PRACTICAL WIRELESS

