elegant glass fronted cocktail compartment, padded. Position for two 10in. elliptical speakers. Record storage space. Height 35¾in., width 52¾in. depth 14½in. Legs 1 gn. extra

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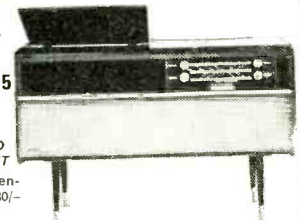

Superbly made and styled in Veneered English Walnut

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Position 8" x 5" Twin Speaker. Dimensions: 45 x 15½ x 15½. Legs 1 gn. Carr. 30/–

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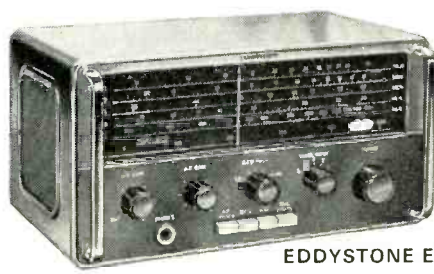

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3in.	150ft.	2/3	3in.	225ft.	2/9
4in.	300ft.	4/6	4in.	450ft.	5/6
5in.	600ft.	7/6	5in.	900ft.	10/6
5¾in.	900ft.	10/6	5¾in.	1,200ft.	13/-
7in.	1,200ft.	12/6	7in.	1,800ft.	18/6
Double Play			**Triple Play**		
3in.	300ft.	4/-	4in.	900ft.	13/-
4in.	600ft.	8/-	5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	5¾in.	2,400ft.	34/-
5¾in.	1,800ft.	19/6	7in.	3,600ft.	44/-
7in.	2,400ft.	27/-	**Quadruple Play**		
			3in.	600ft.	8/6

Postage 1/- reel.
Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE. *Large tape stocks at all branches*

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Microsonic 7

7 TRANSISTOR RADIOS

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1% to 5% 100 Ω to 5 mΩ.
CO-AX. low loss. 6d. yd.. 25 yds 11/6; 50 yds. 22/-; 100 yds. 42/6. Plugs 1/3.

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Miniature Ceramic, Silver, Mica, etc., 3pF to 5µF. LIST VALUE OVER £4.

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Transistorised FM Tuner

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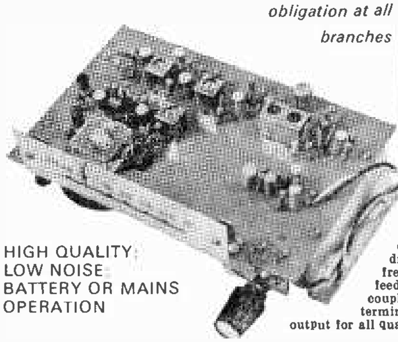

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Stereo ceramic cartridges	19/6

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Universal fitting de luxe Teak for SP25, 1,000, 2,000, 3,000, AT60 **59/-**
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Satisfaction or Money Back Guarantee on goods if returned unused within 14 days. ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 9d. 2-11 6d. per valve. Free over 12

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6F23	8/-	12J7GT	9/-	DY86	6/-	EL42	9/-	PL81	7/9	UF85	7/6
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6J5GT	6/6	12K8GT	9/6	EABC80	6/9	EM80	7/-	PL83	6/-	UL41	10/-
6J6	3/3	12Q7GT	6/6	EAF42	8/-	EM81	7/6	PL84	7/-	UL44	14/-
6J7G	5/6	12SJ7	5/6	EB41	4/6	EM84	7/9	PY31	7/6	UL46	10/6
6J7GT	9/6	14S7	14/6	EB91	2/9	EY51	7/6	PY32	9/6	UL84	6/8
6K7G	2/8	19AQ5	5/6	EBC33	7/6	EY86	7/6	PY33	7/6	UM80	9/6
6K7GT	5/9	20D1	8/9	EBC41	9/6	EY88	8/6	PY80	5/9	UY21	8/9
6K8GS	9/6	20F2	9/6	EBC91	6/9	EZ40	7/6	PY81	5/9	UY41	7/-
6L1	9/6	20L1	16/-	EBF80	7/9	EZ41	8/6	PY82	5/6	UY85	5/6
6L6G	8/6	20P1	9/6	EBF89	7/-	EZ80	5/6	PY83	5/9	VR105	5/-
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With two 10 x 5in. speakers.

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INTER-COMM. DE-LUXE 2-WAY. Highly efficient. safe **BABY ALARM.** Works off PP3 battery. Buzzer call system, complete with lead, plugs. battery, **55/-.** P. & P. 2/6.

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AMPLIFIER. Compact for use in mains portable grams 6¾ x 2¼ x 5¾in., printed circuit, vol. and tone controls attached by fly leads, over 2 watts output, **55/-.** P. & P. 4/6.

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UA25—Very popular—4 speed. Cap. six 7in., 10in., 12in. records	**£5 19 6**
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7in. 1200ft. Standard Play	12/6	5¾in. 1800ft. Double Play	22/6
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P. & P. 1/- per reel. Four reels and over post paid.

POCKET MULTI-TEST METER. 1000Ω per volt. Volts 0/10/50/250/500/1000 A.C. and D.C. Current: 0–1–100–500mA. Resistance: 0–100kΩ. Complete with test prods, instructions. **37/6.** P. & P. 1/6.

MULTI-TEST METER. Pocket size: 4½ x 3¼ x $\frac{15}{16}$in. 20,000Ω per volt. D.C. Volts (20,000Ω P.V.) 0/5/25/250/500/2500 D.C. Current 0–50 micro amp/2·5 mA/250 Am A.C. volts (10,000Ω P.V.) 0/10/50/100/500/1000. Resistance: 0/6kΩ–0/6 megΩ. Capacity: 10μF to ·001μF, ·001μF to ·1μF. Decibels: —20 to +22dB. Complete with battery, instructions, leads **72/6.** P. & P. 1/6.

TRANSISTORS: Some popular types from our range: **OC44** and **OC45 3/6** each. OC71 2/9. OC72 3/6. OC81 and **OC81D 3/-** each. OC169 3/9. **OC170 3/6. AF117 4/-.** OC26 7/6. GET8 5/9. General purpose (Approx. OC71) **1/-** each.

NEW HIGH FREQUENCY TRANSISTORS. Sinclair ST140 4/-; ST141 6/-. both capable of operating up to 700 Mc/s. **ALSO MAT100 7/9.** MAT101 8/6. MAT120 7/9. MAT121 8/6. ADT140 15/-. High speed switching transistors: BSY26, BSY28, BSY65, 5/- each.

THYRISTORS. 100PIV 5A, 12/6. 200 PIV 5A, 15/-. All Transistors postage 6d. up to 3. Over 12 sent P. & P. paid.

R.F. FIELD INDICATOR. For use with radio controlled models. Checks radiation from existing antenna. Tunes 1 to 250Mc in 5 bands. Sensitive 200mA meter movement. 5 section plug-in aerial. Phone jack and crystal earpiece for monitoring. No battery required. Powerful magnet for attaching to metal surfaces. Complete with instructions. **47/6.** P. & P. 2/6.

TERMS. Cash with order. No C.O.D. Orders total £5 and over sent carriage paid (excepting record player decks where carriage is shown). Guaranteed money refunded if goods returned perfect within 7 days of despatch.

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		USUAL PRICE	OUR PRICE inc. P. and P.
TP718	Car Cassette Tape Recorder ..	£23 2 0	**£19 16 0**
RX60N	Communication Receiver	£27 15 0	**£23 12 0**
PA539	30 Watt Mains P.A. Amplifier ..	£29 10 0	**£25 1 6**
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SA200	15 Watt Integrated Stereo Amp ..	£27 15 0	**£23 12 0**
FMT640	Hi-Fi FM Tuner	£24 17 6	**£21 12 6**
SA100	10 Watt Integrated Stereo Amp ..	£18 18 0	**£16 2 6**
VTA40	All Transistor Stereo Amp	£39 10 0	**£33 11 6**
VFM40	All Transistor FM Tuner	£12 19 6	**£11 2 0**
TSA10	10 Watt Transistor Amp	£13 19 6	**£11 19 6**
FMT10	All Transistor FM Tuner	£13 19 6	**£11 19 6**
TSA20	Transistor 20 Watt Amp	£23 2 0	**£19 16 0**
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HT20	Rectangular Horn Tweeter	£4 2 6	**£3 10 6**
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FMT41	Battery operated FM Tuner ..	£8 10 0	**£7 4 6**
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EEK28	Construction Kits, 28 Projects ..	£6 10 0	**£5 10 6**
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Terms of business: Cash with Order

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5Z4G	7/6	30C15	11/6	EAF42	8/6	EY86	6/-	PY33	8/6	VP1321	21/-
6/30L2	11/9	30C17	12/6	EB91	2/3	EZ40	6/9	PY80	5/3	W77	3/6
6AL5	2/3	30C18	11/9	EBC33	7/-	EZ41	6/9	PY81	5/3	Z77	3/6
6AM6	3/6	30F5	12/-	EBC41	8/-	EZ80	4/6	PY82	5/-	Transistors	
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6BG6G	15/-	30P4	12/-	ECC83	7/-	N18	5/6	R19	7/-	AF115	6/-
6BJ6	6/9	30P12	11/-	ECC84	6/3	N78	14/9	R20	12/9	AF116	6/6
6BR7	7/9	30P19	12/-	ECC85	5/6	N108	14/6	U25	11/6	AF117	5/-
6CS6	6/6	30PL1	14/6	ECF80	7/-	PC86	8/-	U26	11/6	AF118	8/6
6F1	7/9	30PL13	14/6	ECF82	6/9	PC88	8/-	U47	13/6	AF124	7/6
6F13	3/6	30PL14	14/6	ECF86	9/-	PC97	5/6	U49	13/6	AF125	7/6
6F14	9/-	35L6GT	7/6	ECH35	6/-	PC900	7/9	U52	4/6	AF126	7/-
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6K7G	1/6	35Z4GT	4/6	ECH81	5/3	PCC89	9/9	U191	11/-	OC22	9/9
6K8G	4/3	6063	12/6	ECH84	6/6	PCC189	8/6	U301	13/-	OC25	9/6
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6L18	6/-	B36	4/9	ECL82	6/3	PCF82	6/-	UABC80	5/9	OC44	3/9
6V6G	3/6	B729	12/6	ECL86	7/9	PCF86	9/-	UAF42	7/9	OC45	3/3
6V6GT	6/6	CCH35	9/-	EF39	3/9	PCF800	11/6	UB41	6/6	OC71	3/6
6X4	3/6	DAC32	7/3	EF41	9/6	PCF801	7/9	UBC41	6/9	OC72	4/9
6X5GT	5/9	DAF91	3/9	EF80	4/9	PCF802	9/6	UBF80	6/-	OC75	5/9
7B6	10/9	DAF96	6/-	EF85	5/-	PCF805	11/9	UBF89	5/9	OC81	3/6
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7C5	12/-	DF33	7/9	EF89	5/-	PCF808	12/6	UC92	5/-	OC82	5/9
7C6	6/9	DF91	2/9	EF91	3/6	PCL82	6/9	UCC84	7/9	OC82D	5/-
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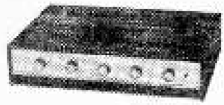
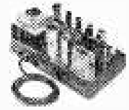
HI-FI AMPLIFIERS —— TUNERS —— RECORD PLAYERS

20+20 STEREO AMP AA-22U

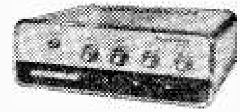


GARRARD PLAYER AT-60

10W POWER AMP MA-12



9+9W STEREO AMP. S-99



TRANSISTOR MIXER. MODEL TM-1. Four channels. Battery operated. Kit **£11.16.6.** Assembled **£16.17.6**

TRANSISTOR STEREO AMPLIFIER, Model AA-22U. 20 + 20W ± 1dB over 15 to 30,000 c/s into 8Ω. 5 stereo inputs each channel. Versatile controls. 20 transistor, 10 diode circuit. Modern low silhouette styling . . . matches AFM-1, AFM-2 Tuners. **Kit £39.10.0. Assembled £57.10.0** (Cabinet £2.5.0 extra).

GARRARD AUTO/RECORD PLAYER. Model AT-60, less cartridge **£15.18.2.** With Decca Deram pick-up **£20.12.6** incl. P.T.

LOW-COST MONO AMPLIFIER, Model MA-5, 5W. Built in pre-amp. Inputs for Gram, Radio. Separate bass, treble, volume controls. Easy printed circuit construction. Modern functional appearance. **Kit £11.9.6. Assembled £15.15.0**

HI-FI MONO AMPLIFIER. Model MA-12. 10W output, wide freq. range, low distortion. Use with control units. Models UMC-1 (Mono) or USC-1 (Stereo). Kit **£12.18.0** Assembled **£16.18.0**

CONTROL UNITS. Mono, UMC-1. Kit **£9.2.6.** Assembled **£14.2.6.** Stereo, USC-1. Kit **£19.19.0.** Assembled **£27.5.0.**

DE LUXE STEREO AMPLIFIER, Model S-33H. 3 + 3W output. Three stereo inputs . . . ceramic/crystal pickup. radio tuner and aux. Separate bass, treble, volume and balance controls. Easy printed circuit construction. Attractive styling. Kit **£15.17.6** Assembled **£21.7.6**

HI-FI STEREO AMPLIFIER, Model S-99. 9 + 9W output. Ganged controls. Stereo/Mono gram, radio and tape inputs. Push-button selection. Printed circuit construction. Matches FM-4U and AFM-1 tuners in styling. Kit **£28.9.6** Assembled **£38.9.6**

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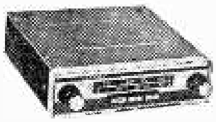
HIGH PERFORMANCE CAR RADIO CR-1

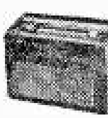


Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

● 8 Latest semi-conductors (6 transistors, 2 diodes) ● For 12 volt positive or 12 volt negative earth systems ● Powerful output (4 watts) ● Pre-assembled and aligned tuning unit ● Push-button tone and wave change controls ● Positive manual tuning ● Easy circuit board assembly ● Instant operation, no warm-up time ● Tastefully styled to harmonise with any car colour scheme ● High quality output stage will operate two loudspeakers if desired. Can be built for a total price.

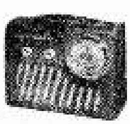
Kit (less spkr.) **£12.17.0** incl. P.T. (6″ x 4″ LS £1.4.5 extra).

RADIOS



Oxford

"OXFORD" LUXURY PORTABLE Model UXR-2. 7 transistor, 3 diode circuit. 7″ x 4″ LS. Push button LW/LM and Tone. Specially designed for use as a domestic or personal portable receiver. Many features, including solid leather case. Kit **£14.18.0** incl. P.T.



UXR-1

TRANSISTOR PORTABLE. Model UXR-1. Pre-aligned I.F. transformers. printed circuit. Covers L.W. and M.W. Has 7″ x 4″ loudspeaker. Real hide case. Kit **£12.11.0** incl. P.T.

JUNIOR EXPERIMENTAL WORKSHOP Model EW-1. More than a toy! Will make over 20 exciting electronic devices, incl.: Radios, Burglar Alarms, etc. 72 page Manual. The ideal present! Kit **£7.13.6** incl. P.T.

TRANSISTOR STEREO FM TUNER. Elegantly designed to match the Stereo Amplifier, model AA-22U seen above. Many special features include built-in power supply. Available in two units sold separately, can be built for a TOTAL PRICE KIT (STEREO) **£24.18.0** incl. P.T. Cabinet **£2.5.0** extra (MONO) version **£20.19.0** Kit.

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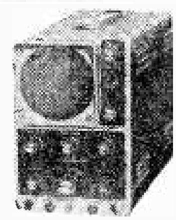
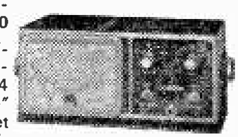
Our wide range includes:



OS-2

3″ LOW-PRICED SERVICE OSCILLOSCOPE. Model OS-2. Compact size 5″ x 7⅜″ x 12″ deep. Wt. only 9¾lb. "Y" bandwidth 2 c/s-3 Mc/s ±3dB Sensitivity 100mV/cm. T/B 20 c/s-200 kc/s in four ranges, fitted mu-metal CRT Shield. Modern functional styling. Kit **£23.18.0** Assembled **£31.18.0**

5″ GEN.-PURPOSE OSCILLOSCOPE. Model 10-12U. An outstanding model with professional specification and styling. "Y" band width 3 c/s-4·5 Mc/s ±3dB. T/B 10 c/s-500 kc/s. Kit **£35.17.6.** Assembled **£45.15.0**



VVM, 1M-13U

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model 1M-13U. Circuit and specification based on the well-known model V-74 but with many worth-while refinements, 6″ Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling. Kit **£18.18.0** Assembled **£26.18.0**

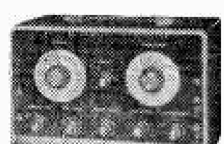
V-7A

VALVE VOLTMETER. Model V-7A. 7 voltage ranges d.c. volts to 1,500 A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0·1Ω to 1,000MΩ with internal battery. D.C. input resistance 11MΩ. dB measurement, has centre-zero scale. Complete with test prods, leads and standardising battery. Kit **£13.18.6** Assembled **£19.18.6**

MULTIMETER. Model MM-1U. Ranges 0–1·5V to 1,500V a.c. and d.c.; 150μA to 15A d.c.; 0·2Ω to 20MΩ 4½″ 50μA meter. Kit **£12.18.0** Assembled **£18.11.6**

RF-1U

R.F. SIGNAL GENERATOR. Model RF-1U. Up to 100 Mc/s fundamentals and 200 Mc/s on harmonics. Up to 100mV output. Large accurate calibrated dial scales. Factory wired and aligned coil and band switch assemblies. Ideal for the service shop. Kit **£13.18.0.** Assembled **£20.8.0.**



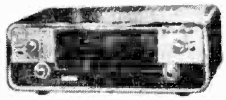
HFW-1

TV ALIGNMENT GENERATOR. Model HFW-1. Covers 3·6 Mc/s—220 Mc/s with 0-42 Mc/s max. sweep width. Stable all-electronic sweep circuit. Built-in marker oscillators—5 Mc/s crystal and 20 to 60 Mc/s variable. AGC circuit. Positive action return trace blanking. Kit **£38.18.0.** Assembled **£49.15.0.**

TRANSISTOR POWER SUPPLY: Model IP-20U. Up to 50V, 1·5A output. Ideal for Laboratory use. Compact size. Kit **£35.8.0** Assembled **£47.8.9**

Prices and specifications subject to change without notice

VALVE TUNERS


TUNERS
←FM
AM/FM→


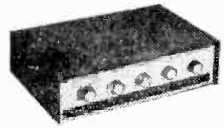
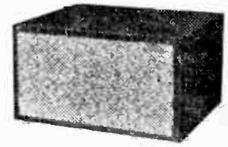
★**HI-FI FM TUNER.** Model **FM-4U**. Covers 88-108 Mc/s. Fly-wheel tuning. Pre assembled and aligned, R.F. tuning unit (£2.15.0 incl. P.T.) with I.F. output of 10·7 Mc/s and I.F. amplifier unit, with power supply and valves (£13.13.0). For free standing or cabinet mounting. Total Kit **£16.8.0**

★**HI-FI AM/FM TUNER.** Model **AFM-1**. Covers AM 16 to 50 200-550 and 900-2000 metres FM 88-108 Mc/s. Pre-aligned Tuning Heart (AFM-T1—£4.13.6 incl. P.T.) and I.F. amplifier (AFM-A1—£22.11.6). Printed circuit board, 8 valves Built-in power supply. Total Kit **£27.5.0**

★Models available in two units for your convenience.

MULTIPLEX DECODER, Model **SD.1**. Convert above models to stereo at low cost. Transistorised circuit. Self powered. Compact, matching unit. Kit **£8.10.0**. Assembled **£12.5.0**

LATEST MODELS

STEREO AMPLIFIER, TS-23 **AVON SPEAKER**

Low-priced 3+3 watt TRANSISTOR AMPLIFIER, TS-23
Breaks the price barrier in quality stereo amplifier cost. Incorporates all the essential features for good quality reproduction from gram, radio and other sources. 3W rms (15Ω) each channel. Good frequency response. Modern, compact, slim-line styling. Ganged controls. 6 position selector switch. 16 transistor, 4 diode circuit. Walnut veneered cabinet, optional extra. Kit (Amplifier) **£17.15.0** Cabinet **£2.0.0** extra.

Good performance from a Mini speaker with the **'AVON' BOOKSHELF SPEAKER SYSTEM.** Occupies the minimum space consistent with first class reproduction. Only $7\frac{3}{4}$" x $13\frac{1}{4}$" x $8\frac{3}{8}$" deep. Two special speakers $6\frac{1}{2}$" BASS, $3\frac{3}{8}$" HF unit and crossover network. Kit **£4.18.0** incl. P.T. Walnut veneered. Fully finished cabinet, kit **£8.18.0**.
TOTAL PRICE KIT **£13.16.0** incl. P.T.

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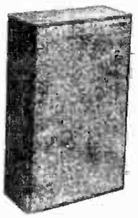
SPEAKER SYSTEMS


SSU-1

HI-FI SPEAKER SYSTEM. Model **SSU-1**. Ducted-port bass reflex cabinet "in the white". Two speakers. Vertical horizontal models with legs, Kit **£12.12.0** without legs, Kit **£11.17.6** incl. P.T.


Berkeley

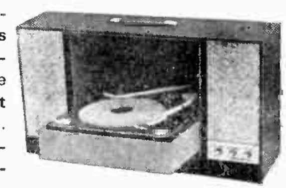
The **BERKELEY SLIM-LINE SPEAKER SYSTEM**, fully finished walnut veneered cabinet for faster construction. Special 12" bass unit and 4" mid/high frequency unit. Range 30–17,000 c/s. Size 26" x 17" only $7\frac{3}{8}$" deep. Modern attractive styling. Excellent value. Kit **£19.10.0** Assembled **£24.0.0**

COTSWOLD SPEAKER SYSTEMS. Outstanding performance for price.
MFS: Size 36" x $16\frac{1}{2}$" x 14" deep. Kit **£25.12.0** Assembled **£33.4.0**
STANDARD: Size 26" x 23" x $14\frac{1}{2}$" deep. Kit **£25.12.0** Assembled **£33.4.0**

- Deferred terms available in UK over £10.
- Extended terms over £75 UK only.
- Full specification sheet of any model available upon request
- Prices quoted are Mail Order, retail prices in general slightly higher.

New! Portable Stereo Record Player, SRP-1

Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250v ac mains operation. Overall cabinet size $15\frac{9}{16}$ x $3\frac{7}{8}$ x $10\frac{1}{4}$in.

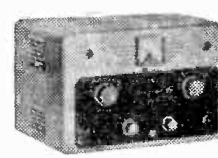


Compact, economical stereo and mono record playing for the whole Family—plays anything from the Beatles to Bartok. All solid-state circuitry gives room filling volume.

KIT **£27.15.0** Assembled price on request.

"AMATEUR" EQUIPMENT

80-10m TRANSMITTER, DX-40U. Power inputs 75W. C.W., 60W peak CC phone. Output 40W to aerial. Provision for VFO.
Kit **£29.19.0** Assembled **£41.8.0**


DX-40U

AMATEUR BANDS RECEIVER Model **RA-1**. To cover all the Amateur Bands from 160-10 metres. Many special features, including: half-lattice crystal filter; 8 valves; signal strength "S" meter; tuned R.F. Amp. stage.
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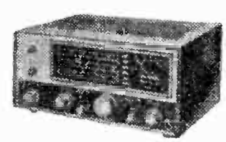
RA-1

160-10M TRANSMITTER. Model **DX-100U.** Careful design has achieved high performance and stability. Completely self-contained.
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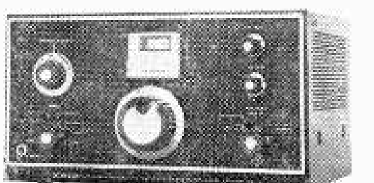
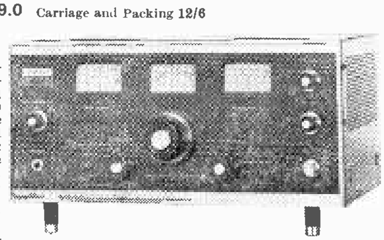
NOW AVAILABLE FOR THE FIRST TIME IN GREAT BRITAIN—TWO NEW TRIO RECEIVERS



MODEL JR-500SE

This high performance receiver is made especially to cover the amateur bands and utilises a crystal controlled double heterodyne circuit for extra sensitivity and stability. **Brief spec.:** Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. **Special features:** Crystal controlled oscillator ● Variable BFO ● VFO ● AVC ● ANL ● S meter ● SSB-CW ● Stand-by switch ● Special double gear dial drive with direct reading down to 1 kHz ● Remote control socket for connection to a transmitter. Audio output 1 watt. For use on 115/250 V A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 × 13 × 10 in. Weight 18 lbs. Fully guaranteed, complete with instruction manual and service data.

LASKY'S PRICE **£61.19.0** Carriage and Packing 12/6



MODEL 9R-59DE

Brief spec.: 4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. **Special features:** SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. band spread dial ● IF frequency 455 Kc/s ● Audio output 1·5 W ● Variable RF and AF gain controls. For use on 115/250 V A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size: 7 × 15 × 10in. Weight 19 lbs. Fully guaranteed, complete with instruction manual and service data.

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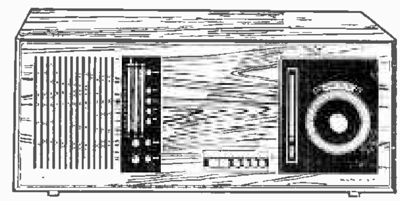

MUSIC CENTER MODEL 5001 COMBINED 126 TRACK TAPE RECORDER AND VHF/MW/LW/SW RADIO

An incomparable piece of equipment—combining 126 track tape recorder and 4 band radio in one unit of outstanding modern design. The recorder section of the Music Center gives an almost unbelievable 46 hours continuous unrepeated playing time—that's right 46 hours on 126 tracks.

Brief spec.: TAPE section: 20 transistor and 9 diode circuit, a wide magnetic tape records 126 separate tracks of 22 minutes each. Every track is able to record/replay instantly and runs from track one to 126 completely automatically so that you need not touch the machine for the total 46 hours record/replay time. Rewind time for each 22 minute track only 25 seconds. Tape speed 10·5 cm/sec. Frequency response 14–40,000 Hz. Inputs for direct recording from VHF, external microphone, record player. Pause control. RADIO—AMPLIFIER Section: 7 transistors and 6 diode circuit, 4 bands VHF/Medium/Long/Short with exclusive "Auton control" which takes over the precise tuning into the station required. Bass and Treble controls. Output 10 watts. Built-in 10in. speaker and tweeter. Sockets for extension speakers. Beautifully finished dark polished wood cabinet size 31 × 13 × 11in. Brand New, Boxed and fully guaranteed.

Lasky's huge purchase enables us to offer this amazing equipment at a fantastic saving. Value over £200.

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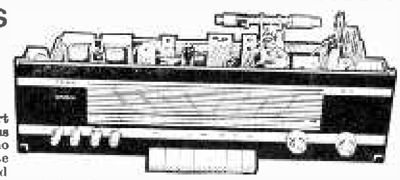

Long, medium and short wave bands coverage, plus VHF/FM mutiplex. Piano key wave change, separate fly wheel tuning on AM and FM, bass, treble and balance controls and magic eye tuning indicator. Ferrite rod aerial. The very latest printed circuitry. Output 5 watts per channel. Complete with multiplex decoder. 5 valves, line-up: ECC85, ECH801, ECC83, ELL80, EAF801. Full vision tuning scale size: 21 × 6in. Overall dimensions: 21 × 6½ × 8in. Made to very highest standards.

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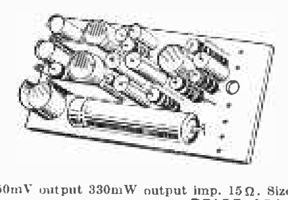

Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extreme small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9v. miniature battery.

Add 1/- on each for Post and Packing.

TYPE LRPC 1. 3 transistor. Input sens. 50mV. Output 150mW. Output imp. 40 Ω. Size 2 × 1 × ⅝in. ...... PRICE 27/6

TYPE LRPC 4. 5 transistor. Input sens. 150mV output 330mW output imp. 15 Ω. Size 2¼ × 1¼ × ⅝in. .... PRICE 18/–

TYPE LRPC 5. 6 transistor. Input sens. 8mV output 3W output imp. 3 Ω. Size 5¼ × 1¾ × 1in. .... PRICE 59/6

LRPC 9. High to Low input matching pre-amplifier. Input imp. 1 meg ohm output imp. 2 k/ohms. Size 1¼ × 1¼ × ⅝in. .... PRICE 10/6

LRPC 10. Magnetic tape replay preamp. designed so that a 450 mH head can be matched into any of the audio amp. modules listed above. Sizes 2¼ × 1¼ × ⅝in. .... PRICE 10/6

Note the **LRPC 9** and **10** are ideal for use with the **LRPC 1, 4** or **5** and **are available at the reduced price of 7/6 if bought with the LRPC 4.**

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Permeability tuned—covering 87 to 108 Mc/s. For use with one ECC85 valve. In metal case size 3 × 2¼ × 1¾in. Circuit supplied.

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

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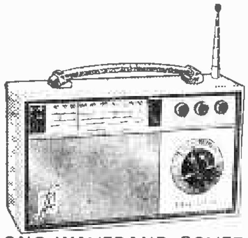
Lasky's Radio

CONSTRUCTORS BARGAINS



THE SKYROVER De Luxe

7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31–94M and also 4 separate switched bandspread 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. Superhet, 470 Kc/s. All Mullard Transistors and Diodes. Uses 4 U2 batteries. 5in. Ceramic Magnet P.M. Speaker. 500 mW Output. Telescopic and Ferrite Rod Aerial. Tone Control. Volume Control. Tuning Control and Waveband Selector. In wood cabinet, size 11½ × 6¼ × 3in. covered with washable material, plastic trim and carrying handle. Car aerial socket fitted.

Can now be built for **£8.19.6** Post 5/- extra

H.P. Terms: **60/-** deposit and 11 monthly payments of **12/9**. Total H.P.P. **£10.0.3.**

Four U2 batteries 3/4 extra.

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LONG WAVEBAND COVER FOR THE SKYROVER

A simple additional circuit provides coverage of the 1100/1950M. bands (including 1500M. Light programme). This is in addition to all existing Medium and Short wavebands. All necessary components with construction data.

Only **10/-** extra Post Free.

This conversion is suitable for receivers that have already been constructed.

LASKY'S CLEAR PLASTIC PANEL METERS

Precision made in Japan by HIOKI. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Add 1/6 Post on each.

Type KR-52 3 × 2¼in. (illustrated)

1mA DC	**32/6**	100µA	**47/6**
5mA DC	**32/6**	500µA	**37/6**
300 V DC	**32/6**	1mA S Meter	**39/6**

Type MK-38A 1⅝in. square

1 mA DC	**22/6**
5 mA DC	**22/6**
300V DC	**22/6**
100µA	**29/6**
500µA	**27/6**
1 mA S Meter	**29/6**

Type MK-45A 2in. square

1 mA DC	**25/-**
5 mA DC	**25/-**
300V DC	**25/-**
500µA	**25/-**
1 mA S Meter	**35/-**

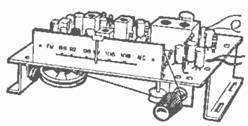
Type KR-65 3¾ × 3in.

1 mA DC	**36/-**
5 mA DC	**35/-**
300 V DC	**35/-**
100µA	**49/6**
500µA	**42/6**
1 mA S Meter	**39/6**

Type MK-65A 3in. square

1 mA DC	**36/-**
5 mA DC	**35/-**
300 V DC	**35/-**
500µA	**39/6**
1 mA S Meter	**37/6**

TRANSISTOR FM TUNER CHASSIS



Fully tunable—range 88 to 108 Mc/s. Completely wired on printed circuit. 10·3 Mc/s. IF. 6 transistors and 3 diodes. Slow motion tuning drive. Size 6¼ × 4 × 2¼in. Operates from any 9v. D.C. source. Full data and circuit supplied.

LASKY'S PRICE **£6.10.0** Post 5/- extra.

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Now you can enjoy stereo sound with the model FM Tuner above. Brief spec.: MPX input sensitivity 100mV. Output 150mV. Self powered 1 × a 9v. battery. 4 transistor and 6 diode circuit. Size 5¼ × 2 × ¾in. Also suitable for use with other FM tuners with MPX input.

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In metal case size 4 × 6 × 1¼in. Fully tunable—complete with PC86 and PC88 valves.
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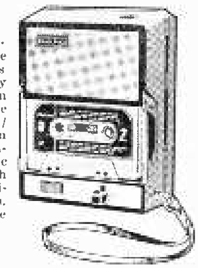
SPECIAL INTEREST ITEMS

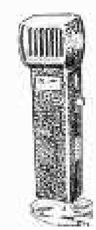
JUST ARRIVED — FANTAVOX TAPE CASSETTE PLAYER



This machine is the first of its type and is designed specifically to replay pre-recorded tape cassettes made for the PHILIPS and other cassette systems. The cassette is simply slipped into the machine and is immediately ready to play. Each cassette gives over 40 minutes play (twin track), no loss of time if rewinding—simply turn cassette over. Constant tape speed 1⅞ i.p.s. Only two controls off/play and vol. Fully transistorised, powerful vol., built in speaker, socket for personal earpiece. Operates on 6 penlight batteries. Very attractively styled shockproof plastic cabinet size 6¾ × 4½ × 2in. with wrist strap. Complete with earpiece and batteries. There are now over 200 musicassette titles available: jazz, pop, shows and classics. This machine allows you to play the music of your choice anywhere—anytime.

LASKY'S PRICE **£9.19.6** Post 5/-

NEW VOICE ACTUATED MICROPHONE



MODEL B 5001

This new voice actuated microphone is designed for use with tape recorders with facilities for remote control. The microphone is fitted with a three position switch allowing normal hand remote control, voice sensitivity action and off. The degree of voice or sound level required to operate the recorder can be adjusted. The microphone is self powered by one 9V (PP3 type) battery giving 6 to 10 hrs. operating time. Super sensitive 6 transistor circuit. Strong black plastic case. Length 7¼in. Designed for hand held use or lying flat. Fitted with 2·5 and 3·5 mm. plugs for fitting polarised sockets.

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THE ROYAL CR-62

A new high quality imported all transistor superhet car radio that really breaks the quality/price barrier. A unique feature of this set are the four M/W band station preselection button which you yourself set to your own four favourite stations—this is in addition to full M/W band cover over 535–1605 Kc/s and full L/W band cover over 150–300 Kc/s (IF frequency 455 Kc/s.). Externally adjustable aerial trimmers ensure maximum output. Six transistor (including one drift type) and one diode circuit provides powerful 2W output. **The set is adjustable for use on either positive or negative ground 12V systems (external line fuse fitted). Standard mounting** size 6¾ × 5⅝ × 2in.—front panel ⅛in. larger all round—finished in anodised aluminium with black push buttons. Complete with mounting brackets, full installation instructions and 2 baffle boards (for round or elliptical speaker). Fully guaranteed.

LASKY'S PRICE **£9.19.6** Post 5/-

6 × 4in. elliptical 8Ω dynamic speaker 17/6 extra—Post FREE.

SPECIAL OFFER—LOCKING CAR AERIAL Model S3003 five section 40? extension heavy chrome telescopic wing mounting type with unique locking device to protect the antenna when closed. Complete with mounting bracket, lead and plug and two "keys". **LASKY'S SPECIAL PRICE 39/6** Post Free with the Royal CR-62. Post Sep. 2/6.

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3¼in.	Triple play, 600ft. Mylar	10	0
4in.	Triple play, 900ft. Mylar	17	6
5in.	Double play, 1200ft. Mylar	15	0
5in.	Long play, 900ft. Acetate	10	0
5in.	Standard play, 600ft. PVC	8	6
5in.	Triple play, 1800ft. Mylar	35	0
5¾in.	Double play, 1800ft. Mylar	22	6
5¾in.	Long play, 1200ft. Acetate	12	6
5¾in.	Standard play, 850ft. PVC	11	6
5¾in.	Long play, 1200ft. Mylar	15	0
5¾in.	Triple play, 2400ft. Mylar	45	0
7in.	Standard play, 1200ft. Acetate	12	6
7in.	Standard play, 1200ft. Mylar	12	6
7in.	Long play, 1800ft. Mylar	19	6
7in.	Double play, 2400ft. Mylar	28	0
7in.	Long play, 1800ft. Acetate	15	0
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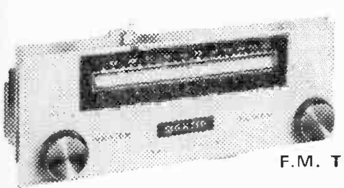
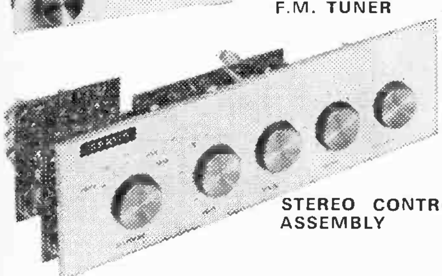


F.M. TUNER



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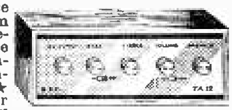
R·S·C TA12 13 WATT STEREO AMPLIFIER

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



Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge. Radio tuner. Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output—3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 30-20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 100mV (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams and instructions. Factory built with 12 mth gntee 14 gns. Or Deposit 55/- and 9 mthly. pymts. 31/- (Total £16.14.0) **11 GNS.** Carr. 10/6. Teak finished cabinet as above 73/6 or as below 86/6 extra.

RECORD PLAYING UNITS

All types available on Credit Terms. Ready for plugging into Amplifier or Tape Recorder.

RP2 Consisting of Garrard SP25 (with heavy cast turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus, plinth and cover. Normally £25 **22 Gns.** Carr. 15/-.

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge **26½ Gns.** Normally over £33. Carr. 15/-. ONLY

AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6. AT60. SP25 or Goldring GL68. **66/-** Available with clear Perspex cover as illustrated. **£5.19.11** Carr. 7/6

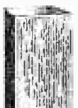
Or deeper type cut for TA12, Super 15 or 30 13/6 extra.

SENSATIONAL STEREO OFFER!

Inc. Garrard SP25 Player Unit (with heavy cast turntable) on plinth, ready wired, with plugs and fitted Goldring CS90 high compliance cartridge with diamond stylus. Assembled TA 12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. Total £56. Special Price or Deposit £5.3.2 and 9 mthly. pymts. £5.3.2. (Total £51.11.8). Carr. 25/- **44 Gns.** Perspex cover 50/- extra with above.

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets of latest styling Satin Teak or Walnut acoustically lined (and ported where appropriate). Credit terms available on all units.



The DORSET Size 16 x 11 x 9in. Response 45-18,000 c.p.s. Rating 8-10 watts. Fitted Audiotrine HF810D speaker. Impedance 3 or 15 ohms. **£8.19.9** Carr. 9/6

The DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D Speaker Rating 15 watts. Impedance 3 or 15 ohms. Frequency Response 30-20,000 c.p.s. Carr. 15/- **12½ Gns.**

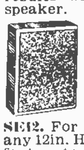
The GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40-20,000 c.p.s. Impedance 15 ohms. Carr. 15/-. **12½ Gns.**

The BRONTE Size 22 x 15 x 9in. Fitted Wharfedale Super 8 RSDD or Audiotrine HF815D Speaker, with Roll surround and dual cone. Rating 6/10 watts. Impedance 3 or 15 ohms. Carr. 16/6 **12½ Gns.**

HI-FI LOUDSPEAKER ENCLOSURES

All types of pleasing modern design acoustically lined and ported and beautifully finished in light Teak or Walnut veneer. Credit terms available

JE8. Size 20 x 11 x 8in. Gives pleasing results with any 8in. Hi-Fi speaker. Carr. 7/6 **£4.19.9**

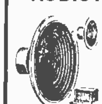


SE8. For optimum performance with any Hi-Fi 8in. speaker. Size 22 x 15 x 9in. Carr. 7/6 **£5.19.9**

SE10. For outstanding results with 10in. Hi-Fi Speaker. Size 24 x 15 x 10in. Carr. 10/- **6 Gns.**

SE12. For outstanding performance with any 12in. Hi-Fi speaker. Cut for tweeter. Size 25x16x10½in. **7 Gns.** Carr 10/-

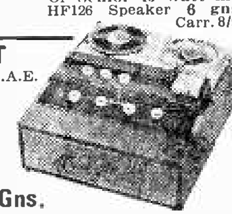
AUDIOTRINE HI-FI SPEAKER SYSTEMS



Consisting of matched 12in. 12,000 line, 10 watt 15 ohm high quality speaker; cross-over unit & Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Carr. 6/9 **5 Gns.** Or Senior 15 watt inc. HF126 Speaker 6 gns. Carr. 8/9.

LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 1⅞in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most Tape Decks. Terms available. **10½ Gns.**

AUDIOTRINE HI-FI TAPE RECORDER KIT

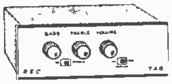


REALISM AT INCREDIBLY LOW COST: CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS. Please send S.A.E. for leaflet.

Incorporating latest Magnavox Tapedeck. High quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leather-cloth. Size 14½ x 17 x 8½in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £50-£60 class. Deposit 4 gns. and 9 mthly paymts 59/6 (Total 29½ gns.) 4 Track Model 3 gns. extra. Carr. 19/6. **26½ Gns.**

LINEAR SOLID STATE AMPLIFIERS IN STOCK

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



200-250v. AC mains operated Frequency Response 30-20,000 cps -2dB. Harmonic Distortion 0·3% at 1000 cps. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input Selector Switch. Output for 3-15 ohm speakers. Max. Sensitivity 5mV. Fully enclosed enamelled case, 9½ x 2½ x 5½ins. Attractive brushed silver finish facia plate 10½ x 3¼ins. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Or factory built with 12 months guarantee £7.19.11. Carr. 7/6. **6 Gns.**

R.S.C. TF MI TRANSISTORISED VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.** Or factory built 15½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments 39/-. Total £22.11.0.

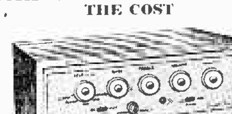
★ High-sensitivity ★200-250v. A.C. Mains operation. ★Sharp. A.M. Rejection ★Drift-free reception. ★Output ample for any amplifier (approx. 500 m.v.). ★Simple alignment instructions. ★Output available for feeding tuning meter. ★Output for feeding Stereo Multiplexer. ★Tuner head using silicone Planar Transistors. ★Designed for standard 80 ohm co-axial input. Made to visually match our Super 15 and 30 amplifiers and of the same high standard of perform'ce and reliability The pre-wired tuning head facilitates speed and simplicity of constctn. Printed circuitry. Only first grade transistors and compon'ts used. A quality product at half the cost of comparable units. Stereo version. all parts 19½ gns. Assembled 25½ gns. Carr. 10/

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

SOLID STATE CONSTRUCTION

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST

FULLY TRANSISTORISED 200/250v. A.C. Mains. **OUTPUT 10 WATTS R.M.S.** cont. into 15 ohms. **15 WATTS R.M.S.** cont. into 3-4 ohms. **LATEST MULLARD TRANSISTORS.** AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107. **5 POSITION INPUT SELECTOR SWITCH EQUALISATION** to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads. **FULL TAPE MONITORING FACILITIES. SENSITIVITIES:** Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV. **FREQUENCY RESPONSE:** ±2dB 20-20,000 c.p.s. **TREBLE CONTROL:** +15dB to —14dB at 10 Kc/s. **NEG FEEDBACK:** 52dB. **BASS CONTROL:** +12dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB. **HARMONIC DISTORTION** at 10 Watts 1,000 c.p.s. 0·25%. Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.** Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 49/- and 9 monthly payments 35/- (Total £18.4.0). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 4 Gns. extra.



ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s. **CONTROL:** 5 position Input Selector, Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Fascia Plate and Spun Silver Matching Knobs. Above facilities. etc., except for Ganging and Balance Control, apply also to Super 15. **THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT.** All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **19 Gns.** Unit factory built 26½ Gns. or deposit 83/9 and 9 monthly payments 59/3. (Total £30.17.0). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £4.15.6 and 9 monthly paymts 67/- (Total £34.18.6). *Send S.A.E. for leaflet*

R·S·C HI-FI CENTRES LTD.

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BRISTOL 14 Lower Castle St. (Half-day Wed.) Tel. 22904
BIRMINGHAM 30/31 Gt. Western Arcade opp. Snow Hill Station 021-236-1279 No half-day
DERBY 26 Osmaston Rd. The Spot (Half-day Wed.) Tel. 41361
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EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766
GLASGOW 326 Argyle St. (No half-day) Tel. CITy 4158; 403 Sauchiehall St. (Opp. Locarno) Tel. 332-1572
HULL 91 Paragon Street. (Half-day Thursday) Tel. 20505

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

Open all day Sats. except High Holborn

32 High Street. (Half-day Thurs.) Tel. 56420 **LEICESTER**
5-7 County (Mecca) Arcade, Briggate (No half-day) Tel. 28252 **LEEDS**
73 Dale St. (No half-day) Tel. CENtral 3573 **LIVERPOOL**
238 Edgware Road, W2 (Half-day Thurs.) Tel. PAD 1629; 96 High Holborn, WC1. Tel. HOL 9874 (Half-day Sat). **LONDON**
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106 Newport Rd (Half-day Wed) Tel. 47096 **MIDDLESBROUGH**
41 Blackett Street (Opp Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE UPON TYNE**
13 Exchange Street (Castle Market Bldgs.) (Half-day Thursday) Tel. 20716 **SHEFFIELD**

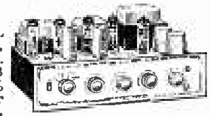
HI-FI LOUDSPEAKER UNITS

Consisting of 8in. Hi-Fi Speaker in Bass Reflex Cabinet size approx. 17 x 11 x 9in. Walnut finish. Limited number only. Impedance 3 or 15 ohms. Peak rating 10 watts. ONLY **7 GNS.** Carr. 7/9.

STEREO/TEN HIGH QUALITY AMPLIFIER

5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Valves ECC83, (2) EL84, (2) EZ81. For 2–3 ohm speakers. Complete kit with full wiring diagrams and instructions. Or supplied factory assembled with 12 months' guarantee for 11 gns. Carr. 11/6 **£8.15.0**
Terms: Dep. 36/- and 9 monthly payments 25/- (Total £13.4.9).

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

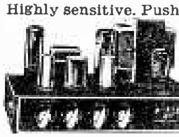


PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 20 millivolts max. **Harmonic Distortion:** 0·2% ★**Four-position tone compensation and Input Selector Switch.** ★**Stereo/Mono switch.** ★**Neon panel indicator.** ★**Handsome Perspex Frontplate.** ★**Separate Bass "Lift" and "Cut" controls.** Output transformers are high-quality sectionally wound. Outputs for 3 and 15 ohms speakers Complete set of parts, point-to-point wiring diagrams and instructions. **14 Gns.** Carr. 12/6
Or factory assembled with our usual 12 months' guarantee 19 gns. Or Deposit £3 and 9 monthly payments 43/2 (Total £22.8.6). *Send S.A.E. for Leaflet.*

R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER

A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and practically all "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feedback 15dB. Reserve power supply 300v. 25 m.a.. 6.3v. 1.5a for Radio Tuner etc. For A.C. mains 200-250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions. Or assembled ready for use 6 gns. plus 5/9 carr. **£4.17.9**

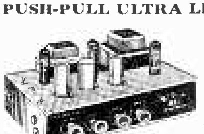
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All first grade components. Valves EF86, EF86, ECC83 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that **any kind of Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls** or **Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **12 Gns.** Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months guarantee for 15 gns. **TERMS:** Deposit 48/- and 9 monthly payments of 33/7 (Total £17.10.3). Send S.A.E. for leaflet.

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER

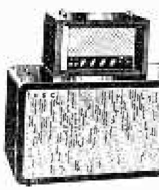
PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP.



Two input sockets with associated controls allowing mixing of "mike" and gram. etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE Frequency response ±3dB 30-20,000c/s. Six negative feedback loops Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s, all types "mikes". Comparable with the very best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Reserve Power** 300v. 30mA. and 6.3v. 1.5a. for **Radio Tuner** or **Tape Pre-Amp.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Full instructions and point-to-point wiring diagrams £8.15.0. Carr. 11/6 (or factory built £11.15.0). Metal cover with 2 handles available for 25/-. **TERMS ON ASSEMBLED UNITS.** Deposit 36/6 and 9 monthly payments of 25/9 (Total £13.8.3). Send S.A.E. for leaflet.

R.S.C. A11T TRANSISTORISED VERSION of above complete kit 9 gns. Carriage 9/6.

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

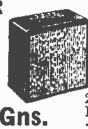


AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.

★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.
★ 4 Jack inputs and two Volume Controls for simultaneous use of
★ up to 4 pick-ups or "mikes", ★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles.
★ Separate Bass and Treble Controls giving "lift" and "cut".

49½ Gns. Carr. 30/- Or dep. £7.17.6 and 9 mthly pymts of £5.10.10. (Total 55 gns.) Send S.A.E. for leaflet.

B20 MULTI-PURPOSE AMPLIFIER especially suitable for Bass Guitar



Incorporating massive 15in. high flux loudspeaker. Rating 25 watts. Individual bass and treble controls. Two jack inputs separately controlled. Substantial cabinet attractively finished in Rexine and Vynair. Size approx. 24 x 21 x 11in. Send S.A.E. for leaflet. **29½ Gns.** Or Deposit £4.14.6 and 9 monthly payments of 66/- (Total £34.8.6). Carr. 17/6.

G15 15 WATT AMPLIFIER for Lead or Rhythm Guitar, Vocal Groups, etc.

High-fidelity output. Separate bass and treble controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Heavy Duty 12in. 20 watt Speaker. Cabinet covered in attractive Rexine/Vynair. Size 18 x 18 x 8in. Deposit 3 gns. **19½ Gns.** Carr. and 9 monthly payments of 43/7 15/- (Total £22.15.3). S.A.E. for leaflet.

G80 80 WATT AMPLIFIER

2 Channels, 6 inputs, Tremolo, 2 Columns and 1 Bass Speaker unit with two 15in. Extra Heavy Duty Speakers. **99 Gns.** Carr. £3

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9. 10a. 25/9.

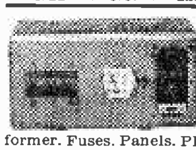
R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5¼ x 4¼ x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or Ready for use 59/11.

POWER PACK KIT

Consisting of Mains transformer. Metal Rectifier. Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied **22/11** with case in lieu of chassis 26/11. Or assembled 39/11.

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



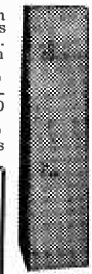
Kits consist of Enamelled steel case, Ammeter, Rectifier, Transformer. Fuses. Panels. Plugs and Leads.

2 amp 39/9, 4 amp. with variable charge rate sel. **49/9**
6 amp heavy duty with variable charge rate sel. **69/9**
All types 200–250 A.C. mains. Ready built 10/- extra.

LONDON-GLASGOW

New branches now open—see addresses

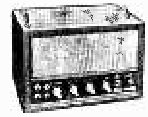
R.S.C. COLUMN SPEAKERS



Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 25-30 watts.** Fitted four 8in. high flux 7 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 44/- and 9 mthly pmts 34/9 (Total £18.1.6 Carr. 10/- **15 Gns.**
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **22 Gns.** Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

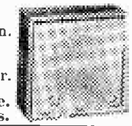
30 WATT HI-FI AMPLIFIER

for Guitar, Vocal or Instrumental Group



A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Peak rating 60 watts. Latest valves. Strong Rexine covered cabinet with handles. Attractive black/gold perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **18 Gns.** Carr. 12/6 Deposit 3 gns. and 9 monthly payments of 39/8 (Total £21).

12in. HIGH QUALITY L'SPEAKERS



In teak veneered cabinets. Size 15 x 15 x 7in. **10 Watt Model.** Gauss 12,000 lines. 3 or 15 ohms. Carr. 7/6 **5 Gns.**
20 Watt Model. 15 ohm. Size 18 x 18 x 10in. Gauss 12,000 lines. **8 Gns.** Carr. 10/6
Rexine covered £1 extra. **Terms available.**
30 Watt Model. Rexine covered **10 Gns.**

LOUDSPEAKERS

Limited number at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available over £8.
12in. 10 watt HIGH FLUX 59/11.
12in. 20 watt DUAL CONE Heavy Duty **£5.11.9.** Carr. 6/9.
12in HEAVY DUTY 30 watts. 7 Gns. Carr. 10/-. Normally £13 approx.
15in. EXTRA HEAVY DUTY 40 watts. 12 Gns. Carr. 15/-. Massive units. Usually 18 Gns.

FANE 'POP' 100 L'SPEAKER

18" 100 Watt Post Free **19 Gns.**
Fantastic power handling. Guaranteed 2 years.

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425-0-425v. 200mA, 6.3v. 4a., 6.3v. 4a., 5.v 3a.	69/9
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250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a.	22/9
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier	39/9
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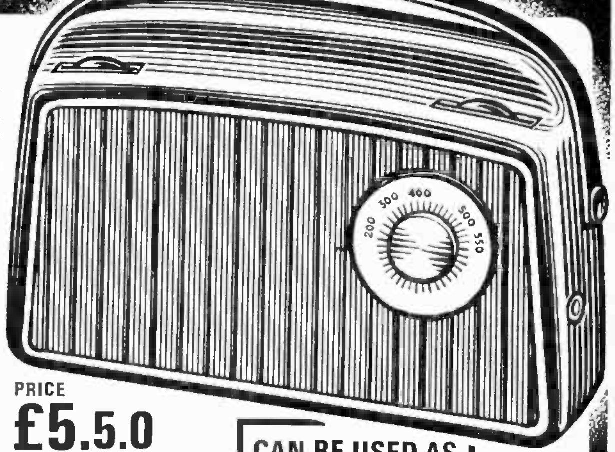
with BABY ALARM facilities



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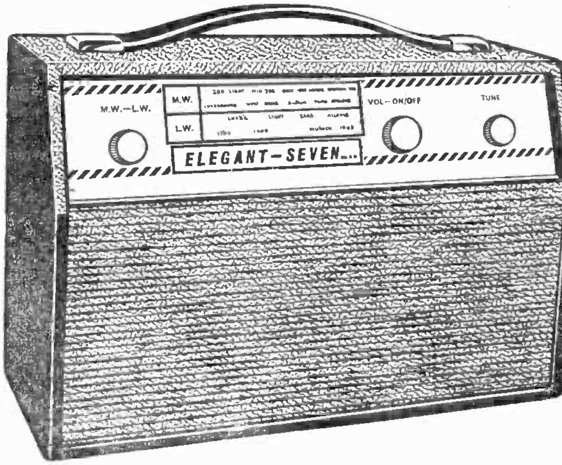

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PRACTICAL WIRELESS

VOL 43 No 9

issue 731

JANUARY 1968

TOPIC OF THE MONTH

Dear Santa . . . . .

AND what, dear reader, would you like Santa Claus to bring you this Christmas—assuming that the old gentleman can negotiate your array of TV aerials, break out of your converted chimney-piece speaker enclosure, avoid falling over your junk box and, if he does, choke back the cries of anguish to avert operating your audio switch and turning on the telly? Apart, that is, from a gadget to stop editors committing sentences like the above to print.

We made a few enquiries. Messrs. Guttridge and Gibson plumped for sockfuls of exotic DX, Henry and Pax wanted an exclusive interview with the man (no doubt as an excuse to work in a Santa Claus and reindeer sketch) and although many readers would ask for the secret of 100% success in constructional projects Messrs. King and Hellyer wanted more and better failures, obviously to justify some more fault finding articles.

The P.W. staff, when pressed, came up with a number of startling (though somewhat predictable) requests which we are glad to forget. But every individual reader would find no trouble in drawing up a splendid list of gifts.

Well, fasten your safety belts, for we have bad news. We learn, on the best authority, that there just ain't no Santa Claus! You will just have to carry on without his help and make the best of it under your own steam. Maybe it's just as well, really. You'll get much more fun and satisfaction working things out on your own. The only sure way to success is in learning by mistakes, building up experience gradually and trying things out.

But if you're still not convinced about Santa Claus, why not ask him for an annual subscription to Practical Wireless? You never know your luck! Or, better still, play Santa yourself and solve that difficult Christmas problem with a subscription to your friend — or, if you have no friends, to yourself!

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

FEBRUARY ISSUE WILL BE PUBLISHED ON JANUARY 5th

Merry Christmas and a Happy New Year

from the staff of Practical Wireless

W. N. STEVENS

L. E. Howes, G3AYA D. L. Gibson, G3JDG J. A. Reddihough C. R. Riches, BRS28358

NEWS AND COMMENT...

"SATELLITE JOURNALISM"

The Post Office made journalism history on October 17th when it provided facilities for the inter-continental transmission of a newspaper page over a 48kc/s satellite circuit.

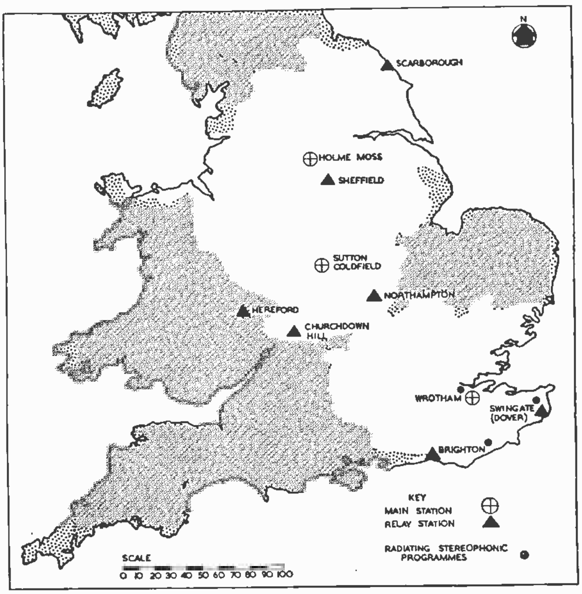
A Muirheads Page Facsimile Transmitter in the London office of the "Daily Express" was connected with a Muirheads Page Facsimile Receiver installed in the plant of the "El Mundo" newspaper in San Juan, Puerto Rico.

The 48kc/s circuit, involving the use of cable and micro-wave systems connecting the "Daily Express" with the GPO's Goonhilly Earth Station, was extended to Mill Village, Canada, through the COMSAT Organisation's "Early Bird" satellite. The link from Mill Village to San Juan was afforded over the facilities of the AT & T and IT & T companies.

This demonstration was undertaken on behalf of the Inter-American Press Association whose annual general conference took place in San Juan during the middle of October.

V.H.F. STEREOPHONIC TRANSMISSIONS

(Extension to the Midlands and North)



Reproduced by courtesy of the BBC Engineering Information Department.

Work is in hand to extend the stereophonic transmissions, at present radiated from Wrotham, Swingate and Brighton, to Sutton Coldfield and Holme Moss and certain relay stations fed from them, early in 1968. The unshaded part of the map above indicates the areas in which satisfactory stereophonic reception should normally be obtained. In places where the field strength is low, increased background noise may be heard on stereophonic programmes; improvements to the receiving aerial should enable the noise level to be reduced.

"KNIGHT KITS"

FROM MESSRS. ELECTRONIQUES

KG-275 Exposure Meter

Messrs. Electroniques have entered the "Kit" market with a vengeance. Their latest catalogue lists a host of units to suit all tastes. Signal generators, Hi-Fi, Oscilloscopes, Power Units and Receivers to mention just a few.

Readers will be pleased to hear that Electroniques claim a near foolproof system of guaranteed satisfaction with all their "Knight-Kits". They run a postal service for any advice needed. They will service the unit if required, and if, after building the Kit, difficulty is encountered, they will get it working too. There is also a money-back guarantee.

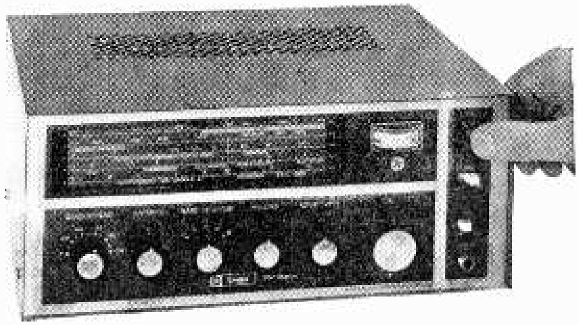
The above photograph illustrates the KG-275 Exposure Meter. It is possible to construct this in an evening and it is claimed that "It responds to light so weak—you can't see to read the meter".

The photograph below is their "Star Roamer" all band receiver which covers from 200 to 400kc/s and from 550kc/s to 30Mc/s continuous thus covering long, medium and short waves both commercial and amateur.

The instruction manuals are laid out in such a manner that Electroniques are able to claim that anyone—regardless of their knowledge of radio and electronics, can build any of these kits. The wiring is taken a step at a time and each manual is generously illustrated. Even the wires are colour-coded and cut to length too. They even tell the constructor when to take a break for coffee!

It is pleasing to note in the catalogue, that against most of the kits is a recommended book to assist the constructor gain the fullest advantage of the unit he has constructed.

A catalogue of the new "Knight-Kits" is available free from Messrs. Electroniques (Prop. STC Ltd.), Edinburgh Way, Harlow, Essex.



Star Roamer receiver

NEWS AND COMMENT...

NON-STOP POP BATTLE

The BBC may face a big clash with the pop record companies if it increases the broadcasting time for playing records. The companies fear that continuous radio pop will stop people buying records.

The BBC chiefs are under pressure from Mr. Robin Scott, controller of Radio 1, who wants record time increased from the present 82-hours-a-week limit.

His plea is backed by young people who have been writing to the BBC complaining about the broadcasting of quiz shows and plays instead of continuous pop "like the pirate stations".

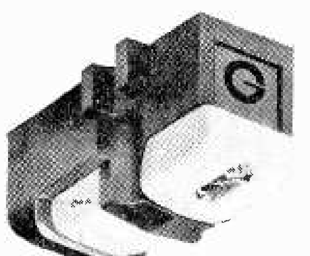
Opposition to an increase of needle time (the broadcasting term for the playing of records) comes from the Musicians' Union and Phonographic Performances, a consortium of record firms.

They claim an increase would mean less work for musicians and "over-exposure" of records, with transistor radios being used as "portable juke boxes".

LONG-RANGE COMMUNICATIONS IN AUSTRALIA

The building of a long-range cable connection is to be commenced in Western Australia early in 1968, involving a cable almost 600 miles long with four co-axial conductors which will connect the towns of Perth and Carnarvon. A 12Mc/s system will simultaneously transmit 1,200 long-distance calls and a TV programme along two conductors; the other two lines are being equipped with a 4Mc/s system comprising 960 telephone circuits. Siemens will be supplying and installing the line amplifiers for both systems. The transistorised wideband amplifiers conform with the latest state of the act, require no maintenance whatever and can be fed with d.c. via the inner conductors of the associated coaxial conductors. These wideband amplifiers are accommodated in more than 200 intermediate repeater points mainly in underground containers.

FREE FIELD STEREO CARTRIDGE

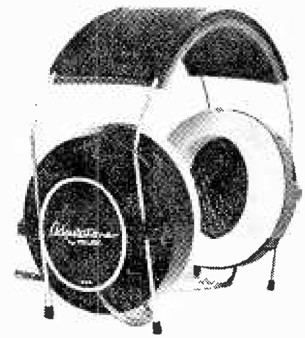


Goldring Manufacturing Co. (GB) Ltd., 486–488 High Road, Leytonstone, London, E.11, announce their new stereo magnetic cartridge, No. 800. In this unit, a very lightweight tube of magnetic material lies in a "free field" generated by a fixed source and is made to follow the record groove modulation by its coupling to a low mass diamond point. Due to the low mass, the mechanical impedance of the moving system has been reduced, pushing the resonance up to a frequency of over 20kc/s.

A significant by-product of this "free field" system is that the cross-talk separation is maintained at a very high level, never falling below 15dB even at the highest frequencies and averaging over 20dB at the mid-frequencies.

Sensitivity is 1mV per cm/sec.; separation is 25dB at 1kc/s; load is 100kΩ–47kΩ; effective point mass is 1mg and stylus point, 0·0005in. diamond. Tracking weight is 8 grams. The price is £12 7s. 6d. which includes P.T.

HEADPHONES WITH TONE CONTROL



A new headphone, from the USA claims to reproduce full bass sound to surpass any headphone made, plus the special "Adjustatone" feature which allows response up to the limits of human hearing yet provides for scratch and hiss elimination.

Frequency response is from 10 to 15,000 c/s. Weight 12 oz. Operation is on outputs from 3 to 16Ω and requires less than 1W. Distortion is less than 1% at levels below the threshold of pain (130dB SPL). Sensitivity is 100dB SPL/mW at 400c/s.

Price is $9\frac{1}{2}$ gns. Transatlantic Music Tapes (Distributors) Limited, Bristol & West House, High Street, Salisbury, Wiltshire.

BBC RADIO LEICESTER

The first of the BBC's local radio stations was brought into service at Leicester on November 8. Transmission is on 95·05Mc/s in the v.h.f. band, with horizontal polarisation, from a transmitter at Anstey Lane. Regular trade test transmissions are radiated daily from 09.30 to 18.00 and started on Friday, October 27.

The local programmes are originated from the headquarters of BBC Radio Leicester at Epic House, Charles Street.

Radio Leicester serves Leicester and its immediate surroundings including Arnesby, Cosby, Desford, Woodhouse Eaves, Burton-on-the-Wolds, Hungerton and Gaulby. The transmissions are on v.h.f. only. Listeners who may not have a v.h.f. receiver should consult their radio dealers who will be able to advise about reception.

Receivers for Radio Leicester are also suitable for reception on v.h.f. of Radio 2 (Light Programme), Radio 3 (Third Network) and Radio 4 (Home Service). The BBC's v.h.f. sound services provide improved reception which is much less susceptible to noise and interference than is reception on medium and long waves.

L. W. Roche

It is with deep regret that we have to announce the death of L. W. ROCHE. "Lew", as he was known to all his many friends and acquaintances, did a great deal of pioneer work in the field of electronic music. Many of his electronic organ designs in "kit form" currently enjoy wide popularity. He was associated at various times with a number of companies who specialised in this field, and at the time of his death was chief design engineer for Henry's Radio Ltd. "Lew" had been failing in health for a number of years. To his family we express our sympathies in their great loss.

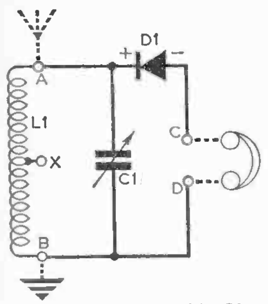
SIMPLE CRYSTAL TUNER

W. E. DODD

THE simple crystal receiver has many advantages to offer. It is cheap to construct, easy to build and doesn't require any form of power either from the mains or batteries. It can be left switched on without waste, and requires only an aerial and an earth lead to provide hours of inexpensive entertainment. This is an ideal project for the beginner and also provides a very acceptable present for the Christmas stocking for a youngster.

LAYOUT

The layout of the receiver is very uncritical and the components can be laid out in almost any style to suit the container or case. The prototype was built in a two-ounce tobacco tin merely because this was to hand and a wooden container would be just as good.



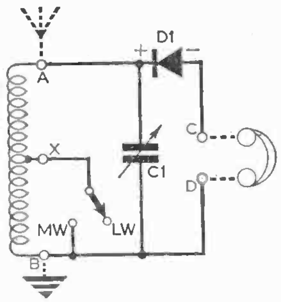


Fig. 1 (left): Simple longwave crystal set.
Fig. 2 (right): Adding a switch for m.w. and l.w.

CIRCUIT

The complete circuit diagram is shown in Fig. 1. Only three components are used: a coil, a capacitor, and a crystal diode. An aerial is connected to point A, the earth to point B, and a pair of headphones to points C and D. If a mistake is made in the wiring no damage will be done, the set just will not work until the fault is rectified.

The prototype receives three programmes in Hertfordshire at headphone strength—Radio 1, Radio 4, and on long waves Radio 2. As it stands the circuit in Fig. 1 will receive only long waves and thus only one station, Radio 2. If a piece of wire is connected to points B and X this will short out the lower part of the coil and the receiver will work only on medium waves. In this condition it receives two stations, Radio 1 and Radio 4. For simplicity this latter connection would be ideal, but if we were to wire-in a simple switch between points B and X we could have a two-band set for either medium or long waves dependent upon the position of the switch. This modification is shown in Fig. 2. Any on/off type of switch will do but in order to ensure that it will fit in the case, one of the small slide switches, mounted on the side of the case, would be best.

CONSTRUCTION

There are only four holes to drill. Three are 6BA—two for the coil and one for the small tag strip. The fourth hole is $\frac{3}{8}$in. diameter for the tuning capacitor. Mount the tuning capacitor first, then the tag strip and finally the coil. The 6BA bolts will make their own thread in the coil former but these should be tightened gently otherwise the coil former might split.

The thick double tag on C1 is the tag to connect to earth, the other tag being the aerial connection. It must now be decided whether a switch is to be used. If not, then now is the time to decide whether long or medium wave is to be selected. Since the

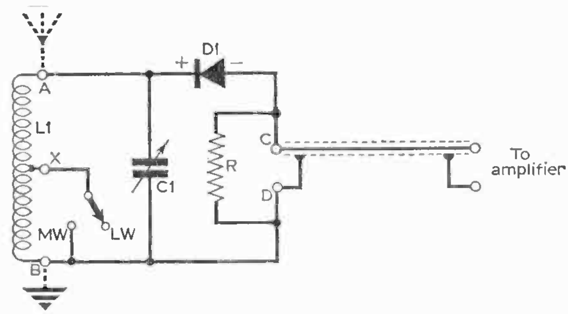


Fig. 3: Adding a $4{\cdot}7k\Omega$ resistor to make a tuner.

prototype was wired for medium wave only, this wiring will be described first.

Take a length of wire and connect it to the red and blue tags on the coil L1. From here the same wire is taken to the large double tags on the tuning capacitor C1 and from this point to tags 1 and 2 on the tag strip.

Next, a wire is connected from the remaining tag on C1 to tag 4 on the tag strip. Now solder another wire from the same point (tag 4 on the tag strip), to the black tag on the coil. The last step is to connect the diode between tags 3 and 4 on the tag strip. The diode should be connected with its positive end to tag 4 and the negative end to tag 3. This completes all the wiring for the medium wave only set.

To test the receiver, connect a pair of high resistance headphones (4,000Ω) to tags 2 and 3 on the tag strip, the aerial to tag 4 and the earth lead to tag 1. By rotating the tuning capacitor it should be possible to hear a station, possibly two stations. The set should receive a station quite well if it is within 40 to 50 miles from the transmitter.

In some cases it might be difficult to separate the two stations and here it would pay to experiment with the length of the aerial. Alternatively, another variable capacitor, the same value as C1, could be connected between the aerial and point A on Fig. 1.

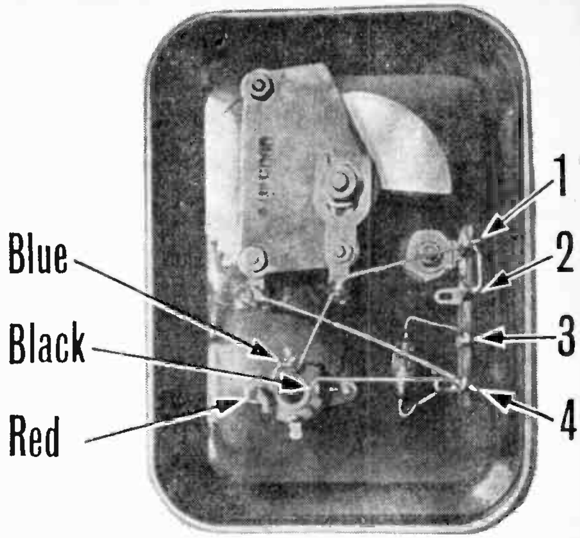
If long wave only is required it is only necessary to break the wire which shorts the red and blue tags on the coil together. In this case the red tag is left unconnected and only the blue tag is wired up.

DUAL WAVE

For the reception of both long and medium waves a switch is required as explained. The set is wired as for long waves only and two wires are taken to the switch. One wire from the blue tag, this is the wire which goes from the blue tag to the double tags on the tuning capacitor and tags 1 and 2 on the tag strip. This wire is continued to one terminal on the switch. Another wire is taken from the red tag on the coil to the other terminal of the switch. Note, this will be the only wire on the red tag of the coil.

The aerial should be as long and as high as possible. A length of 70ft. of bell wire was used on the prototype with the earth taken to a length of copper pipe driven into the ground just outside the window. However, quite good results were obtained using only the bedsprings as an aerial and no earth, although this produced considerably less volume and no stations could be heard on long waves with this set-up. A length of wire around the picture rail should also produce results.

The front of the case was masked with adhesive tape and then sprayed with a paint aerosol, after which the tape was removed. The dial was made from black scraper board which is easily obtainable from most stationers and art shops. It costs 2s. 6d. for a small packet. This is a black-coated card which, when scratched or scraped, will produce a white image. The dial could easily be made from a piece of white card or paper and the marking made in ink.



View of the completed receiver wiring. Component positioning is not critical as there is plenty of room. Note the bottom tag of coil has no connections

The photograph shows the inside of the case and the wiring of the prototype wired for medium waves only. The inside of the tin is not normally black. It was painted this colour purposely, but only so that the wiring and components would show up better on the photograph.

The crystal set may be used as a tuner in conjunction with an amplifier. Good results were obtained using the prototype with a small commercial transistor amplifier. To use the set in this way one extra component is required—a 4·7kΩ fixed resistor. This component is wired across on tags 2 and 3 on the tag strip. A length of screened lead is then taken from these two tags to the amplifier. The braiding or screening of this lead goes to tag 2, and the other wire to tag 3. Similarly, at the amplifier end, the screening goes to the earth line and the other wire to the amplifier input. When the set is used in conjunction with an amplifier the phones are, of course, disconnected from the circuit. ■

★ components list

C1	500pF variable capacitor (Jackson Dilecon).
L1	Dual range crystal set coil (Repanco type DRX1).
D1	Diode. OA81 (or OA70, OA79). Almost any diode will do.

Four-tag tag strip, 6BA bolts and nut, scraper board, pointer knob, two-ounce tobacco tin, high resistance headphones (4,000Ω), aerial and earth wire, wire for wiring up, solder, 4·7kΩ ¼-watt fixed resistor if required.

SEMICONDUCTOR AUDIO

PART 3

R. LEYLAND

IN power amplifiers transistors are required to work at levels that leave only a small margin of safety against thermal runaway. The maximum temperature has to be kept within the limit permissible by the efficient removal of the heat being produced, which is concentrated mainly at the collector junction. Conduction of this heat into a larger area of metal enables it to be radiated and convected at a faster rate, and the power is increased for a given junction temperature.

Germanium transistors in Class B output stages require heat sinks at outputs above a fraction of a watt, and small silicon transistors similarly above a watt or two. In a high-power amplifier the driver stage transistors, when germanium, may also need to be mounted on a heat sink.

A number of transistors of TO-3 or similar construction make thermal contact with the heat sink through a thick copper mounting-plate with two-screw fixing. Small power transistors of TO-5 construction can be fixed on a heat sink by a method that presses the rim of the transistor casing on to the heat sink, so producing metallic contact over the flat area of the transistor. A washer with holes for screws can be used. For other small-output transistors it is necessary to fit a copper clip that is bolted to the heat sink, or which at low power can itself serve as a heat sink.

Any surface unevenness on the heat sink under the transistor should be avoided. Burrs at holes have to be removed, and a special silicone grease is applied to reduce the thermal contact resistance.

INSULATION

The collector in power transistors is connected internally to the metal case of the transistor. There are, however, small output transistors, e.g. of TO-1 construction, which are electrically isolated from their case, or in which it is the base that is connected to the container.

In general, therefore, both transistors of an output stage can only be mounted on the same heat sink if 0·002in. mica and insulating bushes are used to insulate one or both transistors. Instead of mica a ⅛in. thick anodised aluminium insulator can be used, and its very low thermal resistance is an asset when the transistor and heat sink also have very low thermal resistances. The heat sink itself can be anodised to insulate it and improve radiation from it, but the separate insulator provides a double insulating layer.

Heat sinks in direct contact with the transistor can be mounted on insulators inside an amplifier cabinet provided that effective cooling is maintained. The area of a heat sink creates a risk of capacitive feedback to earlier stages, and the preamplifier may have to be screened from it.

There is no harm in merging a number of heat sinks into a single large one providing that the transistors are spaced out and electrically insulated. A metal cabinet or chassis can be used as the common heat sink, or two large heat sinks insulated from each other can serve as the sides of a cabinet. With these methods precautions may be necessary to avoid short-circuits from accidental contact with external metal objects.

HEAT SINKS

The surface of a heat sink, except at the point where the transistor is mounted, can be blackened to improve radiation. This reduces the thermal resistance by about 30% as compared with bright metal. Convection is assisted by mounting the heat sink vertically, and an improvement of possibly 20% can in this way be obtained. The thermal resistance of a rectangle of blackened 16 s.w.g. aluminium measuring 7in. x 4in. is approximately 3·5 deg. C/W.

In determining the thermal resistance necessary for a heat sink from the derating characteristic of the transistor it is usual to assume an ambient temperature of 45 deg. C.

Sometimes a heat sink is chosen that is adequate for music but not for continuous sinewave testing. The lower the thermal resistance of a heat sink the better, as there will be less variation in quiescent current with signal level, but there is little advantage in making it very much lower than the internal thermal resistance of the transistor. For example,

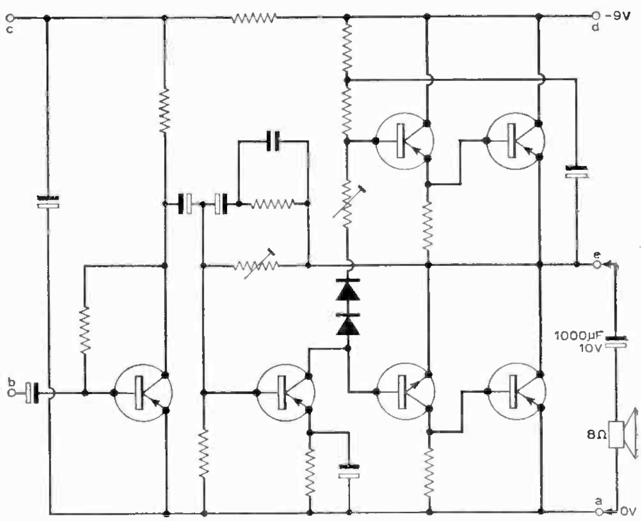


Fig. 10: Packaged 800mW a.f. amplifier type PC7+ (Newmarket Transistors). Dimensions: 3in × 1·75in.

a small transistor with a thermal resistance of 50 deg. C/W junction-to-case would probably not be fitted on a heat sink with a thermal resistance lower than 15 deg. C/W (possibly a 2in. square of metal) but if a power transistor of 1·5 deg. C/W thermal resistance was fitted on this heat sink there would be considerable room for improvement.

Heat sinks of finned design in extruded aluminium alloy are obtainable with specified values of thermal resistance. For example, one measuring 5in. x 4in. x 1in. deep (over the fins) has a thermal resistance of 2 deg. C/W.

NEGATIVE FEEDBACK

Unvarying amplification of varying signals is the ideal, and fidelity amplification implies an amplification that is linear up to the maximum output. It is the effectiveness of negative feedback in promoting linearity that makes fidelity amplifiers possible. Distortion occurs mainly at high signal levels in the driver and output stages and, subject to some reservations, can be reduced to any desired extent, relative to signal, by applying sufficient negative feedback.

A.C. negative feedback stabilises amplifier gain, according to the values of resistances in the feedback network, making it insensitive to changes within the amplifier, and less dependent on the characteristics of the transistors. Since distortion is reduced to the same extent as gain is reduced, the more amplification within the feedback loop the better, and high-gain transistors will result in a lower distortion figure. It is also more effective to apply the negative feedback over a number of stages. Modifications to stages within a negative feedback loop may appear to have no effect until the feedback is disconnected. For example, when negative feedback is in action, bootstrapping does not produce any very noticeable increase of gain.

It is only worthwhile reducing low basic distortion to a small fraction of 1% by negative feedback if the loudspeaker itself produces little distortion. In a portable radio the quality improvement resulting from the use of 10dB of negative feedback, reducing the gain about three times, could be considered adequate, while in a fidelity amplifier as much as 50dB of negative feedback, reducing the gain over 300 times, might be applied. More usual amounts are 20—40dB with gain reductions of 10 to 100 times. Some gain must be retained in the power amplifier however to avoid the need for a high-level output from the preamplifier, which would tend to reintroduce distortion.

D.C. negative feedback used to stabilise the quiescent midpoint voltage can be applied to a much greater extent than a.c. feedback. A single feedback path can be used for both with a decoupling capacitor included, e.g. at the emitter of the driver stage or at a point in the feedback path, to reduce the amount of a.c. feedback applied. It is preferable that the amount of feedback should not depend too much upon the value of the capacitor, as it can when a feedback voltage is developed across the capacitor in series with a low resistance.

Negative voltage feedback from the output reduces the output impedance. Values of output impedance of less than an ohm can be obtained for good loudspeaker damping.

FREQUENCY RESPONSE

Tone controls are usually incorporated in the preamplifier stages, a completely uniform response, obtained by means of a resistive negative feedback network, being aimed at in the power amplifier over the a.f. range. In some amplifiers, however, the negative feedback network is modified and made frequency-dependent to provide a bass or treble control.

Even with negative feedback the maximum power response is not usually maintained with germanium power transistors at a frequency of 10kc/s and above due to a decrease of efficiency. There is an increased risk of thermal runaway in testing with a continuous sinewave signal at high frequency, but little effect on the reproduction of music. Silicon power transistors, made by the newer diffusion process, do not have this limitation of h.f. output. It is usually necessary, however, to limit the response beyond the a.f. range, i.e., above 15kc/s.

Although in a fidelity amplifier the response will extend down to −3dB at 20c/s, with a small loudspeaker a −3dB response at 200c/s is more suitable to avoid the distortion produced by a small loudspeaker at low frequencies. This allows a loudspeaker coupling capacitor much smaller than the 1,000μF or more used with a loudspeaker of low resonant frequency. A disadvantage of the smaller capacitor is its higher series resistance, which could put as much as an ohm in series with the loudspeaker.

When negative feedback is applied via a resistor as a current to the base of the driver stage it lowers the effective input impedance, and the amount of negative feedback depends on the collector load resistance of the predriver stage, being greater if the value of the load is high. If instead the negative feedback is applied as a voltage across a small resistor at the emitter of the predriver stage it raises the input resistance of the predriver stage, and the amount of negative feedback is then maximum when the predriver input comes from a low-impedance source.

H.F. STABILITY

Feedback is a stabilising factor when phased negatively to reduce the effective input. Instability is produced however when amplifier phase shift is sufficient at some frequency to transform negative into positive feedback. This phase shift accompanies the usual decrease in amplifier response outside the a.f. range, at low and high frequencies, and may cause a peak in the amplification. If the loop gain exceeds unity at this frequency, oscillation occurs.

With no transformers to restrict the performance phase shift in a transformerless amplifier is reduced, allowing more negative feedback to be applied without oscillation. Direct coupling of amplifier stages overcomes low-frequency phase shift, but there is still risk of oscillation above the a.f. range, especially with a reactive loudspeaker load. Even when continuous oscillation does not occur there may still be bursts of oscillation following any abrupt transition in the waveform. This shows up in tests with a square waveform, or when the signal is increased to the point where clipping occurs on peaks, or in the presence of some crossover distortion.

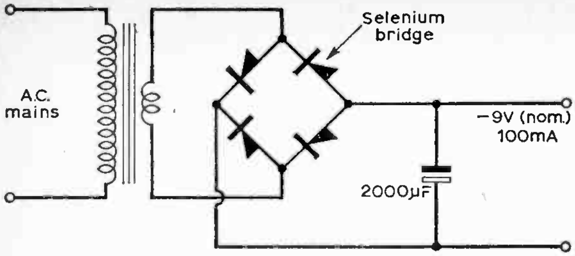


Fig. 11: Bridge rectifier power supply type PC101, for use with amplifier type PC7 (Newmarket Transistors).

To avoid high-frequency instability a number of precautions are taken. Transistors made by the diffusion process, with high cut-off frequencies, can be used to reduce phase shift at high frequencies. A small capacitor of suitable value can be connected across the negative feedback resistance, and is often placed between the collector and base of the driver stage. This improves the pulse response of the amplifier by removing overshoot, i.e. the commencement of an oscillatory response.

Another precaution against h.f. instability is to connect a passive network, consisting of a suitably-chosen resistor and capacitor in series, at some point in the amplifier to reduce the h.f. response. A network of this type is often connected across the loudspeaker.

POWER SUPPLIES

Distortion in an amplifier is less when it is working at only a fraction of full output, and there should be ample output power available in reserve in a quality amplifier to cope with sudden increases in signal. A power capability of several watts is therefore desirable except in small portable radios. A 40- or 50-volt supply enables an amplifier to develop this amount of output power without currents so heavy as to make earthing problems difficult. These currents flowing in earth links or chassis can produce potentials that can be fed back to the input and cause increased distortion.

A mains type power unit will usually be required for a high-wattage amplifier, and involves introducing a mains transformer, but this is able to supply the two amplifier channels of a compact integrated stereo system.

One type of transformerless amplifier, the π-mode Class AB, takes a constant supply current and there

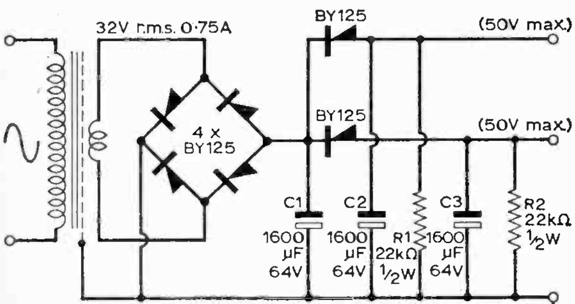


Fig. 12: Diode-decoupled power supply for two amplifier channels of a stereo system.

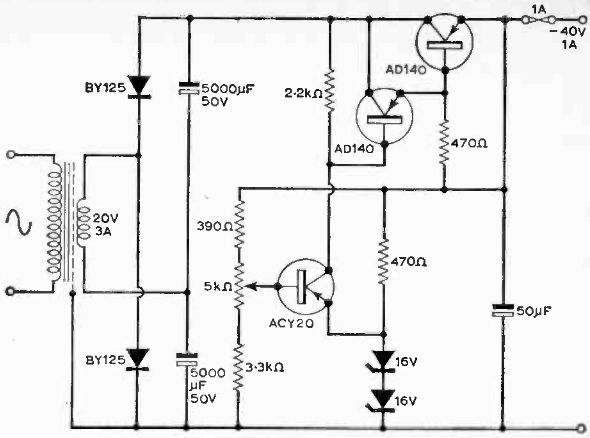


Fig. 13: Stabilised power supply for a Class B amplifier.

is no problem of supply regulation. With Class B amplifiers, however, the power unit must have good regulation to avoid large voltage variations caused by the varying current demands of the Class B output stage. These can restrict the maximum output from the amplifier especially on a test signal consisting of a continuous sinewave, making the sinewave rating less than the power rating on music, which on average takes only a third of the current required for the sinewave signal. Series resistance in the supply must therefore be minimised, and smoothing is sometimes omitted except for a reservoir capacitor of possibly 2,500μF.

REGULATION

Full-wave bridge rectification (Fig. 11) has the advantage of better regulation, and makes the ripple frequency 100c/s. When the current drain is small the voltage nears the peak value, so hum is reduced on quieter signals where it would be more noticeable.

Inductance-capacitance filters are practicable if the chokes are of very low resistance. A 50mH choke with a 2,000μF capacitor will reduce ripple 36 times.

Diode decoupling (Fig. 12) offers some advantages. A forward-conducting junction diode takes the place of the choke as the series element of the ripple filter. Its voltage drop is less than a volt and becomes constant at high currents, where the diode has little effect. At low currents, the a.c. resistance of the diode increases, and provides ripple suppression where it is most necessary. Separate diode decoupling for two channels of a stereo system provides very satisfactory separation between them.

A stabilised power supply can have a very low output impedance and there should then be no difference between the amplifier ratings for sinewaves and for music. An extra power transistor is involved, with a heat sink, and a zener diode reference. The best type of circuit will probably include two other transistors (see Fig. 13). Amplification in the regulator circuit enables the mains unit to have an output impedance of only a fraction of an ohm, and also ensures very effective ripple suppression. ■

learning morse

T. SIMON

EVERY day, thousands of messages are transmitted in morse or c.w., from ships, aircraft or commercial stations. Many news broadcasts from all over the world are in morse and offer interesting listening for keeping up to date with the international situation. Again, amateur radio enthusiasts or Hams can be heard chatting across thousands of miles. If you can't read morse you are missing a lot of interesting fun.

Learning to send and receive c.w. is not difficult, though some will learn quicker than others. There are numerous methods of learning too, but whichever way you finally decide upon, one factor will be far more dominant than the actual method itself—your determination. If you are really determined to learn morse, then you will, no matter how you go about it.

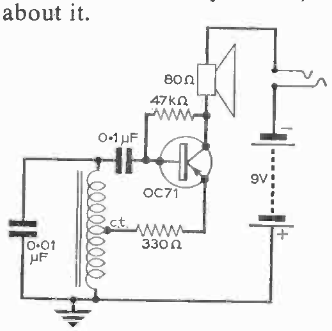


Fig. 1: Circuit for a simple oscillator.

One point is important and agreed by practically all c.w. men. *DO NOT* think of the code in terms of dots and dashes, if you do, and you are determined to learn then you will succeed, but it will be more difficult and will almost certainly take longer. For example, the letter U is thought of as di-di-dah and not dot-dot-dash, while F would be di-di-dah-dit.

Memorising the code can be done in a number of ways. Some people learn the characters containing only dots—E, I, S and H, and then those with dashes—T, M and O. These are quite easy to remember and this takes care of seven characters. Some then proceed to learn all the remaining characters which begin with a dit, and finally those beginning with a dah. Others advocate memorising the five vowels first since these are in common usage.

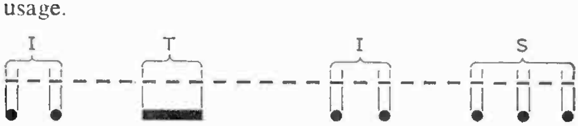


Fig. 2: Correct spacing and character length.

Another method, which the writer can recommend, is to start by learning the first seven characters of the alphabet. When these are memorised, make up little groups using only these seven characters in different sequences. This is to ensure that they are thoroughly committed to memory. The next seven letters are then memorised and the process repeated, after which, jumbled groups using the first fourteen letters are practised. This procedure divides the alphabet roughly into four easy bites and with just fifteen minutes practice every day it should not take longer than two weeks to completely memorise the code. The length of each practice session is a matter of individual preference. However, several short sessions are better than a few long ones.

ESSENTIALS

The first essential is a morse key and an audio oscillator. Failing this a buzzer will do but an oscillator is preferred. Circuitry for a suitable unit is shown in Fig. 1. It is very simple and easy to make up either on Veroboard, printed circuit or a tagstrip.

Hold the key lightly, resting the first and second fingers on the knob. The morse code is sent with the arm, the wrist acting as a pivot, and *NOT* by pecking at the key with the fingers. The fingers should not leave the key, and above all—relax. Send slowly and concentrate on accuracy, speed will come with practise. Remember that—one dah is equal in length to three dits, the spacing between two letters of the same word or group is three dits, the spacing between individual characters of the same letter is one dit, and finally the space between words or groups should be equal to five dits. (See Fig. 2.).

AMZFR	GOLMM	THEFP	QCMOA	IIFMZ
YOOVB	TFORQ	HXCEF	ENJNJ	LWUAF
REDER	TPEKQ	LAKSJ	MCUOI	AIOSH
QLWPS	ODKRU	THNVG	ALOUE	IEOUA
MZNXB	BVGFH	JDKSL	APQOW	IEURY

Fig. 3: Example of some five-letter groups.

Practise sending slowly and accurately, if you develop a sloppy style or a bad fault it will be almost impossible to correct after a time. Guard against clipped characters, incorrect length of characters and spacing. Most important, guard against tension in the hand, wrist and arm muscles. A good c.w. operator can send for a very long time without any apparent effort. If your hand, wrist or arm are tensed up in any way, you will find that you are unable to send for more than a few minutes, so relax, take your time and hold the key very lightly with the fingers just resting on the key.

A tape recorder is a great asset because you can send some morse at a very slow speed, concentrating on well-formed, properly spaced characters, and then play it back thus getting valuable practice at receiving, and at just the right speed too. Receiving morse is always harder than sending. This is mainly because in sending you can think ahead, you know what's coming next, in receiving you must take it as it comes and while you're writing down one character you must already be listening and concentrating on reading the next.

PRACTISE

One excellent way of practising is to write out some mixed groups of characters as shown in Fig. 3. Using five figures to the group you can then count each group as a word. In this way you can time yourself and thus find out your speed in words per minute. In the case of the Ham licence you will need to be able to send *and* receive at 12 w.p.m. so it would be prudent to aim at 15 w.p.m. It might prove easier to write out the groups on graph paper, this makes division easier. Groups are excellent practise, particularly in receiving. With plain language there is a tendency for the brain to cunningly try to guess the next letter. Thus if the letters come out T-H- the brain might guess E making the word THE. However, the word might easily be THAT or THIS or THESE etc. In five-figure mixed groups this is eliminated and the brain can't cheat. It is very tempting to try and read sense into the code, i.e., make out the words, but this should be avoided at all costs in the early stages. When you can receive comfortably at 25 w.p.m. all well and good, but when you're just starting to learn morse remember, while you are trying to read the message, you are not concentrating on the next character and thus your concentration will be divided and you will lose characters and have to pick up again. This is also a bad thing as it is rather demoralising to keep missing characters.

MISTAKES

If you miss a character leave a blank space and carry on. Don't ponder on the character you missed or you'll miss others while you are thinking. If, on checking, you find that a particular character(s) is causing bother, make up some mixed letter groups using the difficult character(s) interspersed with some you know well. Half an hour's practice will soon sort things out, or better still, three or four ten-minute sessions.

Once you have learnt the code, a very good way of practising is to mentally send the code in your head. When you travel on a train or a bus look at the adverts and send these mentally. This exercise will help enormously in improving your speed, while in the early stages it affords a very good exercise in familiarity.

LISTENING

The amateur bands are an excellent hunting ground for practice. Even stations sending very fast will send their callsigns two or three times. If a country's list is obtained, then, by hearing the callsign, it is easy to determine the country where the particular amateur is located. To add to the interest, a world map might be purchased, and coloured pins pushed in when a particular country is heard. This is simple because amateurs in a particular country have their callsigns beginning with the same prefix, only the last few letters differ. Amateurs in Sweden all have callsigns beginning SM, those in Peru all start with OA. Thus if the callsign DU1FFZ was heard, the station would be in the Philippine Islands because DU is the amateur prefix for the Philippines. A list of prefixes for the different countries is obtainable from the R.S.G.B., 28 Little Russell St., London, W.C.1, and costs 9d.

The Radio Society of Great Britain has many members all over the country who send slow c.w. (morse) specially for the benefit of those starting to learn and who wish to improve their speed. The main band on which these transmissions take place is topband 1·8—2·0Mc/s or 160 metres. The Society publish a monthly bulletin (free to all members) and this gives details of the times, dates and frequencies of these transmissions together with the callsign and location of the station.

You can learn morse—anyone can. Get yourself a key and an oscillator or buzzer. If you have a tape recorder all the better, if not borrow one. A cheap one will do fine and you will be able to practise without an instructor. All you need now is determination and you're in business. ■

ALPHABET

A	di dah	N	dah dit
B	dah di di dit	O	dah dah dah
C	dah di dah dit	P	di dah dah dit
D	dah di dit	Q	dah dah di dah
E	dit	R	di dah dit
F	di di dah dit	S	di di dit
G	dah dah dit	T	dah
H	di di di dit	U	di di dah
I	di dit	V	di di di dah
J	di dah dah dah	W	di dah dah
K	dah di dah	X	dah di di dah
L	di dah di dit	Y	dah di dah dah
M	dah dah	Z	dah dah di dit

NUMERALS

1	di dah dah dah dah	6	dah di di di dit
2	di di dah dah dah	7	dah dah di di dit
3	di di di dah dah	8	dah dah dah di dit
4	di di di di dah	9	dah dah dah dah dit
5	di di di di dit	0	dah dah dah dah dah

MISCELLANEOUS

Question mark	di di dah dah di dit
Oblique stroke	dah di di dah dit
End of Message	di dah di dah dit
Error	di di di di di di di dit
Invitation to transmit	dah di dah

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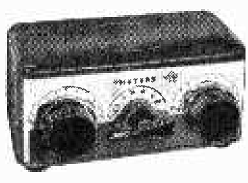

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COAXIAL PLUG 1/-. PANEL SOCKETS 1/-. LINE SOCKETS 2/-. OUTLET BOXES, SURFACE OR FLUSH 4/6. BALANCED TWIN FEEDERS 1/- yd., 80 or 300 ohms. TELESCOPIC CHROME AERIALS. 6in. extends to 23in. 6/6 each. CAR AERIAL PLUGS 1/6. Sockets 1/3.

SPECIAL PURCHASE! STELLA BATTERY RECORD PLAYER

Amplifier and loudspeaker — all transistor — top performance of discs at 33⅓, 45 and 78 r.p.m. LP xtal cartridge. Smart red or blue plastic cabinet. WORTH DOUBLE OUR PRICE! **£8.5.0** P. & P. 5/-

MERRY CHRISTMAS

THE E.A.R. RECORD PLAYER CABINET

Strongly built wooden cabinet covered in Blue and Grey leathercloth. Size 15×17×8in. Motor Board 14½×12½in. ready cut out for B.S.R. Monarch UA12/14/15/16/25 decks. Gilt fittings, strong carrying handle. Amplifier space size 14×7×3in. is completely enclosed. The baffle board is cut out for a 6½in. dia. speaker. Post 5/6. **59/6**

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350 v.	2/3	100/25 v.	2/-	8/600 v.	9/6
4/350 v.	2/3	250/25 v.	2/6	16/600 v.	12/6
8/450 v.	2/3	500/25 v.	4/-	16+16/500 v.	7/6
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SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250 mfd. 15v. 2/6; 500, 1000 mfd. 12v. 3/6; 2000 mfd. 25v. 9/6. CERAMIC. 500 v. 1 pF. to 0.01 mfd., 9d. Discs 1/-.

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350v.-0.1 9d., 0.5 2/6; 1 mfd. 3/-; 2 mfd. 150v. 3/-. 500v.-0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.5 3/-. 1,000v.-0.001, 0.0022, 0.0047, 0.01, 0.02, 1/6; 0.047, 0.1, 2/6. E.H.T. CONDENSERS. 0.001 mfd., 7kV., 6/6; 20kV., 10/6.

SILVER MICA. Close tolerance (plus or minus ½ pF.), 5 to 47 pF., 1/-; ditto 1% 50 to 800 pF., 1/-; 1,000 to 5,000 pF., 2/-. TWIN GANG. "0-0" 208 pF.+176 pF., 10/6; 365 pF. miniature 10/-; 500 pF standard with trimmers, 9/6; 500pF. midget less trimmers, 7/6; 500 pF. slow motion, standard 9/-; small 3-gang 500 pF. 18/9. Single "0" 365 pF. 7/6. Twin 10/-. SHORT WAVE. Single 10 pF., 25 pF., 50 pF., 75 pF., 100 pF., 160 pF., 5/6 each. Can be ganged. Couplers 9d. each. TUNING. Solid dielectric. 100 pF., 300 pF., 500 pF., 3/6 each. TRIMMERS. Compression ceramic 30, 50, 70 pF., 9d.; 100 pF., 150 pF., 1/3; 250 pF., 1/6; 600 pF., 750 pF., 1/9.

250v. RECTIFIERS. Selenium ½ wave 100mA 5/-; BY100 10/-. CONTACT COOLED ½ wave 60mA 7/6; 85mA 9/6. Full wave 75mA 10/-; 150mA 19/6; T.V. rects. from 10/-.

NEW B.A.S.F. LIBRARY BOXED TAPE

7 in. L.P. 1,800 ft. 45/-; 7 in. D.P. 2,400 ft. 70/-
60 min. Cassette C60 (For Philips, etc.) 17/6
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Post 2/6 each

250-0-250 80mA. 6.3 v. 3.5 a, 6.3 v. 1 a, or 5 v. 2 a.	25/-
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MT. 510/300-0-300v. 120 mA., 6.3 v. 4 a.	29/6
MINIATURE 200 v. 20 mA., 6.3 v. 1 a.	10/6
MIDGET 220 v. 45 mA., 6.3 v. 2 a.	15/6
SMALL 250-0-250 50 mA. 6.3 v. 2 a.	19/6
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Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp.	10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a.	25/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60,	29/6

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1½×⅝in. 6/6; ACOS 1½×⅝in. 8/6. ACOS 39. 1in. dia. 12/6
MOVING COIL MIKE with Remote Control Switch ..19/6

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LOW RESISTANCE HEADPHONES, 3-5 ohms. 25/-
H.R. HEADPHONES 2000 ohms ..12/6, 4000 ohms ..15/-
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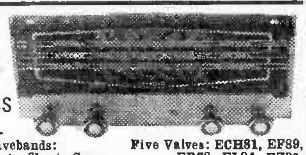
1968 GRAM CHASSIS



Post 5/-
Three Wavebands: Long., Med. Short, Gram. Five Valves: ECH81, EF89, EBC8, EL84, EZ80. 12-month guarantee. A.C. 200-250 v. Ferrite Aerial 5 watts 3 ohm. Chassis 13½in. × 7in. × 5in. dial size 13in. × 4in. Two pilot Lamps. Four Knobs. Aligned calibrated. Chassis isolated from mains **£10.10**
DE LUXE STEREO GRAM CHASSIS V.H.F., MW, SW 19-50m. SW 60-180m. Magic eye, push buttons, 6 valve plus rect. Size 15 x 7½ x 6in. high. **£19.19**

TAPE DECK AMPLIFIERS FOR B.S.R. T.D.2 ETC. With Pre Amplifier, Oscillator, all valves, "magic eye" tuning indicator, 3 watt 3 stage amplifier especially built for B.S.R. T.D.2 Tape Deck. Bolts directly to tape deck chassis. Inputs for mike and radio/gram. Output 3-5 ohms. A.C. 200/250v. Ready built. PRICE £7.19.6. Carriage and Insurance 5/6.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides, 7×4in., 5/6; 9×7in., 6/6; 11×3in., 6/6; 11×7in., 7/6; 13×9in., 9/6; 14×11in., 12/6; 15×14in., 15/-. ALUMINIUM PANELS 18 s.w.g. 12×12in., 5/6; 14×9in., 4/6; 12×8in., 3/6; 10×7in., 2/9; 8×6in., 2/- 6×4in., 1/6.

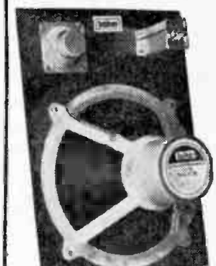
ALL PURPOSE TRANSISTOR PRE-AMPLIFIER

Gain 14:1. 250v. or 9v. input. Ready built with Mu Metal input transformer for Mikes, Pick-Ups, Tuners Instructions and circuit supplied. Post 2/6. **15/-**

THE INSTANT BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E. Post 2/6. **35/-**

BAKER MAJOR "MODULE"



Ideal mono or stereo conversion of existing cabinets, furniture etc. 12in. Baker Major Full range speaker on 19×12½in. baffle board with 2½in. tweeter and crossover. Output 20 watts. Response 30-17,000 c.p.s. Impedance 15 ohms. In kit form with instructions **£10.19.6**

or fully assembled **£12.10.0** Post Free

'Group 25' 12in. 25w. **5 gns.** 'Group 35' 12in. 35w. **8½ gns.** 'Group 50' 15in. 50w. **18 gns.**
"BONDACOUST" Wadding for Cabinet lining 15/- sq. yd.

Quality Horn Tweeters 3-16kc/s. 10w. 27/6. Crossover 14/6. LOUDSPEAKERS P.M. 3 OHMS. 2½in., 3in., 4in., 5in., 7in. × 4in., 15/6 each 8in. 22/6; 6½in. 18/6; 10in. 30/-; 12in. 30/-; (15 ohms 35/-); 10 × 6in. 30/-; 8 × 5in. 21/-; E.M.I. Double Cone 13½ × 8in., 3 or 15 ohm models, 45/-. SPECIAL OFFER! 8 ohm. 2½ in., 5in.; 80 ohm. 2½in., 2½in., **15/6** 25 ohm. 5in., 6×4in., 35 ohm. 3in., 5in., 7×4in., EACH—ANY TYPE. 15 ohm. 3in., 5in., 7×4in. JACK SOCKET Std. open-circuit 2/6. closed circuit 4/6; Chrome Lead Socket 7/6. DIN 3-pin 1/3. 5-pin 1/6; Lead 3/6. Phono Plugs 1/-. Socket 1/-. JACK PLUGS Std. Chrome 3/-; 2.5mm.; 3.5mm. 1/9; DIN 3-pin 3/6; 5-pin 5/-. WAVE-CHANGE SWITCHES WITH LONG SPINDLES. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 3/6 each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 3/6 each. Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. Prices include click spindles, adjustable stops, spaces, etc., 1 wafer, 10/6; 2 wafer, 15/-; 3 wafer, 19/6. TOGGLE SWITCHES, sp. 2/-; sp. dt. 3/6; dp. 3/6; dp. dt. 4/-.

DE LUXE TAPE SPLICERS Cuts, trims, joins for editing and repairs. With 3 blades. **14/6**

4 CHANNEL TRANSISTOR MICROPHONE MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. **52/6**

DYNAMIC MICROPHONE. Dual impedance. 600 ohm/50k Universal Mtg. 70-12,000 cps. **£6.6.0**

AM TUNER MEDIUM WAVE. Three Transistor Superhet. Ready built. Printed Circuit. Ferrite Aerial. Sizes 5¼ × 3½ × 1½in. Ideal for Tape Recorders. **79/6**

FM TUNER 88-108 Mc/s Six Transistor. Superhet. Ready built. Printed Circuit. Calibrated slide dial tuning. Size 6 × 4 × 2½ in. **£6.19.6**

3 WATT QUALITY AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control **65/-**

★ RADIO BOOKS ★ (Postage 9d.)

High Fidelity Speaker Enclosures and Plans	5/-
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RESISTORS. Preferred values, 10 ohms to 10 meg. ¼ w., ½ w., 1 w., 20% 3d.; 1½ w. 8d.; 2 w. 1/-; ½ w. 10% 6d. HIGH STABILITY. ½ w. 1% 10 ohms to 10 meg., 2/-. Ditto 5%. Preferred values 10 ohms to 22 meg., 9d.

5 watt, 10 watt, 15 watt — WIRE-WOUND RESISTORS 0.5 to 8.2 ohm 3 w. 10 ohms to 6,800 ohms — 1/6, 1/9, 2/-
10K, 15K, 20K, 25K, 68K, 10W. 3/-

MAINS DROPPERS. Midget. With sliders. 0.3 a., 1 K., 0.2 a., 1.2 K., 0.15 a., 1.5 K., 6/- each. LINE CORD 100 ohms ft. twin plus resistance, 1/- ft.

WIRE-WOUND 3-WATT POTS. T.V. Type. Values 10 ohms to 30 K., 3/3, Carbon 30 K, to 2 meg., 3/-.

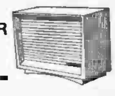
WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE VALUES 50 OHMS TO 100 K., 7/6.

VALVE HOLDERS. Int. Oct. 6d. Mazda Oct. 6d.; B7G, B8A, B8G, B9A, Moulded 9d. Ceramic 1/-. B7G, B9A. Cans 1/-. Valve base plugs B7G. B9A. Int. Oct., 2/3.

60 ONLY—SANGAMO 3 inch SCALE LABORATORY MOVING COIL METERS

Various calibrations and movements. 100 Microamp 55/-; 1 Milliamp 50/-, etc. Post 5/- extra. Send S.A.E. for list.

BRAND NEW QUALITY EXTENSION LOUDSPEAKER



Cream plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohm. POST 2/6 Size: 7½" x 5½" x 3". **30/-**

RETURN OF POST DESPATCH

Post 1/6 unless otherwise stated. C.O.D. 5/- ex. List 1/-.

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practically wireless commentary by HENRY

No. 40

To cut a long Story

IT is Mr. Mendit, isn't it? The wireless man? You may not remember me, I'm Smith. Smith, that's it, with an "I", "but one eye, although popular prejudice runs in favour of two", as Charlie Dickens said. Yes, I know there are a lot of Smiths, biggest family in the phone book, eh? But I was in your shop the other day.

Sorry, didn't quite get that — it's a bit noisy—bit of a party going on here. Yes, you can hear it, can you? Can't pick you up loud and clear, as you wireless chaps say. . . Atmospherics, eh? that's a laugh. The atmosphere here you could cut with a chopper, man, ninety-five per cent proof, ha, ha,

No, I say, don't ring off. I know it's late. . . well, Christmas and all that. Yes, Merry Christmas to you, too, Mr. Mendit. I just wanted to ask you. . .

Important? Well, you judge, you just ask Mrs. Smith if it is important—see what she says. No, I know you don't want to talk to Mrs. Smith—tell the truth, I don't much, either, ha, ha. No, I'm the one who was in your shop the other day. Yes, we met. I was looking at that Super-Special Goldbrick Stereoplex Radiogram, remember?

I thought you would. Yes, the gentleman with the dog, that's right. Listen, I'm sorry about that

Bit of a party going on here

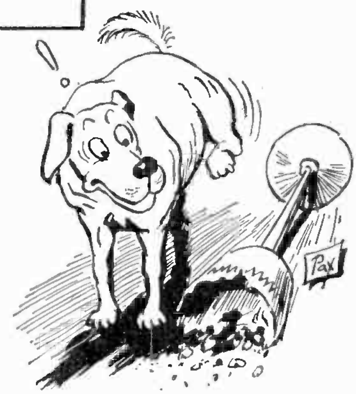
lamp standard. Yes, rather flimsy, wasn't it. And Rover is a big fellow. No, I didn't ring you up to talk about that . . .

The Goldbrick? Well, yes, I was very interested. Yes, I know it has—yes, and what-d'ye-call-it feedback, too. I know I heard you. Quite a bargain, I'm sure. Mrs. Smith was saying . . . yes, that's her you can hear in the background. Well, she always sings *Shenandoah* at family parties. She needs a bit of relaxation since that shock she had from the vacuum cleaner — no, no, I'm not complaining, honest. Not unless it is that the shock should have been a bit bigger!

No, really, I was joking, Mr. Mendit. Yes, I know you've got your code of ethics. Me too. . . what's that? Does it include ringing up in the middle. . . oh, come, friend, it is Christmas. Yes, I know you are opening the shop tomorrow—good luck. Me, I'll be dead—oh, if tonight goes on like this! No time to call around. I wondered if you would be coming out this way—you or one of your engineers? Always a drop of tiddley on hand.

No, I don't suppose you can afford to drink on duty, not with these breathalysers and things. It doesn't bother me, not since I was disqualified last Bank Holiday.

What's that? No, I don't suppose it is easy to fit in deliveries at holiday times—as the midwife said, ha, ha. Oh, really, would you? Make a special case of it. Well, I do declare, that's big of you, I mean, considering we only met the once. . . Previous customer? Well, you could say that. We have had a few bits and pieces. . . ha, ha. Perhaps I am being modest. You've got a sense of humour, Mr. Mendit. It is very good of you. I don't like to bother you really, not with the weather like it is. Look, perhaps I could get the boy to pop round, if I can tear him away from his train set.



Rover is a big fellow . . .

No, train set. . . electric? but of course, what else! Well, no, not actually from your shop—we got it wholesale. Yes, like the fridge, and the telly, yes.

Hallo, you there, Mr Mendit? Bad line, this. All I could hear was a sort of heavy breathing. I said, I could send the nipper. . . Big van, what big van? Do you do all your rounds in a big van? that's not what I would call economic. . . oh, well, I suppose if you sell a lot of big stuff. No, not every day you sell a Super-Special Goldbrick I guess. Good luck to you. Nice bit of profit for the holiday.

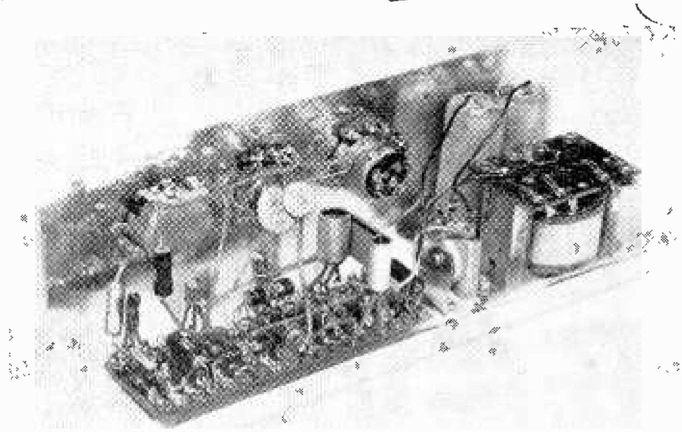
What's that? Cash? Well, ha, ha, you're still joking—that's funnier than that noise Mrs. Smith is making behind here—I must say. Not much of a purchase to run up a contract for, Mr Mendit. I reckon I can scrape up a couple of bob, even after what this party is setting me back. Enough for a dry battery anyway. . .

Goldbrick, what Goldbrick? I thought you said you'd sold it! ME? You're joking again. . . I was just asking if you could drop by with a battery for the kid's transistor radio.

What's that, I don't hear you very well. I know it's late, yes, I know, but it *is* Christmas. I say, Mr. Mendit, hallo—hallo—this is a bad line. I thought I heard you say. . .

Funny, the line's gone dead.

ADAPTABLE LOW COST hi-fi SYSTEM



W. CAMERON **PART 2**

IN THIS PART A PRE-AMPLIFIER STAGE IS ADDED TO THE BASIC AMPLIFIER DESCRIBED LAST MONTH, TO ENABLE A COMPREHENSIVE TONE CONTROL CIRCUIT TO BE INCORPORATED.

AN OC45 is used in the pre-amplifier stage and is shown as Tr1a in the pre-amplifier circuit diagram (Fig. 4). It will be seen that it replaces R2 (4·7kΩ) in the basic circuit, as a bias element for Tr1. Thus these two transistors are directly coupled.

The bias for the first stage is a.c. bootstrapped to the emitter via C2a; this virtually eliminates the shunting effect of the bias elements and gives a relatively high input impedance, about 30kΩ in this case.

An h.t. decoupling resistor and capacitor R4a and C3a have been added to reduce mains hum to negligible proportions when used with a mains power unit. R1 now goes to the other side of the collector load R3. Feedback is provided by the treble control VR1a. C4a serves to increase the negative feedback and hence reduce the gain at higher frequencies, by an amount determined by the setting of VR1a.

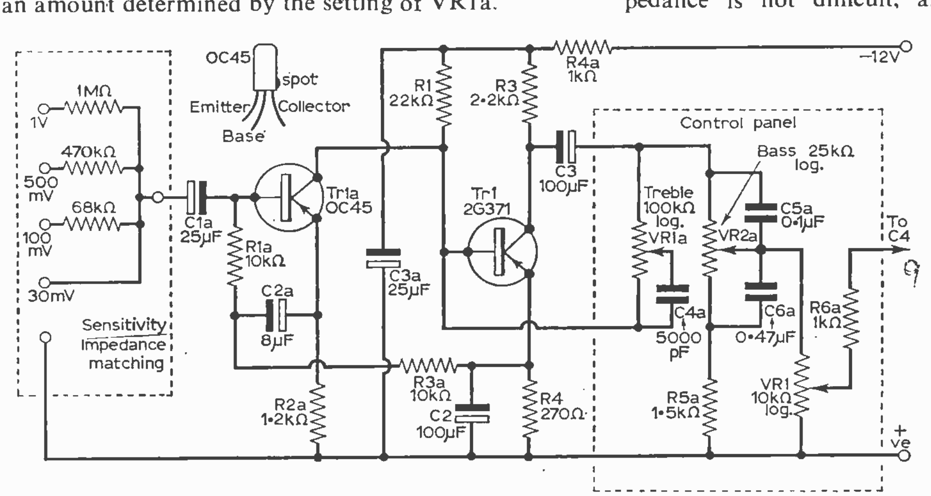


Fig. 4: Pre-amplifier and tone control circuits: additional components are suffixed a.

Bass boost and cut is provided by VR2a and its associated network.

The frequency response characteristics of the tone control circuits plotted against that of the basic amplifier is shown in Fig. 5.

INPUT IMPEDANCE & SENSITIVITY

Due to the higher input impedance, the sensitivity into the base direct (via C1a) is less than previously at 30mV, but whereas the basic amplifier required a series resistor of 100kΩ to give a sensitivity of 1V, in this case the series resistor must be 1MΩ.

To make this clearer it will be remembered that the input impedance of the basic amplifier was about 300Ω with a sensitivity of 3mV. It can be said therefore that the sensitivity is 3mV/300Ω or 30mV/3kΩ if a series resistor of 2·7kΩ is inserted, or 1V/100kΩ with a series resistor of 99,700 (100kΩ in practice). In other words 1mV/100Ω above 3mV.

Compare this with the base sensitivity/impedance now of 30mV/30kΩ, or 100mV/100kΩ with a series resistor of 70kΩ (68kΩ in practice) or 1V/1MΩ with a series resistor of 970kΩ (1MΩ) i.e. 1mV/1kΩ above 30mV, or 10 times better than previously at an input impedance of 30kΩ or more.

Matching the source impedance to the input impedance is not difficult, as it is not particularly critical provided the source impedance is equal to or less than the input impedance. For example a tuner might have an output of 100mV and output impedance of 10kΩ, this would then be fed into the 100mV input even though the impedance at this input is 100kΩ.

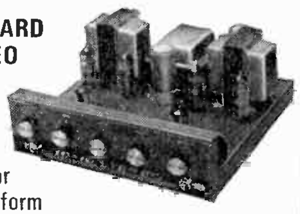
The only difficulty might be when it is desired to use a device with a very low source impedance, with an output of less than 30mV and an impedance of considerably less than 30kΩ, such as a dyn-

BARGAIN OPPORTUNITIES FROM TRS

Amplifiers

KITS AND READY BUILT

MULLARD STEREO 10-10 BY TRS



Built or in kit form

Valve amplifier to exact Mullard spec. With pre-amp tapped o/p transformer, 3 and 15Ω, all controls, H.T. and L.T. outlets, mono stereo and speaker phase switching. Complete with escutcheon, knobs, plugs, etc. Ready built. (p.&p.12/6) **£20.0.0**
Kit for building above, with instructions. (p. & p. 12/6) **£17.10.0**

MULLARD 5-10 MONO

5 valve, 10W basic amplifier kit complete. (p. & p. 7/6). **£9.19.6**
with passive control network and panel £11.19.6.
2 valve pre-amp kit £6.12.6.

MULLARD 3-3 MONO

3 valve 3W amplifier with controls, absolutely complete kit including panel knobs, etc. (p. & p. 7/6). **£7.10.0**

MULLARD MONO PRE-AMP

Complete kit with 2 valves, front panel, controls, etc. for use with 5-10 or other good power amp. **£6.10.0** Built and tested. **£8.10.0** Carriage on either, 5/6.

STEREO 2+2 PRE-AMP

Double 2 valve integrated pre-amp (4 valves in all) for use with TRS MULLARD 10-10. In kit form, with valves, front panel etc. Price to be announced. S.A.E. brings details.

7 VALVE AM/FM RG CHASSIS

A superbly powerful high performance instrument for the keenest enthusiasts. Provides tuning on long, medium and F.M. wavebands. Excellent sensitivity. Permeability tuning on F.M. Large clear dial, A.V.C., good neg. feedback. Magic eye. 3W output. A.C., 200/250V. Circuit diagrams available. Aligned, tested and ready for use. (Carr. and ins. 7/6). S.A.E. brings full details. **£13.19.6**

SINCLAIR Z.12 SYSTEM

Z.12 Amplifier, ready built and tested. Ideal for battery operation, for guitars, hi-fi, etc. etc. As advertised. **89/6**

STEREO 25 PRE-AMP/CONTROL UNIT
Input selector, tone and volume controls. Ready built with elegant front panel as advertised. **£9.19.6**

PZ.3 Mains power unit to drive two Z.12's and Stereo 25. **79/6**

PEAK SOUND SA 88

14 Transistor Kit builds into superb hi-fi amp. 8W per channel (16W mono) with integrated pre-amp to take high quality ceramic p.u. Unusually easy to build by following the instructions (1/6d. purchased separately and refunded when kit is bought). This makes one of the best and most economical stereo transistor amps. we have ever offered. All purchases backed by T.R.S. service facilities. When built and fitted in its special cabinet, the SA 88 equals the best in modern styling.

AMPLIFIER KIT (P/P 4/-) **£9.10.0** POWER PACK KIT (P/P 4/-) **£2.10.0**

MODERN SLIMLINE WOOD CABINET **£2.10.0** (P/P 5/-)

COMPLETE ASSEMBLY £14.10.0 post free if ordered at same time.

NEW DEM FACILITIES

now in operation at our shop at 70 Brigstock Road where you can hear instant combinations of equipment which we advertise and sell and which helps you to compare and decide.

GARRARD UNITS & PLINTHS

GUARANTEED BRAND NEW — SUPERB VALUE

LM 3000 Record Player with 9T.A. Stereo Cartridge. Brand new as from factory .... 8 gns

AT.60 Mk II De-luxe Auto-changer, die-cast turntable. Less cartridge £11.19.6

SP.25 De-luxe single record player, die-cast turntable. Less cartridge .... 9¾ gns

Packing and carriage on any one of above 7/6 extra.

Garrard Plinth. Ideal mounting for the Garrard Units offered here. Will readily suit any hi-fi set-up. In fine Teak. Complete with useful soft plastic dust cover. Packing and carriage 5/- 75/-

Garrard clear-view rigid Perspex cover (carriage 3/6) 57/6

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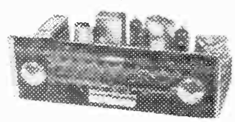
to all who purchase one of the Garrard Units and/or plinths offered here.

MONO
5NBD Turnover, ceramic 17/6
TC8/M Ceramic 25/-

STEREO
Ronette 105/S 32/6
Sonotone 9TA/HC High Compliance 35/-

DECCA DERAM almost half price. With diamond stylus.
List price £4.17.6 Our price **57/6**

6 VALVE AM/FM TUNER



Med and V.H.F. 190m-550m., 85 Mc/s.-103 Mc/s. 6 valves and metal rectifier. Self-contained power unit A.C Magic-eye, 3 push-button controls. Diode and high output Sockets. Illuminated 2-colour Perspex dial 11½in x 4in. Recommended for use with the T.R.S. Mullard "3-3" or "5-10" Amplifiers featured here.
Bargain Price. Complete kit of parts, inc. Power Pack as illustrated. 11 Gns. Carr. 7/6. Ditto less Power pack 10 Gns. Carr. 7/6. Circuit and Const. details, 4/6, Free with kit.

TRS DECODER

Kit based on Mullard design. 6 Transistors. Beacon indicator. All coils pre-checked and aligned. (Carr. & Packing 2/6) **5 Gns.**

MICROMATIC AT NEW PRICES

The world's smallest radio now includes magnetic ear-piece and costs less.
Kit formerly 59/6 *now* **49/6** *Built formerly* 79/6 *now* **59/6**

SINCLAIR MICRO FM

7 Transistor pocket size combined FM Tuner/Rcvr. With earpiece and telescopic aerial. Kit **£5.19.6**

TRS ACOUSTIC ENCLOSURE

Teak finished, 21" high x 15" wide x 7½" cut to take tweeter and 8" or 10" speaker to order. Acoustically proportioned for finest possible audio quality. Supplied ready to take units.
SUPERB VALUE AT ONLY
£4.15.0
Please add 7/6 as part of cost of packing and carriage.

15 OHM SPEAKER UNITS

8" FR.8 Dual concentric, 15 watts loading **£5.15.0**

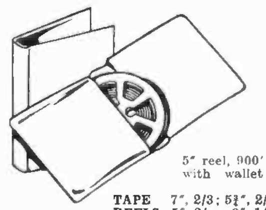
8" Goodman's Twin Axiette, 15 watts loading **£6.16.0**

10" Goodman's Axiom **£7.5.0**

8" Fane with 15000 line ceramic magnet and foam-surround cone suspension **£4.10.0**

SINCLAIR Q.14 complete speaker 9⅝" square. Fantastically good in stereo. Each **£6.19.6**

TRS TAPE AND WALLET OFFER



With each reel of this tape by an internationally famous manufacturer we give you a beautifully made wallet strongly made in simulated leather with space for a reel of tape each side. This is professional quality full frequency tape with metallised leader/stop foils. These library wallets solve once and for all the problems of storing tapes efficiently and tidily.

5" reel, 900' with wallet **12/6**
5¾" reel, 1200' or 7" reel, 1200, with wallet **17/6**
7" reel, 1800' with wallet **22/6**

TAPE REELS 7", 2/3; 5¾", 2/-; 5", 2/-; 3", 1/3.

VOLUME CONTROLS. LOG and LINEAR. We carry very large stocks in the widest possible range of values, single and ganged. 5K-2MΩ. 3in. spindles. Morganite Midget Type 1⅛in. diam. Guar. 1 year. LOG or LIN ratios less Sw., 3/6. D.P. Sw. 5/-. Twin Stereo less Sw. 7/6. D.P. Sw. 9/6 (100K to 2 Meg. only).
STEREO BALANCE CONTROLS. Log/Anti-Log 5KΩ. ½, 1, 2 Meg. 9/- each. **TYGAN FRET** spkr. fabric, 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/-, etc. **BONDACOUST** Speaker Cabinet Acoustic Wadding, approx. 1in. thick, 18in. wide, any length cut, 2/3 ft. 6/- yd.
VEROBOARD—All standard sizes including 2½in. x 5in. 3/8; 2½in. x 3¾in. 3/-; 3¾ x 5in. 5/2; 3¾ x 3¾in. 3/8; 2½ x 17in. 12/6. All accessories and tools in stock.
RESISTORS—Modern ratings, full range 10 ohms to 10 megohms, 10% ¼-½ w. 4d. ea. 5% Hi-Stab., ¼-½ w. 6d. ea. (below 100 ohms and over 1 meg. 9d. ea.). 1% Hi-Stab, ½ w. 1/6d. ea. (below 100 ohms 2/- ea.).
WIREWOUND RESISTORS. 25 ohms to 10 K. 5 w. 1/3; 10 w. 1/6; 15 w. 2/-. **CONDENSERS** Silver Mica. All values 2 pf. to 1,000 pf 6d. ea. Ditto ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd. to 0.1 mf./350 v. 10d. .02 mf. to 0.1 mfd. 500 v. 1/-. .25 T.C.C. 1/9. 5 T.C.C. 2/-.
CLOSE TOL. S/MICAS. 10% 5 pf-500 pf 8d. 600-5,000 pf 1/-. 1% 2 pf.-100 pf. 9d. 100 pf. 9d. 100 pf-500 pf. 11d. 375 pf. 5,000 pf. 1/6.
ALUM. CHASSIS. 18 g. Plain undrilled, folded 4 sides, 2in. deep. 6 x 4in. 4/6; 8 x 6in. 5/9; 10 x 7in. 6/9; 12 x 6in. 7/6; 12 x 8in. 8/- etc.
ALWAYS IN STOCK AT KEENEST PRICES. Transistors, Coils, Switches Valves, Speakers, Materials. See latest T.R.S. lists.
Please send S.A.E. with inquiries.

NEW IMPROVED "CIR-KIT"

using 0.1 in. punched matrix board and new improved "Cir-Kit" instant circuit material. (See Hi Fi News, Nov.)

5ft. spool of "Cir-Kit"	2/-
Matrix Board 5" x 3¾"	4/-
3¾" x 2½"	2/9
3¾" x 2"	1/9

START WITH SIXPENCE

Sending it to TRS brings latest list by return. Packed with bargains and hard to find items to save you money and trouble.

TRS TRANSFORMERS

and chokes of all types available singly or in prototype short runs at very competitive prices. Enquiries invited. S.A.E. with private enquiries please.

WHEN ORDERING

Cash with order please. Unless stated otherwise add p/p as follows—½lb., 1/-; 1 lb., 1/9; 2 lbs., 3/6; 6 lbs., 5/-; 10 lbs., 6/6; 14 lbs., 8/-; Over, 10/6.

TRS RADIO

COMPONENT SPECIALISTS

Established 1946

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Tel.: 01-684 2188. Hours 9 a.m.—6 p.m. 1 p.m. Wednesdays
A few doors from Thornton Heath Stn. (S.R. Victoria section)

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OA2	5/-
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1C5	4/9
1C6	10/6
1D5	6/-
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1FD1	6/-
1FD9	3/3
1G6	6/-
1H5GT	7/-
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1LD5	5/-
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1T2	34/11
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1U4	5/6
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2D13C	7/-
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2X2	3/-
3A4	3/6
3A5	8/-
3B7	5/-
3D6	3/9
3Q4	5/3
3Q5GT	6/6
3S4	4/9
3V4	5/6
4D1	3/9
5R4GY	8/9
5U4G	4/9
5V4G	8/-
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5Z3	7/6
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6/30L2	12/6
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6AC7	3/-
6AG5	2/6
6AG7	5/9
6AJ5	8/6
6AK5	4/9
6AK6	6/-
6AK8	5/9
6AL5	2/3
6AM4	16/6
6AM5	2/6
6AM6	3/3
6AQ5	4/9
6AR6	20/-
6AT6	3/9
6AU6	5/6
6AV6	5/-
6B8G	2/6
6BA6	4/6
6BE6	4/3
6BG6G	20/5
6BH6	6/6
6BJ6	7/-
6BQ5	4/6
6BQ7A	7/-
6BR7	9/-
6BR8	8/-
6BS7	16/6
6BW6	7/-
6BW7	5/-
6BX6	4/6
6C4	2/3
6C5GT	6/-
6C6	3/9
6C9	10/9
6CD6G	19/6
6CD7	9/6
6CH6	6/-

6CW4	12/-
6D3	7/6
6D6	3/-
6E5	9/6
6F1	9/6
6F6G	4/-
6F12	3/3
6F13	3/6
6F14	15/-
6F15	10/9
6F17	12/6
6F18	8/6
6F23	11/6
6F24	10/-
6F25	10/-
6F28	10/6
6F32	3/-
6G6G	2/6
6H6GT	1/6
6J5G	3/9
6J6	3/-
6J7G	4/9
6J7GT	8/6
6K6GT	5/-
6K7G	1/3
6K7GT	4/6
6K8G	3/-
6K8GT	7/6
6K25	24/-
6L1	10/-
6L6GT	7/6
6L18	7/6
6L19	19/-
6LD20	6/6
6N7GT	7/-
6P1	12/-
6P25	12/-
6P26	12/-
6P28	25/-
6Q7G	5/-
6Q7GT	8/9
6R7G	5/6
6R7GT	11/-
6SA7GT	7/-
6SC7	6/6
6SG7	7/9
6SH7	3/-
6SJ7	5/-
6SK7	4/6
6SN7GT	4/6
6SQ7	6/-
6SS7	2/-
6ST7	12/6
6U4GT	9/6
6U5G	5/-
6U7G	7/-
6V6G	3/6
6X4	3/6
6X5GT	5/3
6Y7G	12/6
7A7	12/6
7B6	10/9
7B7	7/-
7C5	40/-
7C6	6/-
7H7	5/-
7R7	12/6
7V7	5/-
7Y4	6/6
9BW6	9/6
9D2	3/-
9D7	7/6
10C1	9/-
10C2	12/-
10D1	7/-
10D2	11/8
10F1	15/-
10F9	9/-
10F18	9/-
10LD3	6/6
10LD11	10/-
10P13	14/6
10P14	15/6
12A6	5/-
12AC6	8/-
12AD6	9/-
12AE6	7/6

12AH7	5/-
12AT6	4/6
12AT7	3/6
12AU6	4/9
12AU7	4/6
12AV6	5/9
12AX7	4/6
12AY7	9/9
12BA6	5/-
12BE6	5/3
12BH7	6/-
12E1	17/6
12J5GT	2/6
12J7GT	6/6
12K5	8/-
12K7GT	3/6
12K8GT	7/9
12Q7GT	3/6
12SA7GT	6/9
12SC7	4/-
12SH7	3/-
12SJ7	5/-
12SK7	3/-
12SQ7	8/-
12SR7	5/-
12Y4	2/-
13D1	5/-
13D3	9/-
14H7	9/6
14S7	19/6
18	12/6
19	10/6
19AQ5	5/-
20D1	13/-
20D4	20/5
20F2	11/6
20L1	15/6
20P1	17/6
20P3	17/-
20P4	17/6
20P5	17/-
25A6G	7/6
25LG6	4/9
25Y5	6/-
25Y5G	8/6
25Z4G	6/3
25Z5	7/-
25Z6G	8/6
30C1	6/3
30C15	12/-
30C17	13/-
30C18	9/6
30F5	11/6
30FL1	15/-
30FL12	15/-
30FL14	12/6
30L1	5/6
30L15	14/-
30L17	13/-
30P4	11/6
30P4MR	13/-
30P12	11/-
30P19	11/-
30PL1	15/-
30PL13	15/-
30PL14	15/-
30PL15	15/-
35A5	15/-
35L6GT	6/3
35W4	4/6
35Z3	10/-
35Z4GT	4/6
35Z5GT	5/6
42	5/-
43	10/-
50A5	21/10
50B5	6/3
50C5	5/9
50CD6G	40/9
50L6GT	6/-
52KU	14/6
53KU	14/6
72	6/6
77	5/-
78	4/9
80	5/3
85A2	8/6

90AG	67/6
90AV	67/6
90CG	34/-
90CV	33/6
90C1	16/-
150B2	14/6
150C2	5/-
161	15/-
185BT	34/11
301	20/-
302	16/6
303	15/-
305	16/6
306	13/-
807	11/9
956	2/-
1821	10/6
5763	10/-
7475	2/6
A1834	20/-
ACO44	14/-
AC2PEN	19/6
AC2PEN/DD	19/6
AC6PEN	4/9
AC/PEN (5)	19/6
AC/PEN (7)	19/6
AC/THI	10/-
AC/TP	19/6
AC/VP1	12/-
AC/VP2	11/-
ATP4	2/3
AZ1	8/-
AZ31	7/9
AZ41	6/6
B36	4/9
BL63	10/6
CK506	6/6
CL4	19/6
CL33	19/6
CV6	2/6
CV63	10/6
CV271	12/6
CV428	19/-
CY1	16/4
CY1C	6/6
CY31	6/6
D1	1/3
D15	15/6
D63	5/-
D77	2/3
DAC32	7/-
DAF91	3/3
DAF96	6/-
DCC90	8/-
DD4	10/6
DD41	12/6
DDT4	7/6
DF33	7/9
DF66	15/-
DF72	30/-
DF91	2/6
DF96	6/-
DF97	10/-
DH30	15/6
DH63	5/-
DH76	3/6
DH77	3/9
DH81	10/9
DH101	25/-
DH107	16/11
DK32	7/6
DK40	10/6
DK91	4/9
DK92	7/6
DK96	6/6
DL33	6/6
DL35	4/9
DL72	15/-
DL75	30/-
DL92	4/9
DL94	5/6
DL96	6/-
DL810	10/6
DM70	6/-

DM71	9/9
DW4/350	8/6
DW4/500	
DY86	5/9
DY87	5/9
E80F	24/-
E83F	24/-
E88CC	12/-
E180F	17/6
E1148	1/9
EA50	1/6
EA76	13/-
EABC80	5/9
EAC91	3/3
EAF42	7/6
EB41	4/9
EB91	2/3
EBC3	20/6
EBC33	6/-
EBC41	7/3
EBC81	6/3
EBC90	3/9
EBC91	5/-
EBF80	5/9
EBF83	7/-
EBF89	5/9
EBL21	10/3
EC52	4/3
EC53	12/6
EC54	6/-
EC70	4/9
EC86	11/6
EC88	10/6
EC91	4/-
EC92	6/6
ECC31	15/6
ECC32	4/6
ECC33	29/1
ECC34	29/6
ECC35	4/9
ECC40	9/6
ECC81	3/6
ECC82	4/6
ECC83	4/6
ECC84	5/6
ECC85	5/-
ECC88	7/-
ECC189	9/-
ECC804	12/6
ECC807	19/9
ECF80	7/-
ECF82	6/9
ECF86	8/6
ECF804	24/-
ECF805	12/6
ECH3	23/3
ECH21	9/6
ECH33	22/8
ECH35	6/-
ECH42	8/9
ECH81	5/-
ECH83	7/-
ECH84	6/6
ECL80	6/-
ECL82	6/-
ECL83	9/-
ECL84	12/-
ECL85	11/-
ECL86	7/9
ECLL800	23/9
EF22	6/6
EF36	3/-
EF37A	7/-
EF39	5/-
EF40	8/9
EF41	9/-
EF42	3/6
EF50	2/6
EF54	6/-
EF80	4/6
EF83	9/9
EF85	4/6
EF86	6/3
EF89	4/9
EF91	3/3
EF92	2/6

EF97	8/-
EF98	9/-
EF183	6/3
EF184	5/9
EH90	7/6
EL32	3/-
EL33	12/-
EL34	9/6
EL35	10/-
EL36	8/9
EL37	16/6
EL41	8/-
EL42	7/6
EL81	8/-
EL83	6/9
EL84	4/6
EL85	7/6
EL86	8/-
EL91	2/6
EL95	5/-
ELL80	13/-
EM71	14/-
EM80	5/9
EM81	6/9
EM84	6/-
EM85	11/-
EM87	6/6
EY51	5/6
EY81	7/-
EY83	9/-
EY84	9/6
EY86	5/9
EY87	5/9
EY88	7/6
EY91	3/-
EZ35	5/3
EZ40	6/-
EZ41	6/6
EZ80	3/9
EZ81	4/3
EZ90	3/6
FW4/500	6/6
FW4/800	8/6
GZ30	7/6
GZ32	9/-
GZ33	12/6
GZ34	10/-
GZ37	14/6
H30	5/-
HABC80	9/3
HL2	7/6
HL13C	4/-
HL22	10/6
HL23DD	5/-
HL41	3/9
HL41DD	19/6
HL42DD	8/-
HL133DD	9/6
HN309	26/6
HVR2	8/9
HVR2A	8/9
IW3	5/6
IW4/350	5/6
IW4/500	6/-
KBC32	20/5
KF35	12/6
KL35	11/6
KLL32	21/7
KT2	5/-
KT8	15/-
KT32	4/9
KT36	29/1
KT41	19/6
KT44	5/9
KT61	12/-
KT63	4/-
KT66	16/6
KT74	12/6
KT76	7/6
KT88	27/6
KTW61	4/3
KTW62	12/6
KTW63	4/-
KTZ41	6/-
L63	4/6
LP2	9/6
MHD4	7/6

MHLD6	12/6
ML6	6/-
MS4B	20/5
MSP4	12/6
MU12/14	4/-
MX40	12/6
N37	23/3
N78	38/4
N108	26/7
N339	25/-
P41	3/6
P61	2/6
PABC80	7/6
PC86	8/6
PC88	8/6
PC95	6/9
PC97	5/9
PC900	8/6
PCC84	5/6
PCC85	6/9
PCC88	10/6
PCC89	9/9
PCC189	8/3
PCF80	6/3
PCF82	6/-
PCF84	8/-
PCF86	8/-
PCF801	8/6
PCF802	9/6
PCF805	9/6
PCF806	11/6
PCF808	12/6
PCL81	9/-
PCL82	6/3
PCL83	8/6
PCL84	7/-
PCL85	8/3
PCL86	8/-
PCL88	15/-
PEN45	7/-
PEN45DD	19/6
PEN46	4/-
PEN383	9/6
PEN384	11/6
PEN453DD	19/6
PENA4	19/6
PEN/DD 4020	17/6
PFL200	13/6
PL33	9/-
PL36	9/-
PL38	19/9
PL81	6/9
PL81A	6/9
PL82	5/9
PL83	6/-
PL84	6/3
PL500	13/6
PL504	15/-
PM84	9/3
PX4	14/-
PY80	5/-
PY81	5/-
PY82	5/-
PY83	5/6
PY88	7/3
PY800	6/-
PY801	6/-
PZ30	9/6
QP21	5/-
QQVO3/10	30/-
QS75/20	10/6
QS150/15	9/6
R10	15/-
R11	19/6
R12	5/6
R16	34/11
R17	17/6
R18	9/6
R19	6/9
R52	7/6
RK34	7/6

S130	25/-
SP4B	19/6
SP13C	12/6
SP42	12/6
SP61	2/-
TDD2A	12/6
TDD4	7/6
TH4B	10/-
TH21C	10/6
TH30C	14/6
TH233	6/9
TP22	5/-
TP25	5/-
TP2620	7/6
TY86F	11/10
UABC80	5/3
UAF42	7/9
UB41	10/6
UBC41	6/6
UBC81	6/6
UBF80	5/6
UBF89	5/9
UBL21	9/-
UC92	5/6
UCC84	8/-
UCC85	6/6
UCF80	8/3
UCH21	9/-
UCH42	8/6
UCH81	6/-
UCL82	7/-
UCL83	8/9
UF41	7/9
UF42	4/9
UF80	6/9
UF85	7/3
UF86	9/-
UF89	5/6
UL41	8/9
UL46	9/6
UL84	5/6
UM80	5/-
UR1C	6/6
UU5	7/-
UU8	16/6
UU12	4/3
UY1N	10/3
UY21	9/-
UY41	5/6
UY85	4/9
U10	9/-
U12/14	7/6
U16	15/-
U17	5/-
U18/20	6/6
U19	40/-
U22	5/9
U25	12/6
U26	11/-
U31	6/3
U33	13/6
U35	16/6
U37	34/11
U45	15/6
U50	5/-
U52	4/9
U76	4/6
U78	3/6
U101	19/6
U107	17/6
U191	12/-
U251	12/6
U281	8/9
U282	12/3
U301	12/6
U329	12/6
U403	6/6
U404	6/-
U801	18/-
U4020	6/-
VMP4G	17/-
VP2	3/6
VP2B	9/6
VP4	14/6
VP4A	14/6
VP4B	11/-
VP13C	7/-
VP23	2/6

VP41	5/-
VR75	21/-
VR105	5/-
VR150	5/-
VT61A	7/-
VT501	3/-
VU111	6/-
VU120	12/-
VU120A	12/-
VU133	7/-
W42	11/-
W61M	24/6
W63	10/6
W76	3/6
W77	2/6
W81M	6/-
W101	26/2
W107	10/6
W729	10/-
X24	16/6
X41	10/-
X61	6/-
X63	7/6
X64	5/6
X65	5/6
X66	7/6
X76M	7/9
X79	40/9
X81M	29/1
X101	29/1
X109	26/-
Y63	5/-
Y65	5/-
Z63	4/9
Z66	7/3
Z77	3/3
Z329	11/6
Z729	6/3
Z759	23/-
Transistors and diodes	
2G225	10/6
2N404	6/-
AA120	3/-
AA129	3/-
AC107	3/6
AC113	5/-
AC114	8/-
AC126	2/-
AC127	2/-
AC128	2/-
AC154	5/-
AC155	6/6
AC156	4/-
AC157	5/-
AC165	5/-
AC166	5/-
AC167	12/-
AC168	7/6
AC169	6/6
AC176	11/-
AC177	5/6
AD140	8/-
AD149	8/-
AF102	18/-
AF114	4/-
AF115	3/-
AF116	3/-
AF117	3/4
AF118	3/-
AF119	3/-
AF124	7/6
AF125	3/6
AF126	7/-
AF127	3/6
AF139	11/-
AF178	10/-
AF179	13/6
AF180	9/6
AF181	14/-
AF186	10/-
AFZ12	5/-
ASY27	10/-
ASY28	8/-
ASY29	10/-
AY100	26/-
BA115	2/8
BA116	9/-

BA129	2/6
BA130	2/-
BCY10	5/-
BCY12	5/-
BCY33	5/-
BCY34	5/-
BCY38	5/-
BCY39	5/-
BCZ11	3/6
BC107	4/-
BC108	3/9
BC109	4/6
BC113	5/-
BC115	3/-
BC116	5/-
BC118	4/6
BD119	9/-
BFY50	5/-
BFY51	4/6
BFY52	5/-
BF154	5/-
BF159	5/-
BF163	4/-
BF167	2/6
BF173	2/6
BF184	2/-
BY100	3/6
BY101	11/6
BY105	10/6
BY114	8/-
BY234	4/-
BY236	4/-
BY238	4/-
BYZ12	5/-
BYZ13	5/-
CG12E	4/-
CG46H	4/-
GD3	6/6
GD4	6/6
GD5	5/6
GD6	5/6
GD8	4/-
GD9	4/-
GD10	4/-
GD11	4/-
GD12	4/-
GD14	10/-
GD15	8/-
GD16	4/-
GET102	8/6
GET103	4/-
GET105	18/-
GET111	15/6
GET113	4/-
GET114	4/6
GET115	17/-
GET116	7/6
GET118	4/6
GET119	4/6
GET573	8/6
GET587	8/6
GET872	10/-
GET873	4/-
GET874	23/6
GET882	10/-
GET887	4/6
GET889	4/6
GET890	4/6
GET896	4/6
GET897	4/6
GET898	4/6
GEX13	3/6
GEX35	4/6
GEX36	10/-
GEX45/1	7/-
GEX55/1	15/-
GEX64	11/6
GEX66	15/-
GT3	5/-
M1	2/10
M3	2/10
OA5	5/6
OA10	6/6
OA47	2/-
OA70	3/-
OA73	3/-

OA79	1/9
OA81	1/9
OA85	3/-
OA86	4/-
OA90	2/6
OA91	1/9
OA95	1/9
OA182	2/-
OA200	3/-
OA202	2/-
OA210	9/6
OA211	13/6
OAZ200	12/-
OAZ201	10/6
OAZ202	9/-
OAZ203	9/6
OAZ204	9/-
OAZ205	9/-
OAZ207	10/6
OAZ210	7/-
OAZ224	13/-
OC19	25/-
OC22	5/-
OC23	7/-
OC25	5/-
OC26	5/-
OC28	5/-
OC29	16/6
OC30	7/-
OC35	10/-
OC36	7/6
OC38	11/6
OC41	10/-
OC42	6/9
OC43	12/6
OC44	2/-
OC44PM	8/3
OC45	1/9
OC45M	8/-
OC46	3/-
OC65	22/6
OC66	25/-
OC70	2/3
OC71	2/-
OC72	2/-
OC73	16/-
OC74	8/-
OC75	2/-
OC76	3/-
OC77	3/4
OC78	3/-
OC78D	3/-
OC79	8/-
OC81	2/-
OC81D	2/-
OC81M	5/-
OC82	2/3
OC82D	2/6
OC83	2/-
OC84	3/-
OC123	4/6
OC139	12/-
OC140	19/-
OC169	3/9
OC170	2/6
OC171	3/4
OC172	4/-
OC200	6/6
OC201	23/-
OC202	5/6
OC203	5/6
OC204	10/6
OC206	10/6
OC812	8/-
OCP71	27/6
ORP12	15/-
TS2	12/6
TS3	15/-
8X641	10/-
V10/15A	12/-
XA102	19/6
XA103	15/-
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
P346A	2/-
ZE12V7	1/9

MATCHED TRANSISTOR SETS 1—OC44 and 2—OC45 8/6; 1-OC81D and 2-OC81 7/6; 1 OC82D and 2-OC82 8/6; Set of three-OC83 (GET118/119) 8/6; 1—GET874P sleeved yellow, 1—GET873P sleeved white (1st I.F.) 1—GET873P sleeved blue (2nd I.F.) 8/6; LP15 package (AC113, AC154, AC157, AA120) 15/6; AF10 package (BC135, BC136, BC137, 2—BC138, 2—BA130) 17/6. Postage 6d. per set.

S.T.C. 1 watt Zener diodes. 2·4v: 2·7v: 3·0v: 3·6v: 4·3v: 13v: 16v: 18v: 30v. All 3/6d. each.

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF ABOVE GOODS LOOSE OR BOXED, BUT MUST BE NEW

ELECTROLYTICS. Can types: 8 × 8mfd/500v **6/9**; 8 × 16mfd/500v **7/3**; 16mfd/500v **5/6**; 16 × 16mfd/500v **8/-**; 16 × 32mfd/450v **9/-**; 32mfd/500v **7/-**; 32 × 32mfd/450v **4/9**; 50 × 50mfd/350v **5/6**; 60 × 250mfd/275v **9/9**; 60 × 250mfd/350v **16/6**; 60 × 250 × 10mfd/275v **13/-**; 64 × 100mfd/450v **18/9**; 64 × 120mfd/350v **8/6**; 100 × 200mfd/275v **8/-**; 100 × 200mfd/350v **17/9**; 100 × 200 × 60mfd/300v **17/9**; 100 × 300 × 100 × 16mfd/275v **22/-**; 100 × 400mfd/275v **12/9**; 100 × 400 × 16mfd/275v **20/9**; 150 × 200mfd/350v **20/9**; 200mfd/350v **10/9**; 200 × 200 × 100mfd/350v **24/9**; 1000mfd/50v **9/-**; 2000mfd/50v **11/9**; 5000mfd/25v **13/6**; 5000mfd/50v **24/9**; **Tubular types:** 1mfd/500v **2/3**; 2mfd/500v **2/6**; 4mfd/500v **2/9**; 8mfd/450v **1/9**; 8mfd/500v **3/-**; 8 × 8mfd/450v **2/9**; 8 x 16mfd/450v **3/-**; 10mfd/50v **1/9**; 16mfd/450v **2/6**; 16 × 16mfd/450v **3/6**; 16 × 32mfd/350v **3/6**; 32mfd/350v **3/-**; 32mfd/450v **3/6**; 32 × 32mfd/350v **4/9**; 50mfd/350v **5/3**; 100mfd/450v **9/6**; 64mfd/450v **8/9**.

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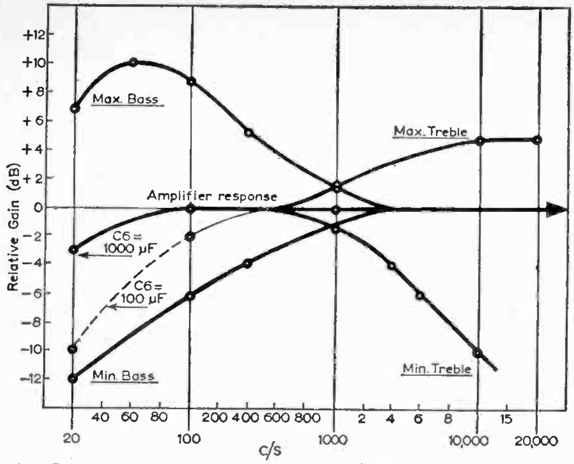


Fig. 5: Frequency response characteristics of the complete amplifier and tone control system.

amic microphone. This difficulty could be overcome by using a pre-set in place of R2a, with the slider taken to earth via a 100μF capacitor. This would then give an input impedance range of 300Ω to 30kΩ, being 300Ω at better than 1·5mV with the capacitor at the emitter end of R2a. Adjusting the slider will optimise the sensitivity for any value of source impedance up to 30kΩ, above which it has no advantage whatsoever, and robs the circuit of its very low noise properties.

OVERLOAD CAPABILITY

The foregoing remarks concerning sensitivity for maximum output assume the volume control at maximum, but the overload capability of the stages preceding the volume control is about four times, so the maximum input into the 30mV terminal can be 120mV, and into the 100mV terminal 400mV and so on.

Even so, some crystal pick-ups will overload the first stage and result in distortion unless the series resistor is increased in value. An example is the TC8H cartridge which on loud passages has an output of about 6V r.m.s., so in this case the series resistor could well be 2 to 4MΩ to prevent overload distortion. However, with this type of input, with the load resistor in series, there is a noticeable loss of top response when the resistor exceeds 1MΩ, due to the capacitive nature of crystal pick-ups, and it is necessary to compensate for this by shunting the whole or part of the series resistor(s) with a small capacitor of 50 to 100pF, the most suitable value being a matter of individual taste, found by trial.

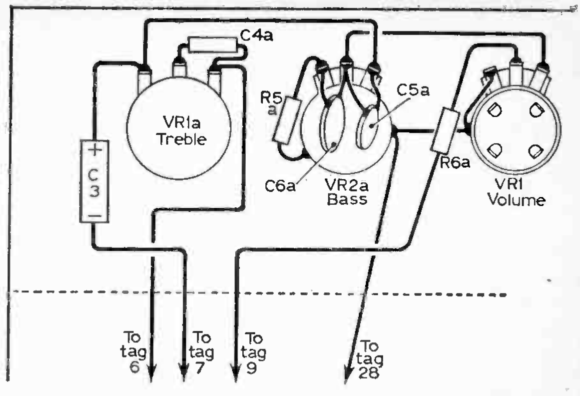


Fig. 6: Wiring to the bass, treble and volume controls. Tags referred to are those in Fig. 8.

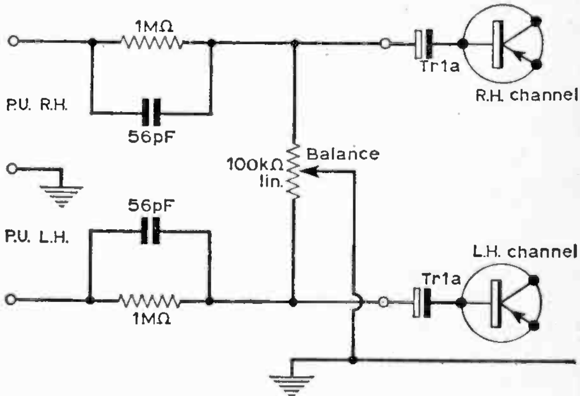


Fig. 7: Input and balance control arrangement for stereo operation. Suitable for use with a crystal or ceramic pickup.

Alternatively, an attenuator could be used in the input and its simplest form could be a 1MΩ pre-set across the input, with the slider taken via C1a to the base of Tr1a. The slider should at all times be near the earthy end of the control.

STEREO OPERATION

Two of these amplifier units can be used to pro-

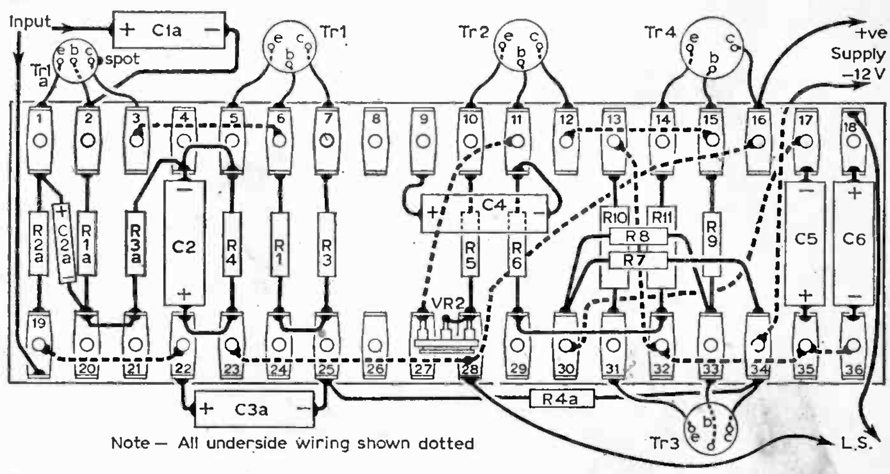


Fig. 8: Modified tagboard layout. The sensitivity/impedance matching network is not shown: this consists of a group of sockets mounted at the rear of the chassis.

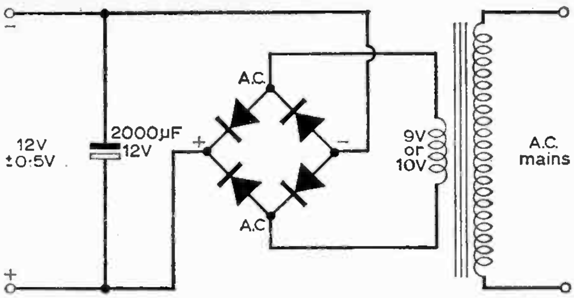


Fig. 9: Simple mains power supply unit for the basic 1-watt amplifier

★ components list

Resistors:

R1a	10kΩ
R2a	1·2kΩ
R3a	10kΩ
R4a	1kΩ
R5a	1·5kΩ
R6a	1kΩ

Capacitors:

C1a	25μF electrolytic 6V
C2a	8μF electrolytic 6V
C3a	25μF electrolytic 12V
C4a	5,000pF paper or polyester
C5a	0·1μF paper or polyester
C6a	0·47μF paper or polyester

Potentiometers:

VR1a	100kΩ log
VR2a	25kΩ log

Transistors:

Tr1a	OC45
Tr1	2G371

vide stereophonic reproduction, simply by utilising dual controls for volume and tone control functions, and adding a balance control.

This is shown in Fig. 7. The 56pF capacitors shunting the series resistors are optional and are to compensate for some loss of top due to the high series resistors.

A tweeter may be incorporated in the speaker system, provided the main speaker is not less than 15Ω impedance, and the tweeter, also 15Ω, is fed via a reversible or non-polarised capacitor of not more than 4μF.

OPERATION FROM THE MAINS

The power requirements are modest and a mains transformer rated at 9 or 10V at 0·5 amp and a 0·5 amp 12V selenium bridge rectifier are more than adequate to supply either a single amplifier or two amplifiers of a stereo pair.

A suitable power supply circuit is shown in Fig. 9, but constructors intending at some future time to proceed with the power amplifier described next will do well to obtain the larger mains transformer and rectifier specified with this, using one-half of the centre tapped secondary to obtain the 12V required for the 1 watt unit.

To be continued

ADAPTABLE LOW COST HI-FI SYSTEM

(Part 1, December issue)

The text giving Chassis Details on page 614 should have appeared instead at the end of the article on page 572. The author has drawn our attention to the fact that the Texas range of transistors (i.e. 2G371 etc.) were used in the prototype. He recommends their use if the performance figures given are to be expected. If constructors experience difficulty in obtaining these semiconductors, and other components, they may be obtained from Messrs. C. & D. Electronics, 17 St. Luke's Road, Pallion, Sunderland. They can supply the recommended transistor package (matched set of driver and output pair) at 12s. 6d. per set.

LETTERS...

Letter of thanks

I feel very flattered to think that fellow readers have responded to my appeal for help as they have. I am also grateful to you for publishing my letter.

Readers and yourself will therefore be pleased to know that I succeeded in getting results, after replacing the electrolytics, and repairing a broken joint on the L.S. mains windings.—**W. M. Mackenzie** *(Gosport, Hants.)*.

Not only button pushing!

I would like to comment on the letter by R. T. Brown in the September issue of P.W. As a part-time commercial operator, I object to the statement that the only qualification to operate is the ability to push a button and speak into the microphone. The ability to rig aerials and to maintain the equipment is essential in most cases.

I would like to see some of the "competent amateurs" working directed net with ten outstations under difficult conditions.

I personally do not want a licence because I could not stand the few poor amateurs to be found on the bands in this district. I am no anti-RAE or anti-Morse man, but I do consider myself a competent operator in my own field and would like to be treated as such and not as just a "button pusher".—**M. Fisher** *(Huddersfield, Yorkshire).*

19 Set Mods "Mods"

I have, with the assistance of Mr. S. Simpson's extremely good articles on 19 Set Mods, modified my own 19 Set. I found it beneficial to earth the centre pin on the set's tone control pot, but I have gone one step further. I by-passed a 4,800Ω resistor fixed to the b.f.o. triode anode tag. I now find that s.s.b. signals are not saturated as was the case before. A further modification I attempted was for Top Band. Four 100pF capacitors (1% silver mica) which were to hand, were fitted across the four ganged tuning capacitors and earthed through a four-pole two-way wafer switch when necessary.

I am pleased to say that this modification is successful and by moving the wavechange switch to the 4·5 to 8Mc/s position, I find that Top Band appears between 2 and 2·5Mc/s. This is very convenient as it is on the same scale as 80 metres.—**J. Scott** *(Newquay, Cornwall).*

P.W. DATA RULE

PART 3

by I. J. KAMPEL

THE PRACTICAL WIRELESS Data-Rule was originally presented free with the November issue of this magazine, together with complete summary of instructions. This is the second of a short series of articles explaining the use of the rule, especially aimed at the beginner. The rule is now available from the PRACTICAL WIRELESS Blueprint Department, price 5/-.

Last month's article dealt with the more general uses of the L and M scales, the component tolerance scale, the reciprocal scale, the decibel scale and the log scale. This article will now complete the instructions concerning the same side of the rule.

DIRECT CONVERSION

The rule provides a means of ready conversion between many of the more common electrical units, or units closely associated with electrical engineering or electronics.

Conversion between two given units is straightforward given suitable log scales, such as the L and M scales on the rule. It is only necessary to place the significant figures of two equivalent units adjacent to each other, for the rest of the rule to then give direct conversion. Take, for example, conversion between metres and yards. Now it is known that 1m. = 1·09 yds., therefore, if the 1 of scale L is placed adjacent to the 1·09 of scale M, direct conversion between the two units is now possible. Thus, if we wished to know the metric equivalent of 6 yards, this is found to be 5·5 metres, for 5·5 in scale L is adjacent to 6 in scale M, i.e., scale L reads in metres, scale M in yards.

The decimal point may be placed easily if a note is made of relative magnitude at the initial setting. In the previous example, with the rule set as indicated, since scales read 1—10, direct conversion between scales is possible, and thus if one scale was multiplied by some factor of 10, the other scale must be multiplied by a similar factor. Thus had we wished to know the metric equivalent of 600 yards, we would call this $6{\cdot}0 \times 10^2$ in scale M, giving the reading in scale L, as indicated, but also $\times 10^2$, i.e., $5{\cdot}5 \times 10^2 = 550$ metres.

Take the point where the conversion falls off the scale, for example, find the distance in yards corresponding to 9·5m. The rule must be reset, placing the 10 of scale L opposite the 1·09 of scale M. The significant figures of the answer are then seen to be 1036, but this is known to represent the end of rule, in scale M, just above the 10. Thus we can correct this to read the true answer, 10·36 yds.

It is thus possible to mark on the slider, marks indicating the conversion factors between various units, and this is done on the Data Rule in windows combining I and J. When the slider is set so that the correct conversion factor is set on scales L and M, the appropriate units are displayed in the window. Note that there are two windows, and any units conversion may only appear in one window at once.

It has been shown that when the 1 of scale L has been set against the correct conversion factor in scale M, direct reading conversion is available, where the bottom scale is multiplied by the same factor as is required to be multiplied by the indicated value in scale L. A further conversion factor may be required to allow for differences in magnitudes. Now when the scale is reset to 10 in scale L, it is necessary to multiply by 10 on top of any other conversion factors. This factor consideration is taken into account automatically by the calculator, by means of the two small circular Conversion Factor windows in the two bottom corners of the rule. When the slider is pulled out to the left of the rule, units to be converted will only appear in the left-hand IJ window, and the conversion factor will appear in the left-hand small circular window, both right-hand windows remaining blank. The converse applies, i.e., with the slider pulled out to the right, the appropriate conversion factor appears in the right-hand small circular window, the units to be converted being in the right-hand IJ window, the left-hand windows being blank. Thus a different conversion factor will appear for the same units conversion, according to the choice of two slider settings.

The procedure to convert between the units given on the rule is thus as follows. Expose the desired units conversion in one or other of the two units conversion windows. When this is done, as the black arrows indicate, the I portion of the window indicates the units described by the L scale, and the J portion of the window indicates the units described by the M scale. The conversion factor in the appropriate small circular window then indicates the multiplication factor of scale M for this to read correct conversion from scale L, where the units in scale L refer to magnitudes of between 1 and 10. Thus, if the indicated conversion factor is 10^n, and if it is necessary to multiply a quantity in scale L by 10^x to give it in the form $N \times 10^x$, where N is between 1 and 10, then multiply the read-off value in scale M by $\times 10^{n+x}$. Due to the space available in the conversion factor windows, a minus index could not be shown in the usual form $\times 10^{-n}$, and has instead been shown with

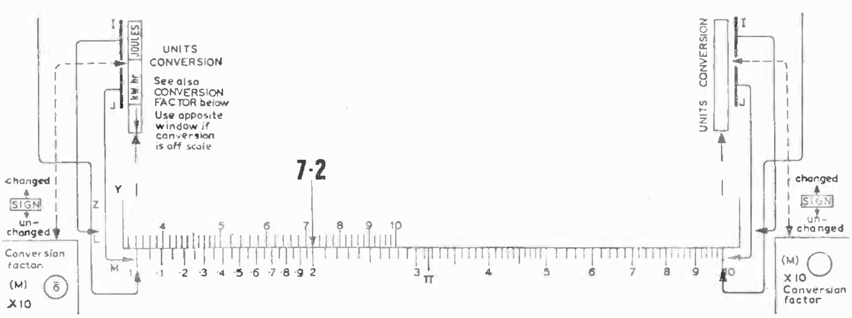


Fig. 9: Conversion to kW. hours of 72 x 10⁶ joules.

a bar above the index, thus: $\times 10^{\bar{n}}$.

Example: Convert 72×10^6 joules into kW.hrs. (see Fig. 9). This must firstly be mentally converted to the form $7{\cdot}2 \times 10^7$ joules, and a wise precaution is to jot down the factor $\times 10^7$. Now adjust the slider until JOULES appears in window I, and kW.hrs. in window J. The left-hand window is required for this example. Ensure that the positioning arrow in the window is correctly aligned. Now scale L reads directly in joules, and scale M directly in kW.hrs., times the appropriate factor, and thus we see that 7·2 joules (scale L) is equivalent to 2 (on scale M) $\times 10^{-6}$ (left small conversion window) kW.hrs. But we wish to convert $7{\cdot}2 \times 10^7$ joules, not 7·2 joules, therefore the answer is times the same factor, i.e., $2 \times 10^{-6} \times 10^7 = 2 \times 10^1 = 20$ kW.hrs.

To convert from the units in the lower scale to those in the upper scale, the procedure is reversed, and the same example, 20 kW.hrs. would be approached thus:—

Convert to the form 2×10^1, and keep a note of the factor $\times 10^1$. Now with reference to the upper scale, the lower scale is times the factor 10^{-6}. Thus the upper scale, relative to the lower, is $\times 10^6$. Thus, opposite 2 in the lower scale, we see 7·2 in the upper scale, and thus the answer is $7{\cdot}2 \times 10^{6+1} = 7{\cdot}2 \times 10^7$, or, in the original form, 72×10^6 joules.

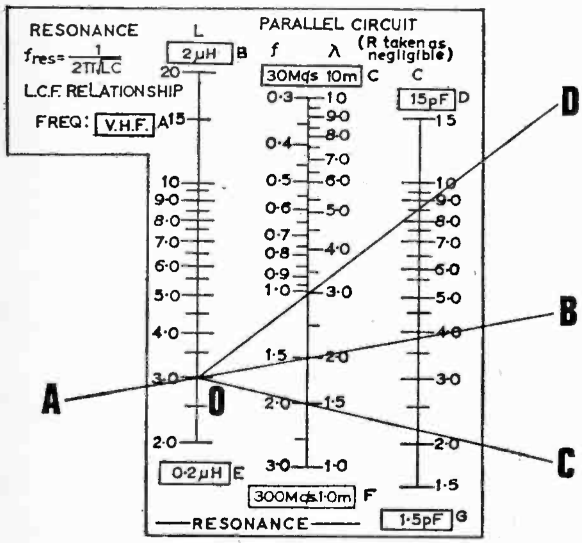


Fig. 10: Resonance example taken from the rule.

A method of simplifying this even further has been devised, eliminating thought about the sign of the conversion factor according to the direction of conversion, in the form of the "SIGN" symbols above the conversion factor windows. This indicates that when changing *down,* that is from the upper units in the window to the lower units, the units are unchanged, i.e. the units being converted to are times the indicated factor. If changing up, however, from the lower window units to the upper, the sign changes, i.e. scale L is $\times 10^{-z}$, where z is the indicated factor. From this it will be seen that 7·2 joules corresponds to 2×10^{-6} kW.hrs., and 2 kW.hrs. corresponds to $7{\cdot}2 \times 10^{-(-6)} = 7{\cdot}2 \times 10^6$ joules.

If the reader wishes to add any other units conversions to the rule to suit individual needs this is easily achieved, provided that at least one equivalent is known. If the rule is set up to give the required conversion, provided that this particular conversion does not overlap one already shown on the rule, the new position arrow may be marked in the window, and the appropriate units entered together with the conversion factors.

As an example of this, let us say that it was desired to add on the yards-metres conversion. We know that 1m. = 1·09 yds., thus set the 1 of scale L against the 1·09 of scale M. If this is done, it is seen to be too near the LUX-ft. can. conversion, and it is not possible to mark the yards-metres conversion at this point.

The other point is the reciprocal of one of the units however, or more simply, set the 1·09 of scale L against the 1 of scale M, and now we have the conversion, and also a blank window on the left, where we may fill in yards in the upper section of the window, and metres in the lower section of the window. Now 10 yards is equivalent to 9·17 metres, therefore no multiplication factor is required for the M scale to be correct, thus put the index 0 in the left-hand window ($\times 10^0 = 1$), and by resetting the rule to place the newly-created units conversion in the right-hand window, insert the index $\bar{1}$ in the right-hand conversion factor window. This is so since 1 yard must correspond to the indicated 9·17, but $\times 10^{-1}$ metres. Thus the right-hand window conversion factor will always be one factor of ten lower than the corresponding left-hand window factor.

RESONANCE

Resonance for an inductance and capacitance in a parallel circuit may be computed from the ABAC provided on the rule. The full formula for parallel circuit resonance is given as: $f_{res} = \frac{\sqrt{L/C - R^2}}{2\pi L}$ In radio circuits, however, "R" may nearly always be taken as negligible in comparison with $2\pi fL$, and therefore:— $C \simeq \frac{1}{(2\pi f)^2 L}$ and the frequency expression may be simplified to read:— $f_{res} = \frac{1}{2\pi\sqrt{LC}}$ as in fact shown on the rule. The ABAC scales are based on this expression, and by relating the log scales by a straight-edge, given two of the three variables, the third may be fixed directly.

Let us consider the following example by calculation, and by evaluation by the rule. A capacitor is measured at 3·76pF. What inductance is required for the circuit to resonate at 150Mc/s? Also, deduce the capacitor range required, if the above capacitor is a variable, to give the tuning range 100—200Mc/s assuming a fixed inductance.

We shall evaluate the first part of this question mathematically, check on the rule, and then complete the question by the rule only. Now, $150 \times 10^6 =$

$$\frac{1}{2\pi\sqrt{3{\cdot}76 \times 10^{-12} L}} \therefore (150)^2 \times 10^{12} = \frac{1}{4\pi^2 \times 3{\cdot}76 \times 10^{-12} L}$$

$$\therefore L = \frac{1}{4\pi^2 \times 3{\cdot}76 \times 10^{-12} \times (150)^2 \times 10^{12}}$$

$$L = \frac{1}{4\pi^2 \times 3{\cdot}76 \times 22{,}500}$$

$$L = 0{\cdot}3\mu H$$

To check this on the rule, adjust the slider to expose V.H.F. in the frequency window (A), thus making the resonance panel correspond to Fig. 10. If a ruler is placed to cut the C scale at 3·76pF, and the f scale at 150Mc/s, it is also seen to pass through 0·3µH on the L scale, agreeing with the far more complicated method of evaluation shown above. Note that the coloured scale markings on the ABAC represent significant figures only, and the decimal point, or rather the magnitude of the points, is defined by the windows above and below the scales, the windows defining the upper and lower limits of the scales.

To complete the question, refer to Fig. 10. In the figure, the line AB indicates the straight line evaluation in the first part of the question, where point O is the answer to the first part of the question. Since inductance is constant, all other lines drawn on the scales in this question must also pass through point O. The frequency range 100—200Mc/s is asked for, thus line OC through the red 2 in the f scale, representing 200Mc/s, and the line OD through the red 1 in the f scale, representing 100Mc/s, define the limits of capacitance required on the C scale, and this is seen to be, approximately, 2·1pF to 8·2pF.

PARALLEL RESISTOR CHART

The red numbers and lines on the chart represent preferred values of resistance which are normally obtainable. The right-hand numbers in black are specific values from 0 to 100. A problem often encountered is when a particular value of resistor is required which is not a preferred value. One way to overcome this problem is to use two other resistors of the appropriate value wired in parallel. The chart works out the required values at a glance without recourse to mathematical problems.

Let us assume that 490Ω is the required value (see Fig. 11). Firstly locate 49 on the right-hand black scale. On the chart, decimal points are placed by inspection, hence look at 49 for 490. Now look across the chart, in line with the 49, until the nearest intersection of coloured lines is seen to the 49 line. Reference to the chart on the rule will confirm that this is the intersection of the lines marked 120 and 82 in the left-hand column, and as shown in the figure. These two values represent the significant figures of the parallel resistors.

From the rule of thumb that when two resistors are in parallel, the combined resistance must be lower than the lowest of these resistors, and also remembering that two resistors of equal value in parallel will give a combined resistance of half their individual value, we can easily estimate the correct values. The reader will also realise that if one resistor is very much larger than the other, it will have little effect, and the combined resistance will be just slightly lower than the lower resistor value. Since we are evaluating for 490Ω, common sense tells us that the two values must be 1·2kΩ and 820Ω. As a quick check on this assumption, we could consider the case where the two resistors were both of the lower value, 820Ω, and this would give a combined resistance of 410Ω, too low. Thus, since the other resistor is a fair bit larger than this approximation, we can assume that it would lift the combined resistance to 490Ω. If the value is required really accurately, then multiply out:—

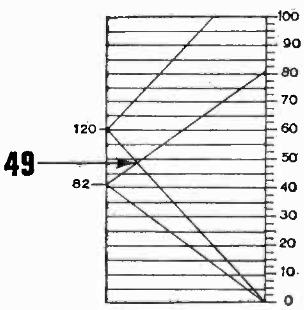


Fig. 11: Parallel resistors determined for a non-standard resistance.

$$R_{tot} = \frac{820 \times 1{,}200}{820 + 1{,}200} = 488\Omega.$$

As described last month, we could then rapidly evaluate the percentage difference this is with the tolerance scale, by setting the central line to the required 490, and thus seeing that the chart has given a value better than ±1%.

In the practical case, do not overlook the actual resistor tolerances that will be used. Thus the chart rapidly evaluates the resistance values, and the L and M scales provide the means of evaluating the check shown above accurately, having worked out that 820+ 1,200 = 2,020. To do this, divide 820 by 2,020, then multiply the answer by 1,200, to get the answer 488.

As indicated, the chart can also be used for series capacitors, however it is really designed for parallel resistors, therefore the preferred resistor values are not really suitable for capacitors.

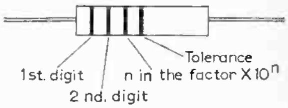


Fig. 12: Interpreting the resistor colour code.

For capacitors it will serve as an approximate guide, but since capacitor tolerance is usually exceedingly wide, particularly in electrolytics, it can serve a purpose for capacitors as well.

RESISTOR SELECTION

The two upper tables on the rule are designed to ease selection of resistors, the left-hand table gives the resistor colour code, and the right-hand table gives the preferred resistance values. Fig. 12 indicates how the coloured bands on the resistor should be interpreted. It should be noted that the bands start from one end of the resistor, leaving the far end of the resistor blank, and when reading the colour code, always start with the colour next to the nearest end of the resistor, and then work along taking colours in turn. The first colour indicates the first digit, and the second colour the second digit of the resistance value. The third colour indicates the number of noughts which should be placed after the previous two digits, or the factor "n" if the previous two digits are multiplied by 10^n. The last band, if there is one, indicates the resistance tolerance allowed. If there is no fourth band a tolerance of ±20% is assumed.

As an example, take the following four colours, reading in from the end:—red, violet, orange, gold. Obtain the first digit by looking for red in the top left-hand table. This is seen to be 2. The second digit, from the same table, is seen to be 7, the code number for violet. We must then add on to this three noughts, due to the orange band, and the gold band at the end tells us the resistor's ±5% tolerance. Thus the resistance value is nominally 27kΩ, and it is read as 27×10^3 from the code, or 27 with 3 zeros after this giving 27,000Ω.

Another example:—green, blue, black. This represents 56×10^0 i.e. 56Ω.

A final example, the resistance 3Ω would be coded 03Ω, i.e., black, orange, black.

The top right-hand table indicates the first two digits of resistance values that are usually obtainable. Thus, if a calculation calls for a resistance of say 5·9kΩ, reference to this table tells us that the nearest preferred value to this will be 5·6kΩ.

Next month's issue will deal with the scales on the other side of the rule.

To be continued

THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA

FOLLOWING the formation of a local Amateur Radio Club, many junior members expressed the desire to purchase or build a receiver but either lacked the finances or felt that building a receiver was beyond their capabilities. With these and other requirements in mind, the Clubman MK I receiver was designed to provide:

1 Satisfactory reception of a.m. signals on Top Band (160m), Trawler Band and the 80 metre amateur band.
2 Easy construction from readily available parts.
3 Minimum cost.
4 Pleasing appearance.
5 Facility for adding extra stages and refinements at a later date.

Basic Circuit

The basic circuit is that of a 5-stage superhet receiver, as shown in Fig. 1. In order to economise on transistors and components, a reflex circuit is employed as shown in Fig. 2. In this circuit the i.f. amplifier transistor is also used as an a.f. amplifier. Only one double-tuned i.f. transformer is used providing a reasonable degree of selectivity which is in keeping with the general performance of the receiver. The complete circuit is shown in Fig. 3.

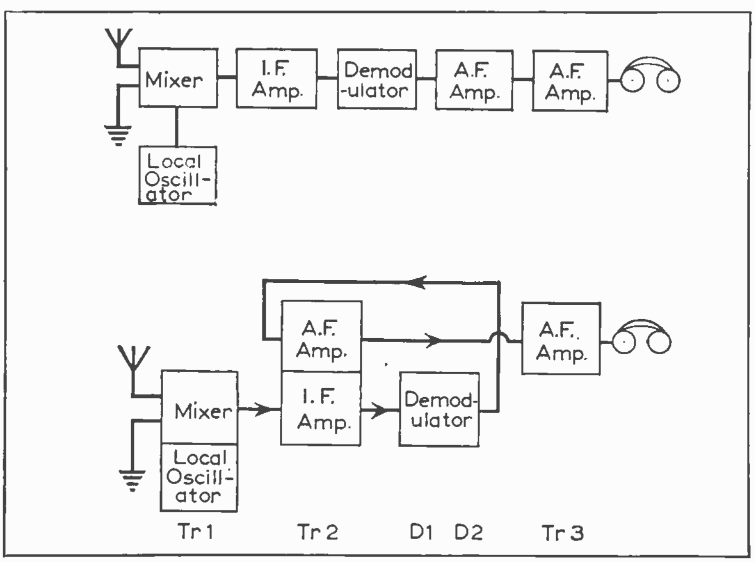


Fig. 1 (above): Block diagram of a conventional 5 stage superhet. Fig. 2 (below): Basic block diagram of the "CLUBMAN".

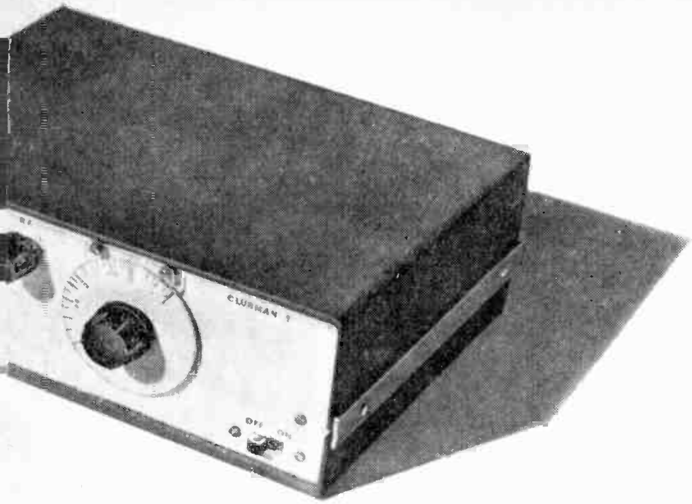
Frequency Changer Stage

Incoming signals pass through the r.f. gain control VR1 to the coupling coil L1. VR1 is connected so as to provide to L1 an impedance which varies as little as possible with the setting of the control. L2 is the tuning coil which, with VC1 and TC1, is tuned to incoming signal. L3 is the coupling coil to Tr1 base. Tr1 and its associated components comprise a self-oscillating mixer stage which follows standard practice. The local oscillator frequency is determined primarily by L6 and VC2. TC2 is the oscillator trimmer and C4 is the padding capacitor. The feedback required for oscillation is provided by the collector coupling winding L4 and the emitter coupling winding L5. D.C. biasing for Tr1 base is provided by the potential divider R1 and R2, while R4 is the emitter stabilising resistor. Decoupling of the various circuits is provided by C1, C2, and C3. The purpose and value of R3 is discussed later.

The I.F. and Detector Stages

Signal, local oscillator and resultant sum and difference (i.f.) frequencies appear at the collector of Tr1. The i.f. frequency only is accepted by the i.f. transformer i.f.t.l., the primary and secondary of which are tuned to 470 kc/s. I.F. signals at this frequency are passed to the base of Tr2. Amplified i.f. signals at Tr2 collector are developed across the choke L7 and passed by C7 to the demodulator.

The demodulator consists of a voltage doubling rectifier circuit comprising D1 and D2, the signal load resistor is R7 and decoupling is provided by C6. The audio frequency signal is developed across R7 and is returned to the base of Tr2 by the coupling capacitor C8.



* STEP BY STEP GENERAL PURPOSE RECEIVER

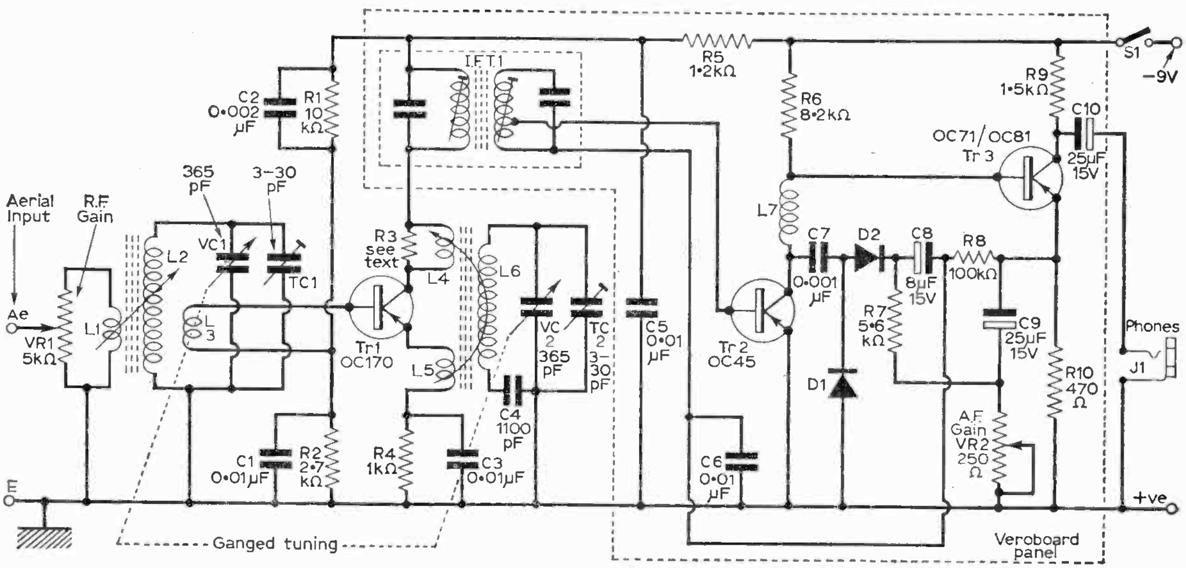


Fig. 3: Circuit diagram of the "CLUBMAN" Mk I receiver.

★ components list

Resistors:

All 10% watt Carbon.

R1	10kΩ	R5	1·2kΩ	R9	1·5kΩ
R2	2·7kΩ	R6	8·2kΩ	R10	470Ω
R3	see text	R7	5·6kΩ	VR1	5kΩ
R4	1kΩ	R8	100kΩ	VR2	250Ω

Capacitors:

C1	0·01µF 20V disc ceramic
C2	0·002µF Hi-K ceramic
C3	0·01µF 20V disc ceramic
C4	1100pF (1000pF and 100pF in parallel) Mica
C5	0·01µF 20V disc ceramic
C6	0·01µF 20V disc ceramic
C7	0·001µF Hi-K
C8	8µF 15V electrolytic
C9	25µF 15V electrolytic
C10	25µF 15V electrolytic
TC1	3–30pF concentric trimmers
TC2	3–30pF concentric trimmers
VC1/VC2	365pF 2 gang Jackson type 02

Semiconductors:

TR1	OC170 Mullard
TR2	OC45 Mullard
TR3	OC71 or OC81 Mullard
D1	OA81 Mullard
D2	OA81 Mullard

Inductors:

L1/L2/L3	3T blue } Denco
L4/L5/L6	3T red } Denco
L7	2·5mH RFC type CH1 Repanco
IFT1	470kc/s type T41/IE Weymouth

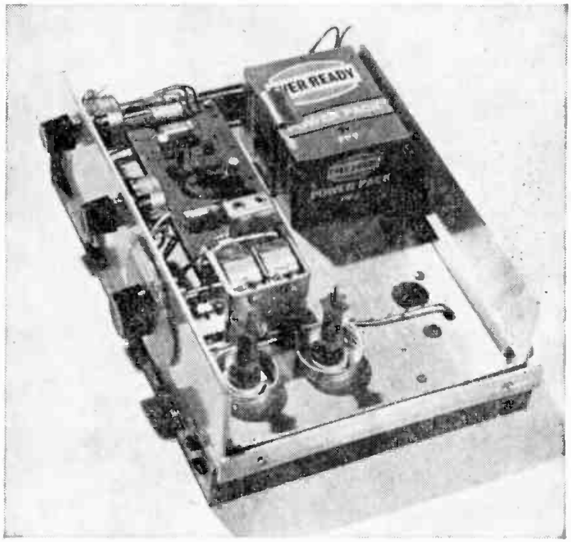
Miscellaneous:

Open jack socket, miniature slide switch, slow motion drive, knobs, terminals, 2 B9A valveholders, solder tags, battery clips, nuts, bolts and screws, materials for cabinet.

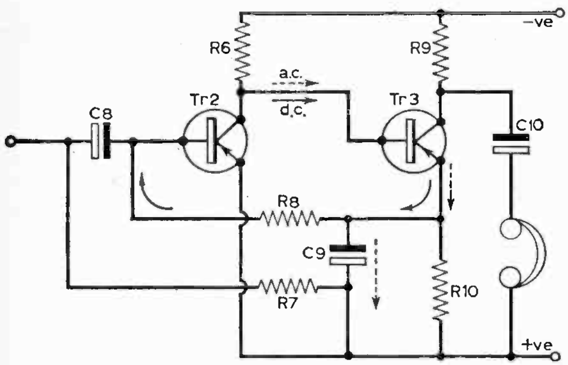
A.F. Amplifier and Output Stage

Tr2 now performs as an a.f. amplifier, the amplified signal appears across the collector load R6 and is passed directly to the base of Tr3. Tr3 is the a.f. output stage and the collector and load resistor R9 are coupled to the headphone jack by C10. D.C. biasing of Tr2 and Tr3 is rather unusual and is shown in Fig. 4. The coupling between Tr2 and Tr3 is seen to be direct. The bias current for the base of Tr2 is obtained from Tr3 emitter. This means that there is a complete d.c. feedback loop. Starting at the base of Tr2, signals and d.c. level changes appear amplified and of opposite polarity at the collector and pass on to the base of Tr3. Corresponding d.c. changes appear at Tr3 emitter and this is fed back to Tr2 base. As the changes fed back to Tr2 base are opposite to those originating there, the circuit is kept stable. A.F. signals existing at Tr3 emitter find an easy path to earth via the decoupling capacitor C9, and are not fed back to the base of Tr2. Strongly amplified a.f. signals appear at Tr3 collector.

For simplicity the a.f. gain control was omitted from the circuit in Fig. 4 and is now shown in its correct position in Fig. 5. As the a.f. gain control VR2 is increased in resistance (anticlockwise rotation) the a.f. currents flowing through C9 produce an a.f. voltage across VR2 and R10. This a.f. voltage provides negative series current feedback to Tr3 and negative shunt current feedback via R7 and R8 to Tr2, thus reducing the a.f. gain of both stages. The feedback provides a variation of gain of about 100 to 1, but will not reduce the output to zero.



Photograph shows internal view of the basic receiver.



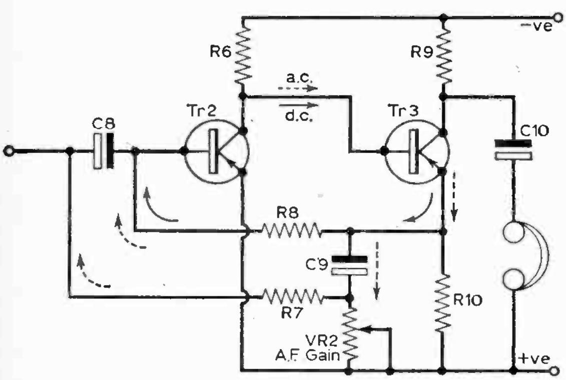


Fig. 4 (upper): Biasing circuit Tr2, Tr3.

Fig. 5 (lower): Biasing circuit Tr2, Tr3, with a.f. gain control.

General Construction

The receiver is built on a simple aluminium chassis with front and rear panels, giving excellent accessibility for construction and adjustment. A two-part wrap-around cover provides neat appearance with easy fixing. Drawings of the chassis, covers and other items are given in Fig. 6.

If you have the usual metalworking tools and have some experience of metalwork, the chassis and panels should present no problems. If you are new to metalwork the following hints may help you.

1—The aluminium for the panels, chassis and brackets should be cut by a guillotine or metal saw, tin shears or snips leave a poor edge to the metal which is difficult to correct. A supplier of sheet metal will probably cut the metal to the required size for you. If you have to cut the metal with a saw, be sure to file the edges level and smooth afterwards.

2—Mark out centre lines on the chassis and panels as all dimensions are given from these lines. Mark out all the other dimensions from the centre lines, double check dimensions and use a small centre punch to mark the centres of all holes. Mark out the brackets etc., as shown in Fig. 6. The holes in the chassis, panels and brackets may now be drilled. It is advisable to run a pilot drill of $\frac{1}{8}$in. diameter through the large holes first before drilling to the correct size. Holes over $\frac{3}{8}$in. diameter should be made using a chassis cutter, the Q-Max type is ideal. The rectangular holes for the slide switches may be made by drilling a couple of holes within the marked-out area and then opening up to size with a small flat or three-cornered file.

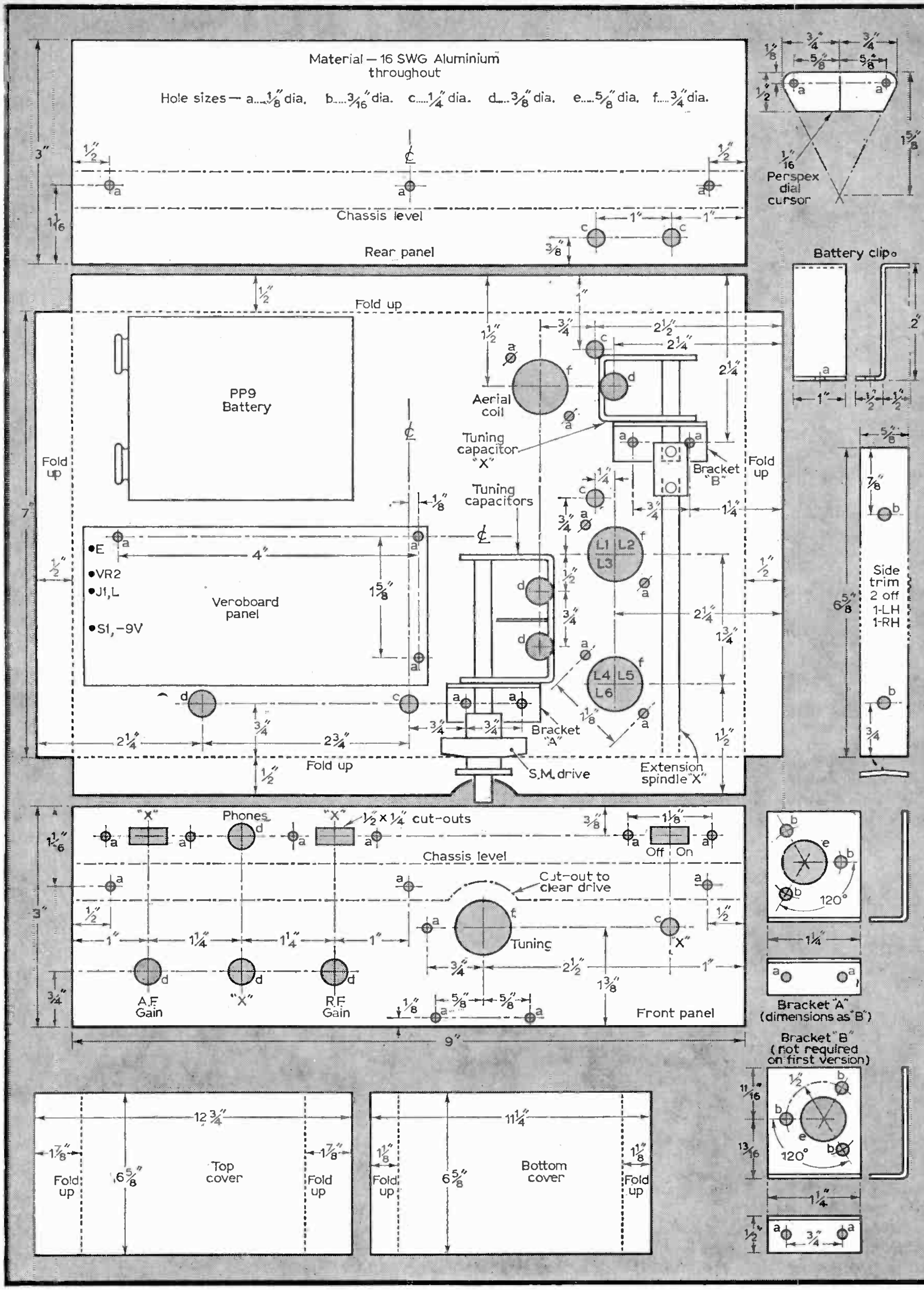


Fig. 6: Details of the main chassis drilling, front and rear panels, top and bottom covers, capacitor brackets, side trims and battery clip.

3—The bending of the chassis and covers is tackled next. If you do not have access to a bending machine, or suitable pieces of angle iron which may be clamped in a vice, an easy way of bending the chassis is as follows. Cut two pieces of ¾in. thick blockboard, size 8⅞ x 6in., make sure all the corners are square and the edges parallel. Sandwich the chassis between them so that the blockboard fits the 8⅞ x 6in. area which will be the inside dimensions of the chassis. Screw the two pieces of blockboard together through two or more of the holes already drilled in the chassis. The whole assembly is now clamped in a vice and each edge of the chassis is gently tapped over, using a block of hardwood and a light hammer. Do not rush this operation as it is difficult to straighten any irregularities that may appear in the edge. Make sure the edges are folded in the correct direction. The covers and brackets may be made in the same manner as the chassis but without drilling holes.

4—The panels now require fixing to the chassis, and it will be seen that no holes exist on the edges of the chassis for this purpose, this is intentional. Cut four small blocks of wood having a distance of exactly ¾in. between two opposite faces, for use as jig blocks. Turn the chassis folded-edge *upwards* and stand this on the four blocks so that the chassis is raised exactly ¾in. Take the front panel and rear panel and stand these against the respective edges of the chassis as shown in Fig. 6. Make sure everything is square and mark through the panel fixing hole on to the chassis edge. Centre punch the centre of the markings and drill ⅛in. diameter holes. The panels may now be bolted to the chassis using 6BA bolts and nuts. The jig blocks should again be used to ensure the complete unit is tightened up squarely.

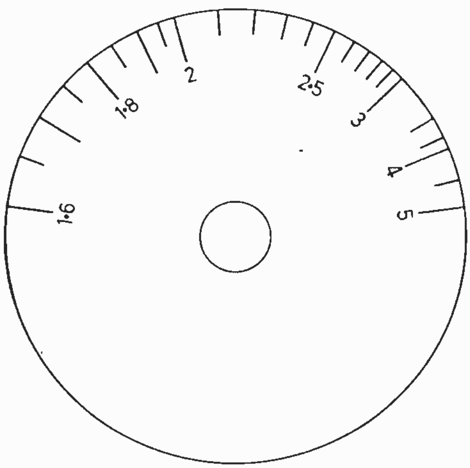


Fig. 7: The receiver dial—shown to scale.

5—The top and bottom covers are now placed in position. The rear panel should be set in about ⅛in. and the front panel about ¼in.

6—To present a good appearance, the front and rear panels are covered with white Fablon or Contact plastic material.

7—The dial is made of an aluminium disc cut to shape and a calibrated paper disc attached. (See Fig. 7.)

To be continued

THE MW COLUMN

ONCE again we bring you some notes on the Medium Wave DX situation. The most interesting items to report are of West Coast North American reception. It must be pointed out that with the approach of the sunspot maximum these are liable to be more difficult to log.

On August 28th KOMO (1000) was heard in Southport at 0430 GMT and in Bristol KOMO again plus KING (1090) (both in Seattle, Washington) on October 22nd—KOMO at 0520 and KING over WBAL, Baltimore, Maryland.

Another interesting catch from Charles Molloy in Southport, who with Pat Dobbs in Bristol are the only ones who have reported West Coast reception recently, is CBW (990) in Winnipeg on September 11th at 0515 with close down announcements followed by their all night programme. Of course the regular East Coast stations in Canada and the USA continue to be logged widely.

Looking to South America we have a report of a *real* rarity in the UK—CP4 (1020) *Emisora del Estado*, La Paz, Bolivia, which was heard in June and July by Al Slater in Southwick, Sussex. This was verified —sign off at 0400. Other South Americans that you can look for are YVQQ (770) *R. Puerto la Cruz*, this is regular—also YVLH (660) *R. Giradot*, Maracay, HJED (820) *La Voz de Cauca*, Cali, and HJCT (1190) *La Voz de la Costa*, Baranquilla and there are Brazilians to be heard when conditions permit from midnight onwards. PRE8 (980) *R. Nacional*, Rio, PRB9 (1000) *R. Pan-Americana*, Sao Paulo, PRG9 (1100) *R. Nacional*, Sao Paulo, PRE3 (1180) *R. Globo*, Rio and PRG3 (1208) *R. Tupi*, Rio. Also we must not forget our old friend LR1 (1070) *R. El Mundo*, Buenos Aires.

Now to Asia—under favourable conditions around 0030 to 0310 one may log All India Radio. We have reports of Ahmadabad (850), Delhi (1070), and you may look for Sangli (1250). Afternoon reception of the latter was known, but we feel it to be *very* difficult now. Others are Hopei (770) around 2220, Urumchi (1525) in Russian from around 1800 and Taiwan (750) from about 2100.

On the African continent there are some excellent potential catches. Fairly often heard is Sao Tome (759) around 2000, also the high power *R. Biafra*, Enugu (620) at 0430 and *R. Lourenco Marques* (917) at 0100. A good source of DX is South Africa and over the past year we have had reports of the S.A.B.C. Springbok Commercial Service, which is an All Night Service. As far as we know the earliest hour for this is about 0130 and the following channels should be carefully watched: *1286*—in Johannesburg, East Rand, *1268* in Pretoria and *782* in Bloemfontein—if Deutschlandsender is off the air.

We hope that these notes are of interest. They have been compiled at very short notice upon an urgent request to help out due to the indisposition of Al Woodland. *KEN BROWNLESS*

replacement RECTIFIERS

by J. LAW

THE growing popularity of transistor portable receivers in recent years has resulted in large numbers of mains table receivers being discarded long before their useful life was over. Many of these sets have excellent short wave bands, others have push pull output and good quality speakers. Many dealers, having taken this type of receiver in part exchange against sales, are glad to get rid of them for a nominal payment.

Many of these receivers have only rectifier and smoothing faults but it is surprising how many different types of bases there are. The amateur has only a limited selection of valve rectifiers in his junk box. An attempt to find an interchangeable rectifier which could be used with base adaptors to test any set resulted in this universal rectifier.

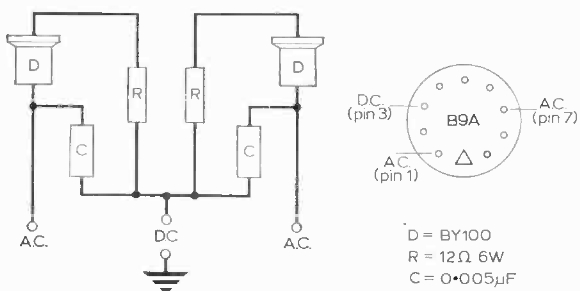


Fig. 1: Full wave rectifier using two silicon diodes.

The problem of catering for different heater voltages has been overcome by the use of silicon diodes. Wiring the diodes and limiting components to a B9A base enables direct replacement of EZ80 and other current rectifiers. Base adaptors, as in Fig. 5 enable the basic unit to be adapted to International and Mazda octal, B7G, B8A and other type bases. Most a.c. receivers using full wave rectifiers have heater supplies of 5 or 6 volts. Removal of the rectifier does not interfere with the heater supplies of the other valves in the receiver. A defective rectifier can, therefore, be removed and a diode replacement unit substituted.

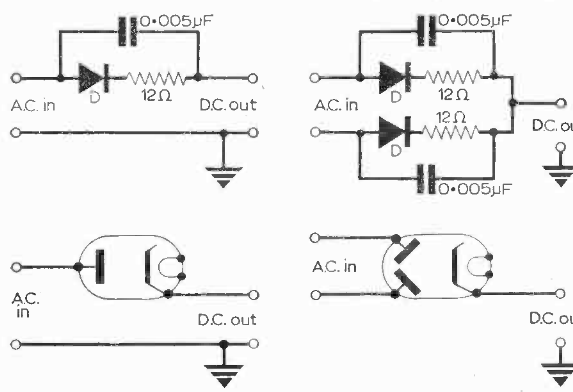


Fig. 2: Half wave rectifier circuits (left) and (right) full wave circuits. The 0·005 μF capacitors should be 1000 V wkg.

Figure 1 shows the component parts of a full wave universal rectifier, namely two B100 silicon diodes, two 12Ω 6 watt resistors, two 0·005μF 1kV wkg., capacitors wired to a B9A pin base. Fig. 2 shows the comparative valve and diode circuits for both full wave and half wave rectifiers.

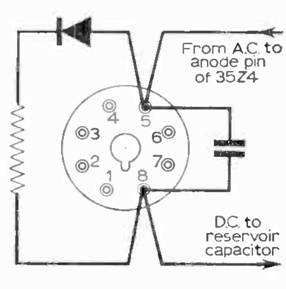
Many a.c./d.c. receivers are still in use despite the ever-growing popularity of the transsistor home radio. Using high voltage filaments for output and rectifier valves they make use of half wave rectification for h.t. supplies. Typical of this design are the Ultra U930 with UL41 output valve and UY41 rectifier, the Philco Model 104 with UL84 and UY85 rectifier and the Pilot Maestro with 35L6 and 35Z4 valves.

A common fault in a.c./d.c. rectifiers is a break in the cathode lead leaving the heater intact. Since half wave rectification is used only one silicon diode and associated components is required to replace the rectifier valve. In such a case the parts can be wired across the valve holder base as shown in Fig. 3.

Where, however, the heater is open circuit, it is necessary to bridge the gap in the heater circuit, in order to restore the current to the remaining valves in the set. The resistance value of the "bridge" must be chosen so that approximately the same voltage will be dropped across it as was developed across the rectifier valve filament.

Reference to a valve data booklet will give details of rectifier heater voltages and currents. The Ultra radio, Model U390, referred to above makes use of a UY41 rectifier. This is a valve with a 31V 0·1A heater and a B8A base. The value of the resistor required to replace the filament can be obtained from Ohm's Law—Resistor R=E/I. The nearest resistor value would be 300Ω (5 watt rating) and this would be wired across pins 1 and 8 of the rectifier base and the diode, resistor and capacitor connected as shown in Fig. 4(a).

Fig. 3: Replacement silicon rectifier (on international octal base) for 35Z4 where filament is still intact.



The Philco radio uses a UY85 rectifier valve with a 38 volt heater at 0·1A. Again from Ohm's Law the heater "bridge" resistor can be ascertained. The nearest commercial value would be 400Ω 5W. The valve has a B9A base and the resistor would be joined across pins 4 and 5. Fig. 4(b) shows the diode wiring.

For the Pilot Maestro which has a 35 volt rectifier a bridge resistor of 200Ω 6W will suffice (see Fig. 4(c).

When a valve rectifier has been proved to be defective, the glass envelope and valve structure may

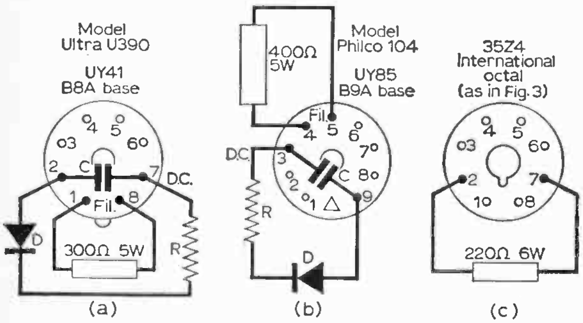


Fig. 4: (a) Complete rewire to replace UY41 with o/c filament; (b) ditto for UY85; (c) used where 35Z4 filament is o/c (also add Fig 3 details).

be removed, and the components wired on top of the base if it is thought undesirable to wire them under the chassis. This allows ventilation of the bridge resistor which will run warm. When wiring up diodes the full length of the wires should be used. Sleeve them and sheath the outer case of the diodes in plastic tape. If the case should contact the chassis the output will be short circuited.

Before fitting a replacement rectifier, the cause of failure must be ascertained; otherwise the diodes may in their turn be damaged. A short circuit in the reservoir capacitor is a typical cause of rectifier failure.

Referring back to Fig. 2 silicon diodes have a lower forward resistance than valve rectifiers. Replacement of a valve with a diode would result in a higher voltage across the reservoir capacitor.

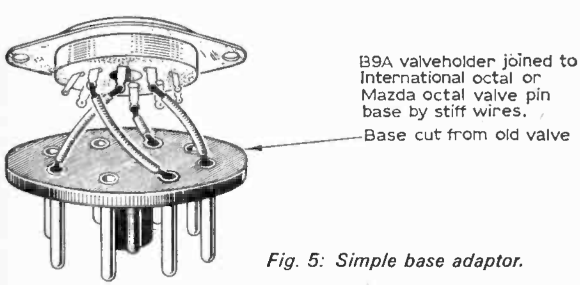


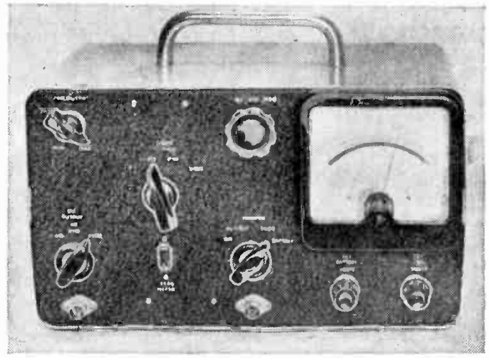
Fig. 5: Simple base adaptor.

Since there is no heater warm and smoothing up period the full voltage appears across the reservoir capacitors immediately the receiver is switched on. This could cause damage. To reduce these dangers a series resistor of 12Ω 6W is connected to each diode. The 0·005μF capacitors are connected across the diodes to protect them from voltage surges.

Universal silicon diode rectifiers have given a new

—continued on page 698

NEXT MONTH IN P.W.



Direct Reading Audio Oscillator and Frequency Meter

This is a compact dual-purpose instrument covering 20c/s to 200kc/s in four ranges. Oscillator outputs are at 10mV, 100mV, 1000mV plus one which is continuously variable, and distortion is only 0·5% (100c/s to 50kc/s), or 1% (40c/s to 100kc/s). The frequency meter is accurate to 5%. Monitor facilities are provided.

Full constructional details are given of this design, which uses 8 transistors and 5 diodes, together with helpful notes on calibration.

Reclaiming Faulty Transistors

Faulty transistors are usually thrown away. But are they always really useless? Only one junction may be damaged and many such components can be reclaimed for use as diodes or zeners. This article shows how to build a simple test unit to check whether damaged transistors can be utilised for other purposes.

Improving the PCR

How to improve the performance of the well-known PCR, PCR2 and PCR3 communications receivers by adding a transistor b.f.o. stage and incorporating variable selectivity.

PLUS

More about The Clubman and the low cost Hi-Fi System and other articles, including all the regular features.

PRACTICAL WIRELESS

February issue on sale January 5th

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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

ASIA

Afghanistan: *Radio Afghanistan* (Ansari Watt, Kabul) using the new outlet of 15,435 from 1100–1200 for a combined Pushta/Dari programme.

China: *Radio Peking* (Fu Hsin Men, Peking) has English to Europe at 2030–2125 and 2130–2225 on approximately 9,890 and also in the 25 and 42 metre bands. English for Africa is at 1930–2025 and 2030–2125 on 9,450.

Indonesia: *Radio Republik Indonesia* (P.O. Box 157, Djakarta) has left 9,865 for its Arabic, French, Indonesian and English programmes at 1615–2000 to Europe. Listed new frequency, on which the station has not so far been reported is 15,200. However part of the Arabic programme at 1615 was heard on 9,588 before being blotted out by interference.

Japan: *N.H.K.* (*Tokyo*) latest schedule for the general service is: on 15,105/15,195/15,300 0100-0130, 0200-0230, 0300–0330, 0400–0430, 0500–0530; on 9,505/15,195/15,300 0600–0630, 0700–0730, 0800–0830, 0900–0930; on 9,505/11,815/15,300 1000–1130; on 9,505/9,560/11,815, 1200–1230, 1300–1330, 1400–1530, 1600–1630, 1700–1730, 1800–1830; on 9,560/11,815/15,105 1900–1930, 2000–2030, 2100–2130; on 9,700/15,195/17,785 2200–2230, 2300–0030.

Lebanon: *R. Lebanon* (Ministry of Information, Beirut) now using 15,180 at 1830–2030 in English, Arabic and French to Africa.

AUSTRALASIA

Australia: *Radio Australia* (P.O. Box 428G, G.P.O. Melbourne) now uses 11,810 from 1800–2115 in English. The 2230–0030 Indonesia programme now goes out over 21,680/15,330. The UK English transmission is now at 0815–0915 on 9,560/11,710.

NORTH AMERICA

U.S.A.: *Radio New York Worldwide* (485 Madison Avenue, New York, NY, 10022) now reported to have the following frequency usage to Europe. On 17,730 1600–1945; 21,530 1600–1700; 11,970 2000–2200; 21,520 1700–1945; 17,760 1945–2200; 15,440 1600–2200. A press release from the station says however that at 1700 it is using 17,760/17,845/21,465/21,530.

CENTRAL AMERICA

Cuba: *Radio Habana Cuba* (Apartado Postal 7026, Habana) has made the following changes: Spanish to Mediterranean: 1630–1730, 0830–0930 11,735; 1855–2030 17,855/17,885. Arabic to Mediterranean 0800–0830, 1000–1030 11,735; 1810–1855, 2030–2110 17,855/17,885; English for the Americas 2050–2150 15,230. French to Mediterranean 0730–0800, 0930–1000 11,735; 1700–1810, 2110–2140 17,855/17,885.

Netherlands Antilles: *Trans World Radio* (Bonaire) reported on 15,255 to Europe at 2000–2130.

Windward Islands: *Windward Islands Broadcasting Service* (St. George's, Grenada) noted at 2015–2130 on 21,690.

SOUTH AMERICA

Chile: *Radio Nuevo Mundo* (Casilla 9255, Santiago) reported on the new outlet of 17,865 at 2400–0200.

EUROPE

Albania: *Radio Tirana* (Rue Ismail Quemal, Tirana) reported using new outlets 6,200/9,510 for the 2200–2230 English transmission to Europe.

Belgium: *Radiodiffusion—Television Belge* (18 Place Eugene Flajey, Brussels 5) transmits as follows at 1830–2100 over 6,010/11,615/17,860; 2115–2200 6,010/9,615/15,335; 2315–0100 6,010/9,615/11,895.

Denmark: *Radio Denmark* (Radio House, Rosenorasalle 22, Copenhagen 5) has retimed its South American service. New times are Danish 2000–2045 and Spanish 2045–2115 over 15,165.

German Federal Republic: *Deutsche Welle* (5 Koln 1, Postfach 344) has made the following frequency changes: Indonesian 1210–1320 15,300/17,830/21,650; English 0300–0340 9,640/11,945; 1550–1620 15,275/17,875. Spanish 0555–0635 9,545/11,945; 2240–2350 and Portuguese 2140–2240 9,545/11,795/15,435. Turkish 0610–0640 9,610/11,795.

German Democratic Republic: *Radio Berlin International* (116 Berlin Nalepastrasse 18–50) now transmits in English as follows at 1730, 2015*, 2200**, 2300** on 6,080/6,115/7,185/7,300/9,730 (also on *1,511; **1,430); 0100, 0230 on 9,730/11,890; 0345, 0445 9,560/9,650; 0345, 11,795; 1215, 1600 21,600; 0615 11,795; 1315 21,655; 1915 17,785; 1600 17,805; 0645 17,700; 1200, 1315 21,610; 1415, 15,125.

Great Britain: *BBC* (C EXB, Bush House, London, WC2) noted on 25,720 with Hindu 1500–1545; Urdu 1415–1500; Chinese 1200–1300; Indonesian 1030–1100; Japanese 1100–1130; Vietnamese 1130–1200.

Manx Radio (*Loch Promenade, Douglas, Isle of Man*) transmits as follows: 0600–0630 and 1730–1900, 1,594; 0630–1730 1,295. There is also a religious programme at 1015–1100 on 1,594.

Greece: *Radio Athens* (Mourouzi Street 16, Athens 138) noted with English and French during the 2200–2230 Greek transmission on 11,720/15,345.

Hungary: *Radio Budapest* (Brody Sandor-S.U. 5–7, Budapest VIII) has English as follows: To Europe 2130–2230 on 11,910/9,833/7,220/6,234 and 2330–2400 on 6,234/3,995/539. To Far East 0800–0815 Wednesday and 1015–1030 Friday 11,910/15,160/17,890. To North America 0030–0130 6,234/7,220/9,833/11,910/15,160; 0300–0400 and 0430 and 0500 6,234/7,220/9,833/11,910.

Thanks for help go this month to D. O. French, Roy Patrick, A. E. Roxburgh, M. A. Golics, Swiss Shortwave Service, Radio New York Worldwide and the International Short Wave Club.

THE AMATEUR BANDS by DAVID GIBSON, G3JDG

THINGS are really hotting up now and if they get any hotter the shack at 3JDG will be growing orchids. Ten metres has burst its banks at times although still rather up and down. Twenty and fifteen have really been wide open and even noisy seven megs has reared its DX head. **David Smith** (Lancs.), has sent in a log for 1·8 Mc/s which shows that it is far from being just a "G only" band. Incidentally W1BB has now worked 97 different countries on 160 metres, anyone beat that?

Best times to listen on the bands is always a good thing to know. At the time of writing topband is interesting after 10 p.m., while twenty and fifteen seem to be at their best from 10 a.m. to 4 p.m. Ten is a daytime band too from 10 a.m. to 4 p.m. but has stayed open till 9 p.m. on occasions.

Many thanks to all those who sent in logs this month. Some were really fine business so let's take a peep at the postbag and see.

L.F.

Brave men still shake at the knees and keen types hide in dark corners, that is if you happen to mention a listen on the l.f. bands. Only two souls came through unscathed this month each with a bag of goodies.

D. Smith (Lancs.), RX6ON, 35ft. end fed scooped this lot on topband c.w.—OK2BOB, OK2BKH, OK2AKU, OL2AIO, OK3KAS, and from the Channel Islands—GC3ODE.

P. Baker (S. Wales), HE30, 150ft. end fed listened on 80 s.s.b. and got—CN8AW, FP8CA, VE1UA, VO1AW, VS6FS, VS9MB, W3BMS, ZC4MO, then a good opening to the Pacific—ZL2FQ, ZL2KT, ZL2BCG, ZL2RJ, ZL4KE, ZL4LM. On 40 (I'm shaking already), Paul raised—CN8AW, CN8BV, EA6BC, K1DRI, K8AWS, OA8NAM, PZ1CF, SVØWV, UJ8GW, VK2AVA, W3BMS, ZB2AP, ZC4AK, ZL2BDA.

TEN METRES

The r.f. coming in on this band is quite devastating at times. Really worth a listen these days too so spin the dial round to 28Mc/s and leave it there ready for the next session.

G. Coomber (Essex), HRO-MX, 15 metre dipole at 16ft. hooked these on s.s.b.—W1HRN, W2QCR, W3GHF, W4MMD, W5TBH, W8OCT, W9LKJ, WØAXE, 5N2AAF, 9H1K.

P. Knowles (Cheshire), CR45 plus PR30, heard these, which is pretty good for a t.r.f.—DJ9HI, EA6BJ, I1KTS, K1FWK, UB5GTW, UB5SLF, VE3CTI, W1TAT, W2EIR, W3TUA, W4CNN, W8YCI, W9HLY, YO2QCA, ZE8JM, ZS1JH all on a.m. too.

L Rowland (Cheshire), lurked with intent on 28Mc/s. Using a Trio 9R-59 and a 150ft. long wire as bait he captured—CE3TS, CN8PR, CR6IV, CR7FM, CX9PP, EA6BJ, EL2AI, EL2S, EP2BQ, IS1IUA, IT1BXX, JA1AG, JA1FGE, JA2GDF, K1YZW, K2QIL, K4KJN, K5DFZ, K6CCY, K6HAD, K8EQH, KØRCH, KG6ALY, KP4BJD, KR6TAB, KV4AD, KV4BW, KZ5MB, OD5BZ, OX3BS, PY2DSE, PZ1BX, SVØWM, UA3AVV, UF6ACR, VE3PWA, VE4GC, VE5LL, VK6BE, VK6CF, VK6XX, VK9DR, VK9DJ, VS6DO, VU2MWP, W2BZ, W3AEC, W4YYY, W5IOU, W6EPZ, W6VIO, WA6HXW, WB6RJG, W7PEY, W8AUE, W9RYX, WØQDW, XE2IW, YV1LA, YV5ANE, ZC4MO, ZE1AA, ZS1FH, ZS5DG (No relation), ZS6AOW, 3V8BZ, 4X4BL, 5N2AAF, 5R8AS, 9J2WR, 9L1GQ, 9L1JJ. All on s.s.b. (My kingdom for a b.f.o.).

I. Davies (Essex), homebrew double superhet transistorised (well done, Sir), 10 metre dipole, logged—OD5BZ, OX3BX, PJ2CQK, VE3BRC, YV6BV, 5N2AAF, 9H1AG, 9H1K, 9G2OK.

TWENTY/FIFTEEN

D. Henbry (Sussex), HA500, 20 metre dipole, shows what's about on 21Mc/s s.s.b.—CE3PY, CR6II, CR7DS, EL8H, HK3BLD, HK5ASA, HL9KB, HR1KAS, KV4CF/M, KZ5SF, LU8DB, LU8DKA, OA4JR, OA8V, TG7AV, VP2GBC, VP8JD, VS6BE, VS6FZ, VU2BK, W7MX, WA7CDM, WA7EVO, YN4WD, ZL1ABO, ZL1JN, ZP5JB, 6O1GB, 9X5GC.

S. Herod (Suffolk), Two commercial sets, one as a b.f.o. On 21 Mc/s s.s.b.—CEØAE, CN8FV, CR6IA, CR7FG, FL8HM, HI8XBA, HR1KAS, JA1BZ, JA2JAA, JA3FSN, JA4COS, JA5CEU, JAØBQF, K7NEQ, K3USL/AM (23,000ft. up off Sardinia), KG6AAY, OD5CN, VS9MB, W7LVI, ZE6JL, ZL2JSC, ZL1PZ, 5Z4IW, 7Q7EC, 9Q5AF, 9U5CM.

R. Dinning (Scotland), HA350, Joystick, logged—CR4CB, DU1FC, DU1FB, HI1MN, KL7SAY, KZ5WL, LU1DAB, JAØPE, VK1GD, VK2AGW, VK3AMK, VK6ALY, VQ9CT, YA1HD, YS1JSL, ZL1IH, ZS6BFY, 9H1R. All 21Mc/s s.s.b.

L. Bousher (Wales), R1155, 50ft. end fed raised these on phone on twenty—CE6EQ, EL3C, HI8LAL, HC6GM, HK3AUE, HK4AZX, JA1P1B, KP4AKB, KZ5NH, KZ5RJ, OA3CL, OX4AA, OY1WP, PX1NV, PY1CLI, PY7GV, PZ1BW, TG9AD, UP2NV, VE3BZU, VK4PU, VO1HQ, VP8JB, YS1RCP, YV5BE, ZE1CGF, ZS9H, 3A2DW, 5Z4IW, 6Y5GG, 8R1S, 9G1BS, 9Y4VT.

J. Edwards (S.E.20), SX24, 80ft. long wire switched in the b.f.o. for these on s.s.b.—CR4BC, EP2BQ, ET3USA, HI8XMY, HK3AUE, JT1BB, KP4AKB, LU8DDI, PY1TX, TI2ALG, UG6AW, VK2AVG, VK7RX, VP8HZ, VP8IU.

P. Leybourne (Glos.), HRO, 60ft. end fed listened from 0500 to 0700 and heard—EP9EP, HB9AA, HP1JC, KP4AST, PY2SO, VE3EWY, VK2WD, VO1FB, WB2RRR, W6ZKM, W9TFU, YV1EL, ZL1AIX, ZL2AAG, ZL2ANR, ZL2AZZ, ZL4GH, ZL4KL, ZL5KL, ZM7WMM.

CONTESTS

Many a tear will be shed in the Christmas pud this month. Only one contest in my diary—3rd December 70Mc/s c.w. contest.

Very best wishes for Christmas and the New Year to all r.f. lovers. Don't forget all those wonderful nets that go on on Christmas Day morning. CUAGN in 1968.

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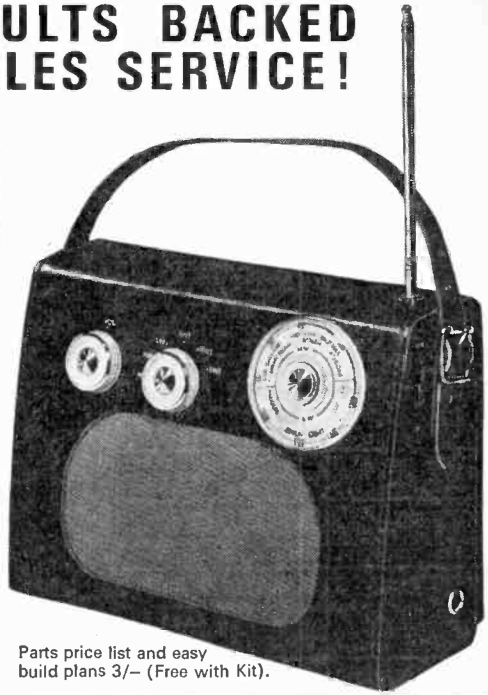

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- Air spaced ganged tuning condenser.
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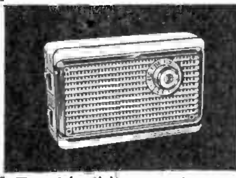
Total building costs **£5.19.6** P. & P. 5/6

Parts price list and easy build plans 3/– (Free with Kit).

TRANSONA FIVE

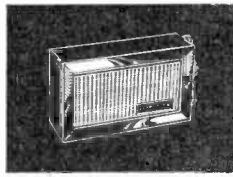


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive case with red speaker grille. Size 6¼ x 4¼ x 1¼in. Fully tunable. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone super dynamic 3in. speaker, all first grade components. Easy build plans and parts price list 1/6. (FREE with kit).

Total building costs **42/6** P. & P. 3/6

POCKET FIVE



MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive black and gold case. Size 5½ x 1½ x 3½in. Fully tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone 2½in. moving coil speaker etc. Easy build plans and parts price list. 1/6 (FREE with kit).

POCKET FIVE Medium and Long Wave version with miniature speaker ONLY 29/6. P. & P. 3/6.

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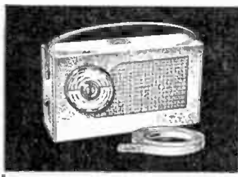
MELODY SIX

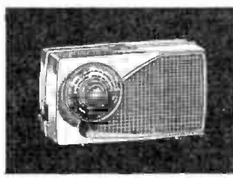


TWO WAVEBAND PORTABLE WITH 3in. SPEAKER

Handsome leather-look case size 6¾ x 3¾ x 1¾in. with gilt trim and hand and shoulder straps. Fully tunable over both Medium and Long waves. Incorporates pre-tagged circuit board, 8 stages—6 transistors and 2 diodes, ferrite rod aerial, push-pull output, wave change slide switch, tuning condenser, volume control, 3in. moving coil speaker etc. Easy build plans and parts price list 2/-. (FREE with kit).

Total building costs **59/6** P. & P. 3/6

MELODY MAKER 6

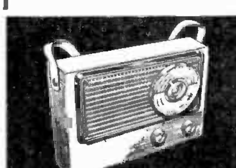


THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Smart pocket size case, 6½ x 3¾ x 1½in. with gilt fittings. Fully tunable over both Medium and Long Waves with extra M.W. band for easier tuning of Luxembourg, etc. 8 stages—6 transistors and 2 diodes, top grade 3in. speaker, 2 R.F. stages for extra boost, high "Q" ferrite rod aerial. Easy build plans and parts price list 2/- (FREE with kit).

Total building costs **69/6** P. & P. 3/6

ROAMER SIX

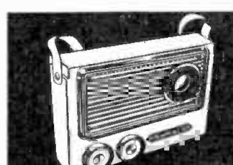


SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings, size 7½ x 5¼ x 1½in. World wide reception. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. All top grade components, 8 stages—6 transistors and 2 diodes including Philco Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra.) Easy build plans and parts price list 2/- (FREE with kit).

Total building costs **79/6** P. & P. 3/6

SUPER SEVEN



THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case size 7½ x 5¼ x 1½in. with gilt fittings and carrying strap. The ideal radio for home, car or outdoors. Covers Medium and Long Waves and Trawler Band. Special circuit incorporating 2 R.F. Stages, push pull output, ferrite rod aerial, 7 transistors and 2 diodes, 3in. speaker (will drive larger speaker) and all first grade components. Easy build plans and parts. Price list 2/- (FREE with kit).

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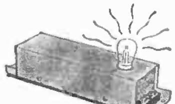

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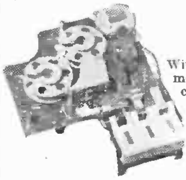

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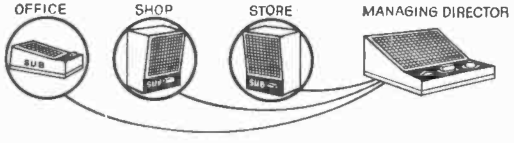
With Capstan control. This unit is extremely well made and measures approx. 6 x 5 x 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5 volts. Supplied complete with 2 spools ready to install. Record, Replay head is the sensitive M4 type intended for use with transistor amplifier. Price £4.15.0. Post and insurance 4/6.

INTERCOM BARGAIN



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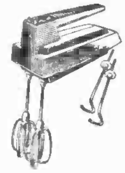

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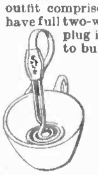

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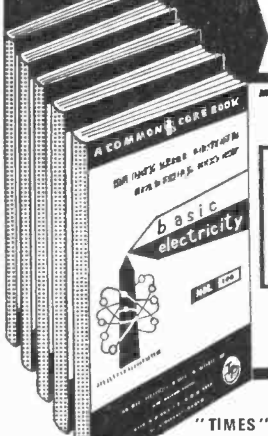

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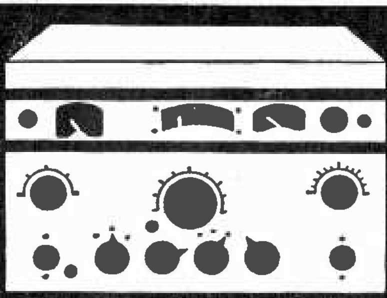


GUIDE TO SURPLUS COMMUNICATIONS RECEIVERS

K. ADKINS

PART 6

The R1155

The R1155 has always been popular. It was first manufactured for the R.A.F. in large numbers during the last war, and was used by Bomber Command. There are several versions but as the differences are minor they will all be dealt with in this section. The frequency range of the R1155 and R1155B (the most common versions) is as follows:—

18·15—7·5Mc/s; 7·5—3·0Mc/s; 1,500—600kc/s; 500—200kc/s; 200—75kc/s.

The R1155L and the R1155N versions have the following frequency range:—

18·0—7·5Mc/s; 7·5—3·0Mc/s; 3·0—1·5Mc/s; 1,500—600kc/s; 500—200kc/s.

The i.f. is 560kc/s.

The circuitry includes an r.f. stage, two i.f. stages, a b.f.o., noise limiter, and a visual tuning indicator of the magic eye type. In its unmodified form, output is for headphones. The R1155 has a very large and distinctive tuning dial. In addition, the R1155B version has a superb high reduction tuning drive. This tuning drive is available separately, and can be fitted to the other versions.

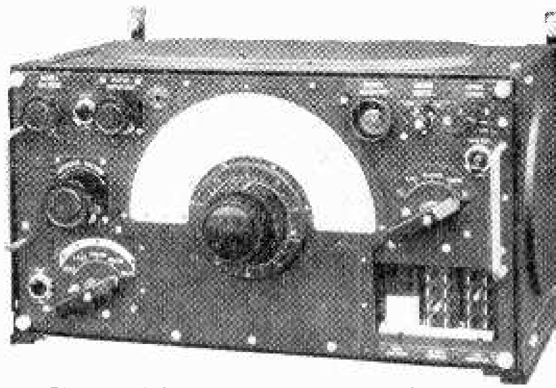
The b.f.o. control is pre-set. This arrangement is quite suitable for c.w., but not quite so convenient for s.s.b.

The R1155 requires an external power unit. Output for headphones, and power input, are all provided for by one Jones socket, located on the front panel. A commercially manufactured power unit/output stage, inclusive of speaker, has been available. This unit will connect with the Jones socket thus enabling the R1155 to be used without modification.

In its original form, the R1155 was fitted with a direction finding device. This is of no use to the amateur, however.

Modifications: Although the magic eye tuning indicator is quite suitable for the accurate tuning in of signals, an "S" meter would be required for the accurate comparison of signals. In spite of the availability of a commercial power unit/output stage unit, many users prefer to modify the R1155 itself, and build a power supply and output stage into the set. There is room for this, if the unwanted D/F components are removed. For s.s.b. use, a fully tunable b.f.o. would be required, and this can be achieved simply by replacing the pre-set component by one with a longer spindle. Another possible modification is the stabilisation of the oscillator supply.

Availability: Quite a large number of R1155's were available before the period covered in this report. A large number of the R1155B version were available in grade 2 condition between mid-1960 and mid-1961, and sold for prices ranging between £8 and £10. The commercial mains power supply/output stage unit, mentioned earlier, was available for £6 10s. Handbooks were not available, but a booklet of technical information was supplied.



Photograph by courtesy of The Marconi Company

Following the R1155B's, a number of R1155L's, or R1155N's (with the 1·5 to 3Mc/s band) in grade 2 condition were available in mid-1961. They were only on sale for a month or two, at £12 19s. 6d., power/output units extra.

No R1155's were released during 1962, 1963 and 1964. In mid-1965, however, a very small number of R1155B's in grade 2 condition were sold for £6 19s. 6d. They are no longer available.

During 1960/61/62, the high reduction tuning drive, (fitted to the "B" version), was in plentiful supply for fitting to the other versions.

Although at the present time the R1155 is not available on the surplus market, and is unlikely to be in the future, they can be quite easily obtained on the secondhand market. Prices are from £10 downwards, and most of them have been modified in various ways.

R1155 manuals are believed to be unobtainable, although a commercially produced booklet, containing technical information is available.

The R1475

Designed by Marconi for the R.A.F., this is generally considered to be the receiver that replaced the R1155, although the authenticity cannot be established. The R1475 certainly has a very fine performance, and is highly stable.

The receiver covers from 2 to 20Mc/s in four bands. The i.f. is 600kc/s. The R1475 has 11 valves as follows:—3 6K7, 1 6K8, 1 6J5, 3 6Q7, 1 6H6, 1 Y63 tuning indicator and a VR150-30 voltage regulator. The circuit includes one r.f. stage and two i.f. stages, a 600kc/s crystal reference oscillator and a crystal controlled b.f.o. A voltage stabiliser is also incorporated. Other features include four-position selectivity with audio filters for c.w. reception; fast and slow a.g.c., and high and low noise suppression. Receiver sensitivity is of the order of 1 microvolt.

The tuning dial, which is of rather unusual design, is accurately calibrated and provides very adequate mechanical bandspread. The dial can be reset against the 600kc/s oscillator by means of a special panel trimmer control.

A unique feature is that it is able to receive on two entirely independent frequencies simultaneously. This feature is provided by means of a plug-in unit with an additional mixer, allowing the R1475 to receive on a guard channel in the range of 2 to 4Mc/s or 4 to 7·5Mc/s.

The R1475 requires an external power supply, and the unit which is normally associated with this receiver is the power pack type 360, which will operate from 200 to 250V a.c. or 12V d.c. The size is 16½in. x 9in. x 11in. and the power pack is 8in. x 9in. x 11in.

Modifications: Modification is hardly necessary, but for the serious user, an "S" meter might be considered more convenient than the tuning indicator that is fitted. It would be possible to replace the front-end valves with miniatures, but this is rather a drastic measure, and might not effect a great improvement.

Availability: A very few of these receivers came on the market in 1961. They were in grade 2 condition and were priced at £12 to £14, with power unit. A few grade 3 specimens were also available at a much lower price.

However, last year another batch arrived on the market, in varying conditions, the price ranging from £10 to £15. Some of these were in grade 3 condition. Power supplies were not available. The receivers were available over a reasonable period of time, and so it should not be too difficult to obtain one secondhand if they are no longer available from surplus dealers.

Information on the R1475 is very difficult to obtain, as it is a relatively scarce receiver. Manuals are not available.

The TCS

This was made by Collins of the USA and it is deservedly popular. It is an exceptionally stable receiver, covering from 1·5 to 12Mc/s. It has seven valves, as follows:—1 12SA7, 1 12SQ7, 2 12A6, and 3 12SK7. The circuit includes one r.f. stage and a separate local oscillator. The i.f. is 460kc/s.

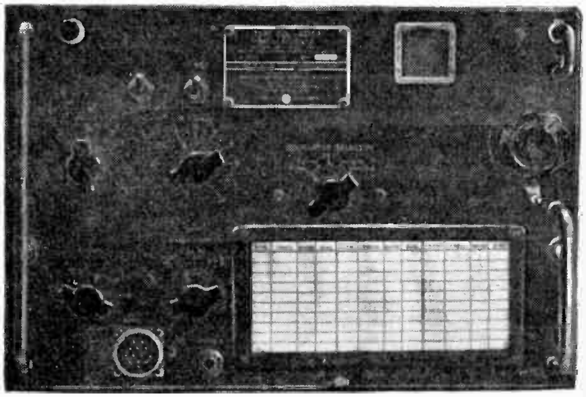
The TCS was originally designed for operation with a matching transmitter, but will operate entirely satisfactorily as an independent unit.

It has a vernier tuning system, fitted with anti-backlash gears. Other panel controls are r.f. gain, a.f. gain, b.f.o. control, bandswitch, power switch, and a crystal local oscillator switch. The last control provides for reception on a crystal controlled frequency. In addition an output jack for 600-ohm phones is provided. It does not have an internal power supply, and requires 250V d.c. at 80mA and 12V a.c. at 1·25 amps.

Modifications: Although the TCS is exceptionally stable, making it eminently suitable for s.s.b. reception, the two main criticisms are the wide bandwidth and inadequate bandspread. The tuning drive can easily be modified by fitting an epicyclic drive; this will provide good mechanical bandspread. A Q-multiplier will improve the selectivity.

The r.f. gain controls both the r.f. and the i.f. stages. The provision of a separate r.f. gain control would doubtless improve the performance. Also, it is considered desirable to replace the 12A6 output and the 12A6 local oscillator with 12J5 valves. (These are a direct replacement.) This will give a more comfortable output for headphones and will reduce the output to the mixer which is considered to be excessive. By carrying out this modification, the h.t. current will be reduced by as much as 25mA.

Availability: Unfortunately, the TCS has not been widely available in this country. It is almost certain that some were released prior to 1960, however. The one and only release in the period covered by



Photograph by courtesy of R.T & I Electronics Ltd.

this report occurred in the summer of 1960. A number were released in grade 2 condition, at prices between £8 and £11. Power units were also available for about £4. It is believed that the sale of receivers from this release continued until late 1961 or early 1962. A few grade 3 specimens were available for a correspondingly lower price.

As this receiver is rather popular, and was probably released in larger numbers in the United States, it should be easy to obtain a manual.

The No 52 Set

The 52 set is a Canadian receiver, and was manufactured by Marconi in large quantities. It was intended for operation in conjunction with a matching transmitter, but it is completely self-contained as a receiver. The frequency range is from 1·75 to 16Mc/s in three bands, as follows:—

1·75—4Mc/s; 3·5—8Mc/s; 7—16Mc/s.

The receiver contains 10 valves, and has the following stages:—r.f., mixer, separate oscillator, two

i.f.'s, detector/a.g.c., first audio, output and b.f.o. There is also a three-valve crystal calibrator to provide marker check points at 10/100/1,000kc/s intervals. The set contains a valve check voltmeter which can also be used as an "S" meter.

Panel controls are r.f. gain, a.f. gain, noise limiter, b.f.o. switch, heterodyne pitch control and wide or narrow bandwidth switch. Also, fast and slow tuning controls with additional oscillator control for fine adjustment. Other features include manual or automatic volume control on both c.w. and r.t., and there is also a c.w. filter. The set contains an internal 3in. loudspeaker, and the whole receiver is housed in a steel carrying case, size 15in. x 12in. x 15in.

An external power unit is required for the 52 set, and must supply 12V and 160V h.t. Suitable power units are available which operate from 115/230V a.c. or 12V d.c.

Modifications: The 52 set does not require modification for satisfactory operation. One drawback to this receiver is the lack of bandspread on the 14Mc/s amateur band, and modification details have appeared for this in the amateur radio press.

Availability: It first became available in small quantities in 1960 in grade 2 condition, for £12, power unit £3 extra. Early in 1961, they became more widely available, and the price was reduced to £9, plus £3 for the power unit. They had all been sold, however, by the end of 1961.

In late 1962, more of them were released in grade 2 condition, and sold for prices between £5 and £8, or for £9 10s. with power unit. These were quickly sold. Also, at this time, a few in grade 3 condition were available, and sold for £2 10s.

In late 1963, grade 2 receivers were available for £7, without case or power unit; and then a quantity of grade 1 52 sets, self-contained with power units, were available at £13 to £14. These latter were quickly sold out by the end of 1963. Some receivers in grade 2 condition were also sold for various prices at the same time. None were available in 1964.

During 1965, a quantity of the complete 52 set installation, comprising receiver, transmitter and power unit, came on the surplus market, and a few receivers were available separately for £10 without the power unit. There should be no difficulty in obtaining a 52 set on the secondhand market, owing to the large number released over the last five or six years.

The 52 set receiver handbook is difficult to obtain, although circuit diagrams were supplied with the receiver in some cases.

END OF SERIES

? YOUR QUESTIONS ANSWERED ?

SCRATCH FILTER

Could you give me any information about a scratch-filter for a record player? I believe there was a simple one published a few years ago in *Practical Wireless* but I have been unable to trace it.—E. Robins (Newport, Monmouthshire).

It is not easy to add scratch-filters to existing record-playing equipment. However, you could try connecting a 50pF or 100pF mica capacitor from each grid to chassis, and from each anode to chassis. The combined effect of these capacitors should reduce the high-frequency response.

If you want comprehensive control of tone, rumble, and hiss, you need a full-scale pre-amp. One such is described in the Mullard publication *Mullard Circuits for Audio Amplifiers.*

LOG OR LINEAR?

Can you please tell me how and why we use log and linear potentiometers in circuits? I cannot find a rule which tells when and where to use these components.—F. Hardy (Hull, E. Yorkshire).

The type of potentiometer used in a circuit depends largely on whether or not the circuit handles audio frequencies. The human ear has what is termed a logarithmic response to sound volume. This means that, for instance, if an amplifier rated at 5W were fully driven, and then compared with a 10W amplifier fully driven with the same signal, then the second volume level would not sound anywhere near twice as loud as the first, even though the output power had been doubled. Thus, in audio gain-control circuits, log pots. are employed so that equal increments of rotation of the pots. result in equal increases in loudness.

If linear pots. were used, then to double a given volume level, and then double it again, the two increments in rotation of the control would be far different. You will find more on this subject in books in your local library.

I WANT TO LEARN

At the moment I know nothing about TV, radio, signs, terms, etc. and would like to learn, especially how to read wiring diagrams. Can you suggest any books which may help me?—M. Sabre (Wellington, Somerset).

Our book entitled *Beginner's Guide to Radio* would be of interest to you. We also publish a Keybook entitled *More Simple Radio Circuits* which contains a number of designs suitable for the beginner. We recommend that you start constructing units as soon as possible in order to gain experience. If you look through recent issues of P.W. you will find a number of simple designs and we suggest you select one which interests you and which you feel capable of constructing.

REPLACEMENT AUTO-TRANSFORMER

I have been using an auto-transformer to drop the local voltage down from 220 volts to 110 volts in order to use a soldering iron of 110 volts 75 Watts. Unfortunately the auto-transformer has burned out so I am writing to inquire if some other means can be employed to do this, such as a resistor to drop voltage, before purchasing another auto-transformer. —J. Macfarlane (Sunderland, Co. Durham).

It would not really be a good idea to use a dropping-resistor instead of your auto-transformer to power your 75W soldering iron. If you were to use a resistor, then it would have to dissipate 75W in order to drop the voltage to the correct amount. We recommend that you obtain another auto-transformer for your iron. Such transformers are available from a number of our advertisers.

LETTERS...

Radio One v Radio Caroline

In a recent poll on the merits of "Radio 1" in our class, the results were as follows:

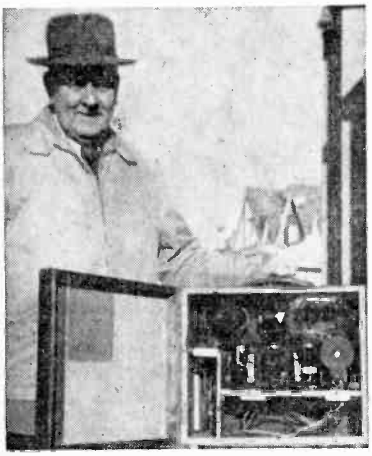
Two pupils admitted they didn't like either station. Another two pupils said they liked Radio Caroline and Radio One, but Radio One lacked something. And *twenty-five* pupils said Radio Caroline was great and Radio One was a flop.—**K. Howes, 3T** *(The Latymer School, Edmonton, N.9).*

An early portable

As a reader of P.W. since No. 1 and having read and gained very much valuable information and advice from it over the years, I thought perhaps the construction for Christmas 1925 of a portable radio, may be of interest to readers.

This early set was of the I.H.F. Detector, and two L.F. Stages with 2V P.M. class valves. The frame aerial was mounted in the lid of the case and could be swung over 180 deg. for the best reception. Provision was also made for the connection of external aerial and earth. A two-pin non-reversible plug for extension speaker (2kΩ) was fitted on the front control panel.

The weight of the l.t. grid and h.t. batteries was approximately 28 lb. This just goes to show the progress of radio in 40 years.—**F. F. Towndraw** *(Newquay, Cornwall).*



Mr. Towndraw with his early portable receiver.

Radio alarm

I was interested to read in the August issue of P.W. *re* Patrick Highams "Radio Alarm".

It is some 30 years ago when I used to experiment with clocks for switching on and off of radios etc. You may be interested to know of my first one which was a chain driven clock and by fixing an ordinary switch to the wall in direct line with the trailing end of the chain and soldering a small hook to the knob it acted very effectively as an automatic switch. It was noted the speed of the chain was exactly 8 links per hour, therefore it was possible to divide the time by 8 and measure off the number of links for any given time; to my surprise the chain was always thrown clear and never prevented the clock from still carrying on.

Later on I progressed further and made one which would put the radio on and off 8 times in the 12 hours, and in addition to this it could be pre-selected to also change from one station to another. One could go to bed listening to dance music on the "Light" until a set time and be awakened at 7 a.m. by the "Home News". It of course needed some planning when setting up for a full day's programme but once set it did the job and amused many of my visitors and friends.

Today I have a surplus to requirements cooker electric clock which switches my f.m. set on and off at pre-set times, and in addition the outlet socket can also be used for other purposes, electric fire, tape recorder, etc.

Still on the subject of clocks, some years ago I had what I thought was a good idea but it was turned down by a British firm as costing too much to make. When an electric clock fails due to a power failure, my idea was to bring into operation an ordinary movement automatically, to keep the clock on time, and when the power of the mains was again restored the spring-driven clock mechanism was automatically stopped until another failure presented itself.

Some of my Swiss friends inform me a similar clock was tried out in Switzerland about 1938 but never came to anything due to the extra costs.

However, all our little ideas and whims seem very much outdated in this modern World of Electronics.

Anyhow, I was pleased to hear of Mr. Higham's idea, and seems he was thinking on the same lines as myself.—**H. S. Barker** *(Lancashire).*

How's this for a shack?

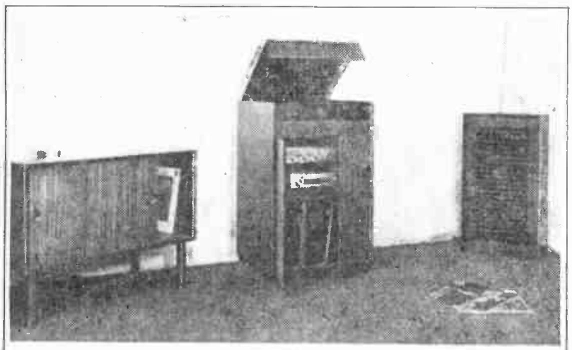
Mr. Rowlinson's wireless cabin on board the S.S. City of Winchester.

I felt that you might like to publish this photograph of my wireless cabin on S.S. *City of Winchester* during the time I served on the ship, 1923-4, in the frozen meat trade on the New Zealand—UK run.

The transmitter was a ½kW job made by Marconi. In the picture, the old Jigger transformer and ATI with plugs to tap windings can be seen.

Also, one can see the Emergency Transmitting Set comprising a 10in. induction coil, and the rotary converter starter and field regulator.

Of chief interest perhaps, is the 31A crystal receiver and the then brand-new one valve amplifier for use with crystal receiver. Also the old sliding ATI for reception of Poldhu, Eiffel Tower and long waves around 2,000 metres.—**L. Rowlinson** *(Farnham Common, Buckinghamshire).*



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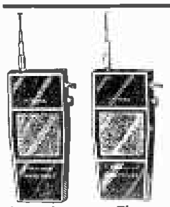

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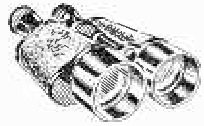

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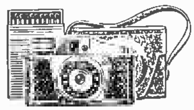

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AF115	6/-	GET103	4/6	OAZ206	8/6	OC140	9/6
AF116	6/6	GET113	5/-	OAZ207	9/6	OC141	12/6
AF117	5/-	GET114	4/-	OAZ208	6/6	OC169	5/-
AF118	10/-	GET115	9/-	OAZ209	6/6	OC170	5/-
AF124	7/6	GET116	8/6	OAZ210	6/6	OC171	6/-
AF125	6/6	GET872	6/-	OAZ211	6/6	OC200	7/6
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AF239	12/6	NKT121	8/8	OC19	7/6	OC206	17/6
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AFZ11	17/-	NKT212	5/-	OC22	10/-	ORP12	12/6
AFZ12	10/-	NKT216	7/6	OC23	12/6		
ASY26	6/6	NKT218	6/-	OC24	15/-		
ASY28	6/6	NKT227	5/6	OC25	7/6		
ASY83	5/-	NKT274	5/-	OC26	6/-		
ASY86	6/6	NKT278	5/-	OC28	12/6		
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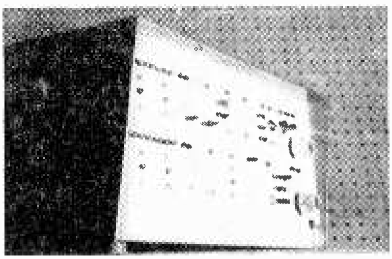

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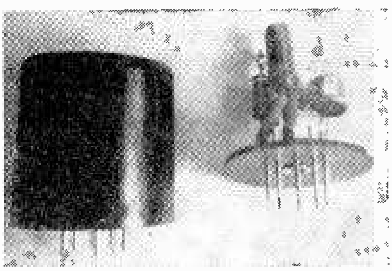

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intermittent fault locator

F. C. PALMER

IT has been said that necessity is the mother of invention. It was certainly necessity which caused the writer to build the following instrument.

To explain how this came about is quite simple. The writer was engaged in repairing and servicing car radios, and, as a result of the vibration to which car radios are subjected a number of intermittent faults were encountered which to say the least were extremely irritating. The next question after deciding that such an instrument was necessary was the manner in which this was to be achieved?

The ideal instrument would be one in which the fault showed itself to be in some particular stage of the receiver. So far so good, but it was also necessary to decide which fault to locate on the instrument.

If one were to consider a voltage fault, then a number of voltmeters would be needed, each connected (a) to the anode or screen of the valves—in the case of valve car radios, or (b) to the collectors of each transistor—when servicing transistor car radios. However, such an arrangement would not locate an open inter-stage capacitor either r.f. or a.f., since such faults would hardly cause any indication on the voltmeters.

An oscilloscope is most useful in receiver servicing, but like other such instruments, may only be connected to one spot at a time. Hence, with such and instrument, luck would play an important part in having it connected to the faulty stage when the fault developed, and in servicing one does not have stores of luck in the same way as parts.

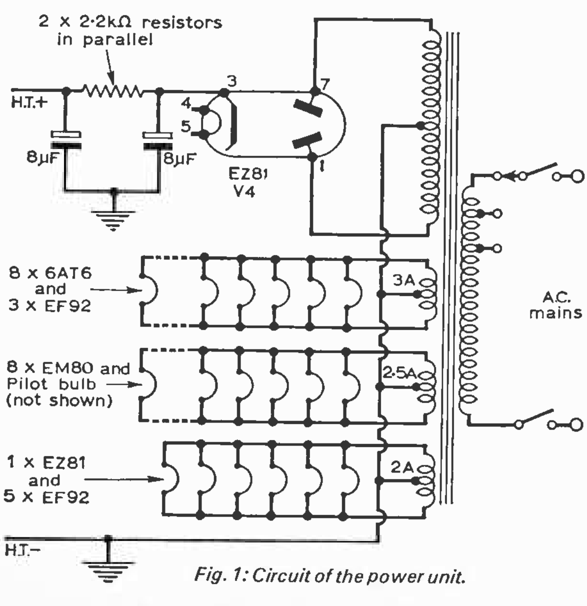


Fig. 1: Circuit of the power unit.

What was left? The answer to that was the actual signal passing through the various stages of the receiver, could something be carried out on those lines? It certainly cold, and what was more, the advantage of the oscilloscope and the voltmeter was employed to give further assistance. Therefore, it was reasoned that a signal indication was of far greater value when considering intermittent faults, however such faults occurred.

It was decided to employ eight magic eyes to provide the means of visual indication of the presence, or absence of a signal, eight r.f. amplifier valves, and eight diode detectors together with a rectifier valve meant 25 valves. This, of course, resulted in another problem, that of providing sufficient h.t. and most important, heater voltage and current.

The valves employed were, eight magic eyes EM80; eight r.f. valves EF92; eight detectors 6AT6; rectifier valve EZ81.

A mains transformer was obtained with the following secondaries, H.T. 350—0—350 at 150mA; L.T.1 6·3 volts 2·5 amps c.t.; L.T.2 6·3 volts 3 amps c.t.; Rec. 6·3 volts 2 amps; Primary, 200—250 volts.

The heaters of the valves were connected in the manner shown in Fig. 1. Despite the advantage of transistors in the reduction of size when such an instrument is considered, the writer was of the opinion that, since most of the intermittent faults were on transistor receivers, he did not require the instrument to suffer in the same way with intermittent faults! Thus the plan to employ valves for those reasons was firmly decided at the start. Hence we have an instrument which has eight inputs, each having an EF92, a 6AT6, and an EM80 indicator, and may therefore be connected to eight points of a receiver providing visual indication of, or the absence of, signal at various parts in a receiver. The next step is to work a circuit around these valves and to incorporate such features as voltage readings, and also oscilloscope graphs at the eight points of connection.

The Circuit

The circuit is shown in Fig. 2, with the exception that only one single stage is given, this being for clearness, and will be quite sufficient for the general function of the instrument to be seen. The other seven stages are exactly the same in all respects.

It will be seen from examination of Fig. 2, that

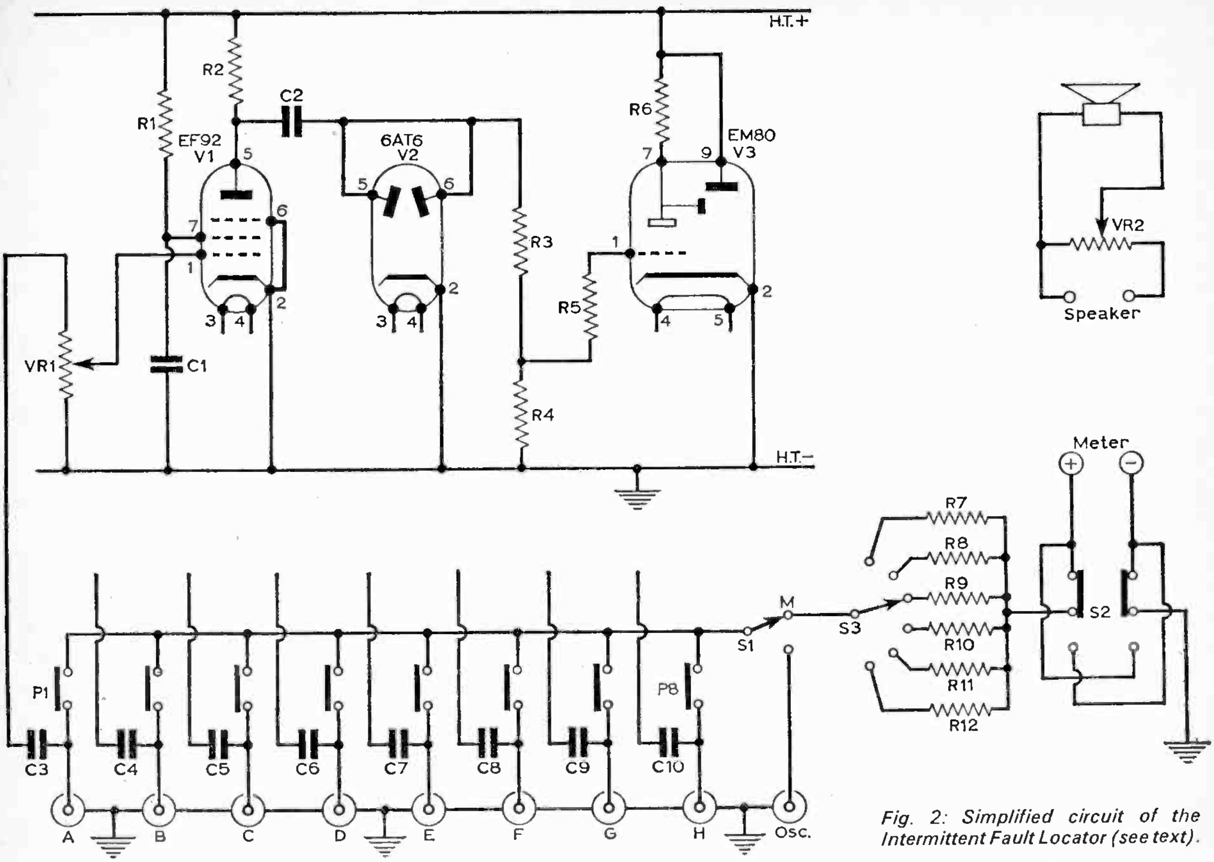


Fig. 2: Simplified circuit of the Intermittent Fault Locator (see text).

the input to the instrument is via the coaxial sockets, and in our own particular case to socket A. It is then fed to the volume control VR1 via the isolating capacitor C3, this capacitor being most necessary when connecting to the anode of valve receivers.

The control VR1 also plays an important part, since as the instrument is connected to the various stages of the receiver, the gain or signal strength is much greater. This would result in overloading of the target, thus making visual indication of the signal difficult, if not impossible. Hence the purpose of VR1 is to limit the signal fed to V1, and in consequence, to V3.

As the signal reaches the grid of V3, the area of the target fluorescent portion increases—in this instance green—and in the absence of a signal, a shadow results. This action is, of course, different to some indicators, where the reverse takes place, i.e., the signal causes the shadow on the target to become small.

The values of the components will be given at the end of this article, in particular, it is important to note that R3 and R4, must be equal in value, in order for maximum signal gain to the grid section of V3.

Voltage Test

So that voltage checks may be carried out, eight "press to test" switches are provided, contact being made when the switches are pressed, and contact is automatically broken when the hand or finger is removed from the button. A d.p.d.t. S1 switch is also provided to enable oscillograph readings to be obtained. This switch is actually a d.p.d.t. connected to act as a s.p.d.t. as shown in the diagram.

This provision will be found very useful in the early stages of transistor receivers, where the signal gain is not very great. However, with the system of the press button, the oscilloscope, or the voltmeter may be quickly connected to eight points in the receiver, and in particular, to the stage where the magic eye has indicated that a fault exists.

With reference to the voltage test which may be carried out on the instrument, it is most essential that the meter used should be of good quality. Therefore, anything less than 20,000 ohms/volt should not be used, this requirement being for transistor receivers where the total voltage supply is extremely low, and from which the meter must draw its own supply to operate its movement, all of which can lead to errors in measurement.

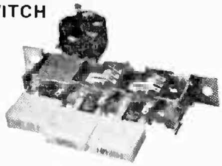
Voltmeter Range

With reference to Fig. 2, it will be seen that S3 is the voltage range switch, this allows voltage checks from 3 to 600 volts to be carried out.

With regard to transistor receivers it is essential that the low voltage ranges have accurate resistance values, to avoid serious errors in measurement. This means that the resistance of the meter *must* be at all times taken into account, even on the low range of 3 volts, a meter movement of 2,500 ohms can introduce an error of 4% at f.s.d. if its resistance is left out of the calculations.

The voltage ranges considered useful by the writer are, 0—3V, 0—15V, 0—30V, 0—100V, 0—300V, and 0—600V. The first three voltage ranges must be considered to be for transistor receivers, this of

3-PUSH SWITCH



for test meter, hi-fi amp., etc. 1st button operates mains on/off switch, the other two operate change-over switches. Knobs engraved On/Off, Bass, Treble, but engraving easily removed leaving clean surface for remarking. 2/9 each 24/- doz.

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Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA. (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers. Zener diode and instructions. Real snip at only 16/6, plus 3/6 postage.

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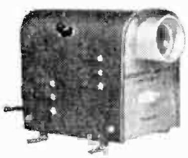
Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A.—15-20 w. 19/6. Kit B—30-40 w. 17/6. Kit C—80 w. 17/6. Kit D—125 w. 22/-. Kit E—65 w. 19/6. Kit MF1 is for 6in., 9in. and 12in. miniature tubes 19/6. Postage on Kts A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

PHOTO ELECTRIC CONTROL SYSTEM



Comprises a light source unit with optional Infra Red filter and lens system to focus the light. Also a photo-electric Relay control unit. Both are housed in metal cases for bench or wall mounting and there is a sensitivity control as well as mains on/off switch. The outfit works from 230/240 v. AC Mains. Can be used as a simple on/off switch by breaking the beam of light (invisible if Infra Red filter is used) and as such it will operate as a burglar alarm, or will open doors, etc. Also in conjunction with a counter or other equipment it will perform many functions in the factory or warehouse. Price £9.19.6 plus postage and insurance 8/-.

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50 OHM 50 WATT WIRE WOUND POT-METER 8/6 each.

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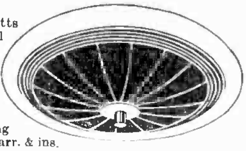

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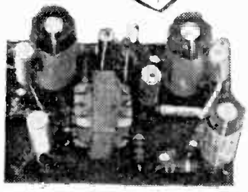

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed-back loops—sensitivity 5mV. Price 19/6. Post and insurance 2/6. Speakers, 3in. 12/6 5in. 13/6, 6 x 4in. 14/6.

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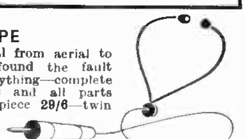

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault use it on Radio, TV, amplifier anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece 29/6—twin stetoset instead of earpiece 7/6 extra—post and ins. 2/9.

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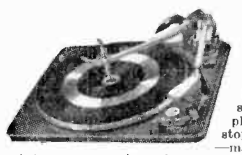

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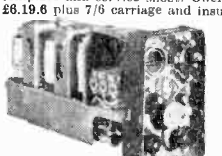

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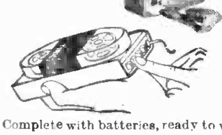

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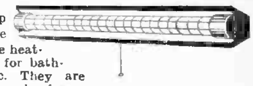

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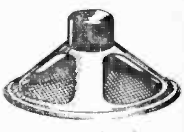

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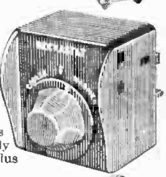

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Mini Immersion Heater. 350 w. 200/240 v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. 19/6. post and insurance 1/6.

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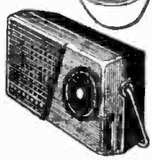

Lots of fun to build and good results when finished—complete kit with detailed instructions and crystal earpiece (batteries 1/2 extra). £5 value only 19/6 plus 3/- post and insurance.

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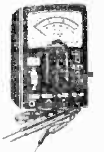

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26 yards length 70W. Self-regulating temperature control. 10/- post free.

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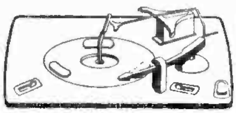

Made by Sanders Electronics. This provides extreme reliability under arduous conditions. Long battery life, compactness and lightness. Unit plate 10½ x 8¼in. Clearance above 3⅞in., below 2⅜in. Take Eight 7in. records, 33 or 45 r.p.m. Motor has governor giving consistent speed despite battery voltage drop. Wow ·4%, Flutter ·2%. Heavy Zinc Turntable gives Flywheel effect with improved reproduction. Pick up is the Acos GP 79/5 Ceramic Cartridge. Frequency response 50–8000 c/s. Output 250 mv. Tracking weight 9 grams. Automatic Trip complete with mounting hardware. Leads ready for connection. 59/6 each, carriage and insurance 7/6.

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

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course taking into consideration coach radio which require 24 volts. After the 30 volt range has been worked out, the meter resistance may be neglected, since an error of 4% means only an error of 4 volts in 100 volts.

The switch S2, allows the meter movement to have its leads reversed, this for transistor car radios, which may have the chassis either negative or positive polarity. It will also be seen that a speaker is provided with a balance control, so that the output stage is always loaded to avoid damage to the output transistor, and to reduce the signal should the phone ring. The receiver's volume control must always be at maximum in order that the magic eyes show the presence of the signal, any change in the volume control would give false indication not only to the magic eye display, but also to the oscilloscope, where perhaps, reference voltages have been used to set the Y amplifier to a certain gain which will prove of no use of the gain of the receiver is changed, or the input to the receiver from the signal generator.

Instrument Front Panel

Figure 3 shows the front panel of the instrument with all its main control positions cut out. The measurements here are very approximate, the volume controls and switches etc. should be of the midget type, or else difficulties will be met when it is desired to fix the front panel to the chassis.

The top row of holes are for the magic eye display, and it is essential that these coincide with the "windows" of the EM80, close working between the top chassis and the front instrument panel clearly being necessary.

The lower rows of holes must also "coincide" when drilling of the panel and chassis are undertaken.

These holes include those for the pilot lamp,

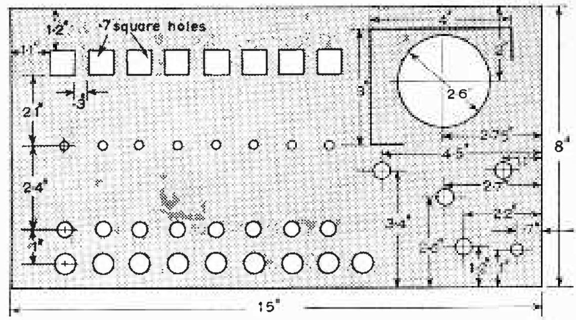


Fig. 3: Front panel of the instrument showing cut outs for the main controls etc.

on/off switch (d.p.s.t.), the polarity switch for the meter, the voltage range selector, and the switch for bringing in either the voltmeter or the oscilloscope.

Wiring Points

The leads to the valves such as V1 in Fig. 2, must be kept apart from each other, in no circumstances must they be made into a neat 8-core cable, for to do so would introduce capacity between them. This would result in a signal input to say point "A" Fig. 2, causing the other magic eyes to indicate the *same signal*, even if there is no other input to the coaxial sockets.

It has been previously stated that the press buttons were mounted very close to the coaxial sockets, the reason for this being again one of capacity effect. It will be seen that the lead from the centre of the coaxial socket up to the press button switch, is constantly present. That is to say, its capacity—with the other leads—are added to the receiver under test. It is, of course, necessary to reduce excess capacity, hence these connections must be kept very short. The press buttons are indicated in Fig. 2 by P1/P8.

In the general construction of the instrument, the heaters were wired first, different colour wiring being used for each section of valves, it is vital that these do not get mixed up!

The next stage is to wire the resistors to the magic eye display, completing one step at a time for instance, one would complete the anode connections of *all* the EM80 valves before they went on to the grid connections. In this way nothing is left to chance and so on with the other valves.

Perhaps the next step will be to describe the manner in which the instrument is employed to locate either (a) an intermittent fault, or (b) a fault which makes the receiver output low after it has been switched on for some time.

Take a typical five transistor car radio, including a germanium diode detector (D1).

We shall assume that we have

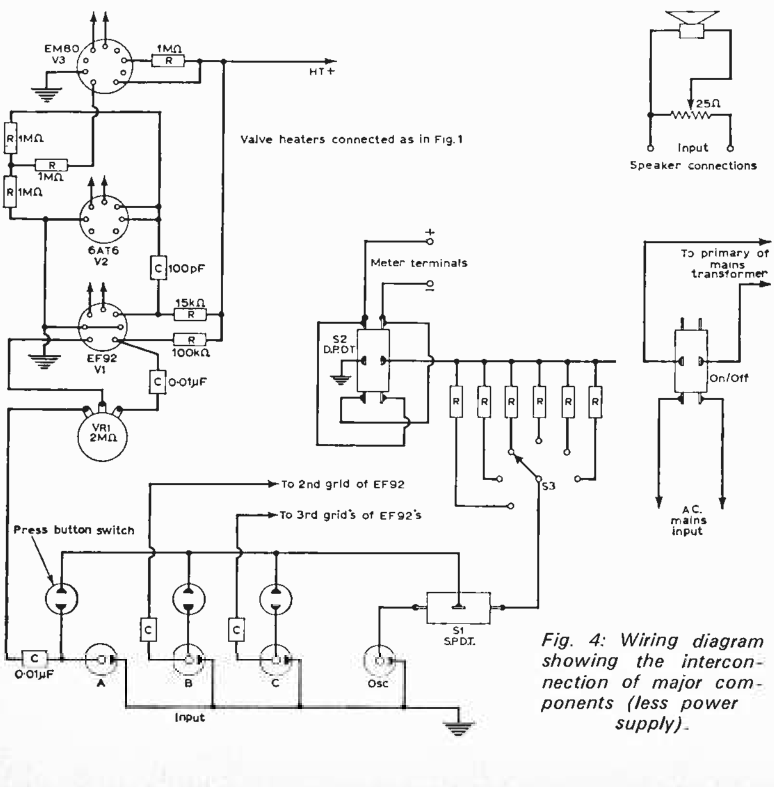


Fig. 4: Wiring diagram showing the interconnection of major components (less power supply).

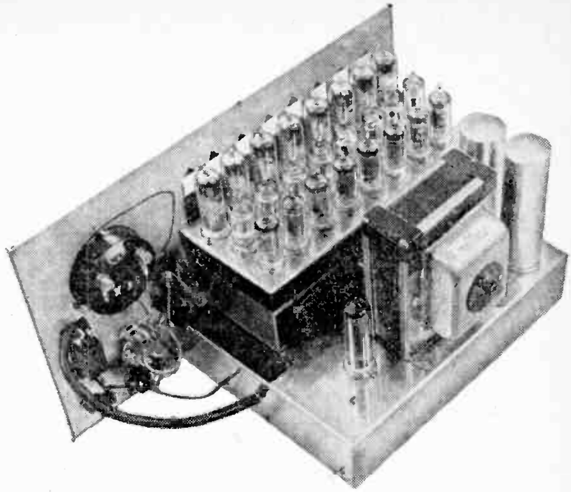
an intermittent fault, and to employ the instrument in its location, the socket "A" would be connected to the collector of Tr1 (frequency changer), socket "B" to the collector of Tr2 (st i.f. stage), socket "C" to the collector of Tr3 (2nd i.f. stage), socket "D" to the secondary of the 2nd i.f. transformer, socket "E" to the a.f. side of D1, socket "F" to the collector of Tr4 (1st audio stage), socket "G" to the base of Tr5 (output transistor—single ended), and socket "H" to Tr5 collector.

We may also obtain voltage readings at the various points so that we can check them, when the receiver cuts out, against those reading when the receiver was working, this would show up on the meter when the press buttons were operated.

In a like manner the oscilloscope, but before we may do this we shall require a signal input to the aerial socket, this being supplied from a signal generator. The car radio is tuned to this signal, and the aerial trimmer adjusted for maximum gain. It will, of course, be necessary to reduce the input to the coaxial sockets so as to prevent overloading of the "magic eye display", this being achieved by the volume controls under each of the windows. The gain of the receiver will become greater as we progress towards the output stage as expected.

As soon as we have a good indication of the signal on each of the magic eyes, the oscilloscope can be connected to each of the points and the various gains noted. This may be recorded, reference voltages from the front of the oscilloscope being used to measure the gain of the "Y" amplifier at any point. For instance, at the a.f. side of D1 the gain of the scope may be set to show 10 divisions on the graticule, for a reference voltage of 1 volt.

If the signal at this point is 0·3 volts, this would be equal to 3 divisions on the graticule; at other points in the circuit, the gain of the "Y" amplifier will be changed, but, if it is necessary to return to the a.f. side of D1, we only need to bring the trace up to



Internal view of the complete instrument.

10 divisions for a reference voltage of 1 volt switch in the scope to D1, where the gain should show 0·3 volt if all is in order.

Let us assume that the magic eye "D" reduced to a shadow instead of producing an area of green. If "C" shows that a signal is reaching the magic eye, then the secondary is o/c, or a capacitor o/c or even s/c.

On the other hand, if no signal is heard from the speaker, but the magic eyes up to "D" show that a signal is reaching those points, the scope should be connected to either "C" or "D", to see if the waveform is modulated, if not, this will point to the frequency changer stage being at fault.

Thus it is possible to locate the stage at fault, however, some faults cause the output to reduce after the receiver has been on for some time, this will be shown by the magic eyes after the stage at fault, to indicate a reduction in area of fluorescence. The fault being between the last good magic eye indication, and the first poor magic eye display.

It is also possible to use a probe for signal tracing, one amplifier stage of the instrument being used. The writer has used the instrument with good results in locating sources of intermittent faults, or the reduction of gain after the receiver has been on for some time.

It will be obvious to some readers that a single germanium diode could perform the function of V2. This is true, but the author had the valves and components to hand and to avoid extra expense these were used instead. ■

★ components list

R1	100kΩ	R4	1MΩ
R2	15kΩ	R5	1MΩ
R3	1MΩ	R6	1MΩ
VR1	2MΩ		

Meter resistances vary according to meter resistance.

All capacitors in Fig. 2 with the exception of C2 which is 100pF are 0·01μF. The balance control resistance for the speaker is 25 ohms.

The smoothing capacitors are 8μF at 600 volts working, the smoothing resistance two 2·2kΩ wirewound resistors in parallel.

REPLACEMENT RECTIFIERS

—continued from page 678

lease of life to a number of old sets for which replacement valve rectifiers have long since disappeared. Perhaps the oddest was replacement of the rectifier section of a 117L7 valve. This was a combined output valve and rectifier with 117V 0·09A heater from a pre-war American receiver. The heater was still intact but the rectifier cathode had collapsed. Substituting a diode unit left the output section functioning and restored the radio to a new lease of life. ■

SEE PAGES 2 AND 3 SINCLAIR ADS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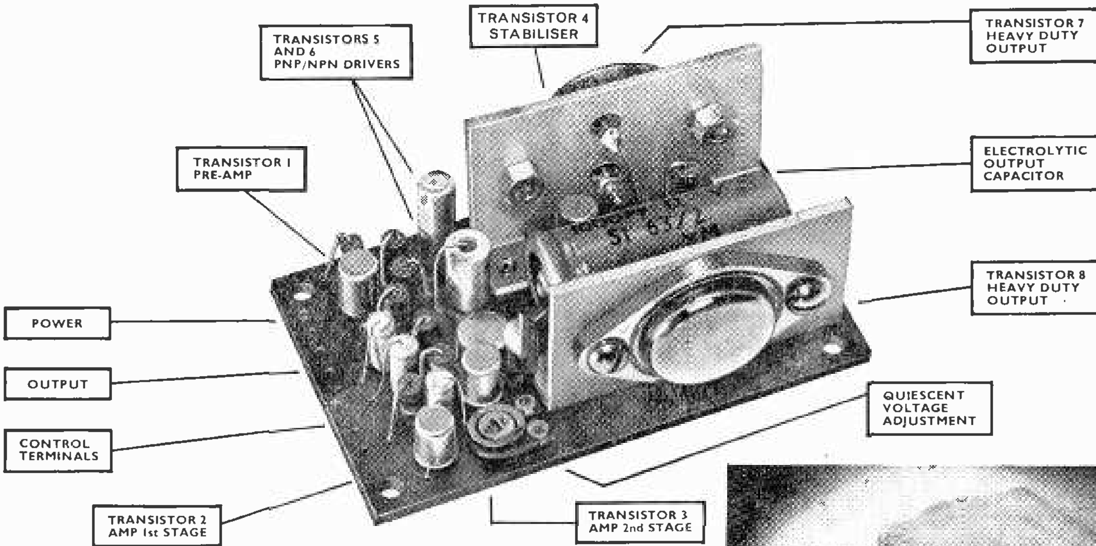

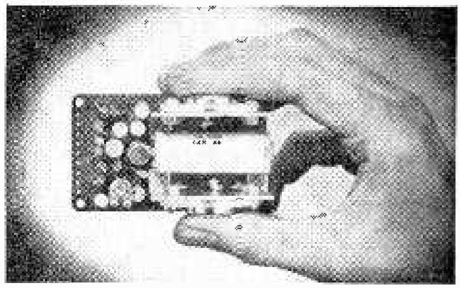

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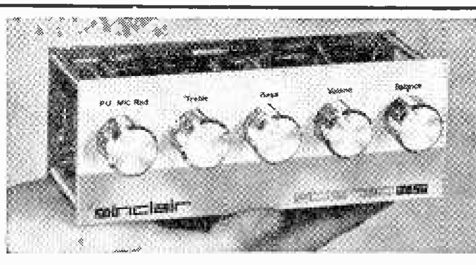

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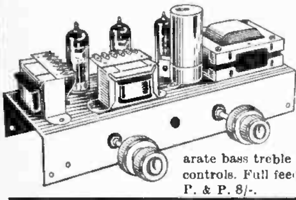

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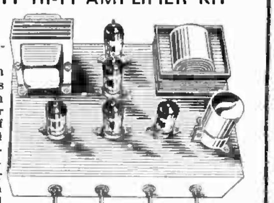

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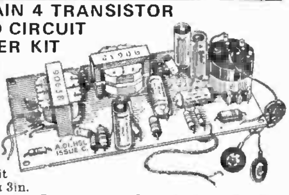

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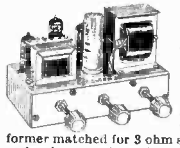

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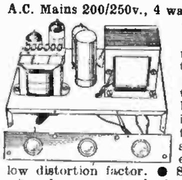

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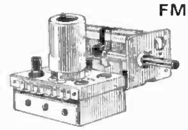

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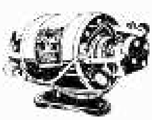

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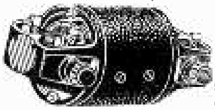

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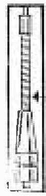

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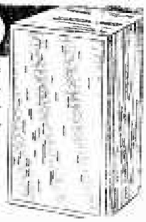

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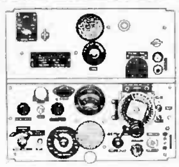

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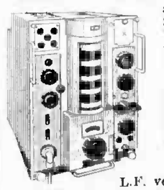

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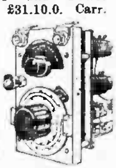

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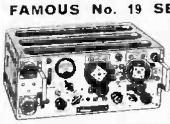

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12¼″	8⅞″	1	8	9	1	14	6	1	18	9
14¼″	3⅞″	1	0	6	1	5	0	1	7	3
14¼″	9⅞″	1	15	0	2	4	9	2	7	0
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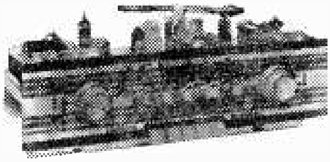

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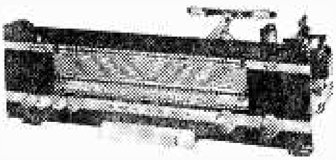

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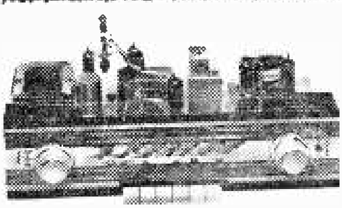

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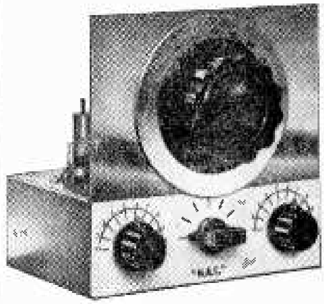

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10 watts 5% STUD MOUNTED (Stud + ve) DIODES Z4·7v., 5·1v., 5·6v., 6·2v., 6·8v., 7·5v., 8·2v., 9·1v., 11·0v., 12·0v.' 14·0v., 15·0v., 16·0v., 18·0v., 20·0v., 24·0v., 27·0v., 30·0v., 33·0v., 36·0v., 43·0v., 47·0v., all at 7/6.

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3/40, 400 p.i.v. 3 amp, stud mounted, Gate voltage 3·0v. at 20mA max.	7/6
BLUE SPOT, 200 p.i.v. 5amp, stud mounted. Gate voltage 3·25v. at 120mA max.	12/6
GREEN SPOT, 400 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max.	17/6

SILICON HALF-WAVE POWER RECTIFIERS

BY100, 700 p.i.v., 450mA., wire ended	7/-
BYZ10, 800 p.i.v. 6a.,	9/-
BYZ12, 400 p.i.v. at 6 a., stud mounted	5/-
BYZ13, 200 p.i.v., 6 amps., stud mounted	7/6
BYZ19, reversed polarity version of BYZ13	7/6
Set consisting of one BYZ13 and one BYZ19	12/-
DD000, 50 p.i.v., 500mA., wire ended	5/-
DD006, 400 p.i.v., 500mA., wire ended	6/6
DD058, 800 p.i.v., 500mA., wire ended	7/6
DD226, 400 p.i.v., 1 amp., wire ended	6/6
DD716, 400 p.i.v., 35A	18/-
DD4526, 400 p.i.v., 10A	5/6
OA210, 400 p.i.v., 500mA., wire ended	6/6
OA211, 800 p.i.v., 400mA., wire ended	9/6
RS27AF, 600 p.i.v., 100mA., wire ended	4/-
RS350AF, 700 p.i.v., 3 amps., wire ended	7/6
RS360AF, 840 p.i.v., 3 amps., wire ended	8/6
RS380AF, 1,120 p.i.v., 3 amps., wire ended	10/-
SJ102A, 100 p.i.v., 2·4A., stud mounted	7/6

BEEHIVE TRIMMERS

30pF and 50pF. One dozen in any combination, 15/- Post Paid.

No 10 HEADPHONE ASSEMBLY

Moving Coil Headphones with Moving Coil Hand Microphone fitted with press-to-talk switch. Low Impedance (D.C. resistance approx. 35 Ω per phone). Insert can be used as small speakers. Cord terminated with army type 5-point moulded connector. Felt or rubber noise excluding earpads. Brand New, 20/-. P. & P. 3/6.

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS

1B20K10 100 piv, 2 amps, dimensions 1·4x1·4x·6in. 25/-
1B40K10 100 piv, 4 amps, dimensions 1·4x1·4x·6in. 30/-
1B100M10 100 piv, 10 amps, dimensions 2¼x2¼x1in. 85/-
Postage 1/6 per rectifier.

OSCILLOSCOPE TUBE 3BP1

Green trace medium persistence tube of three-anode type. Normal working conditions are: Anode 1 (focus) 300 to 600v.; Anode 2 and Anode 3 (coupled together) 1500 to 2000v. Deflection sensitivity at 1500v. e.h.t. is approx. ·170 mm/v. for X axis and ·230 mm/v. for Y axis. **B14A** base PRICE 55/-. P. & P. 7/6. Base B14A 6/6.

Our new (1967/68) price list of Valves, Tubes and Semiconductors is now ready. In addition to listing prices of some 2,300 types it is a useful reference work giving: Valve and Tube Equivalents, Specification of Microwave Tubes, Cathode Ray Tubes and Semiconductors. Send S.A.E. (Quarto) now to get your copy free of charge.

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The following blueprints are available from stock. **Descriptive text is not available** *but the date of issue is shown for each blueprint. Send, preferably, a postal order to cover cost of the blueprint (stamps over 6d. unacceptable) to Blueprint Department, Practical Wireless, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.*

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The Berkeley Loudspeaker Enclosure The Luxembourg Tuner	(Dec. 1962)	5/-
The PW Troubadour The PW Everest Tuner	(June 1962)	7/6
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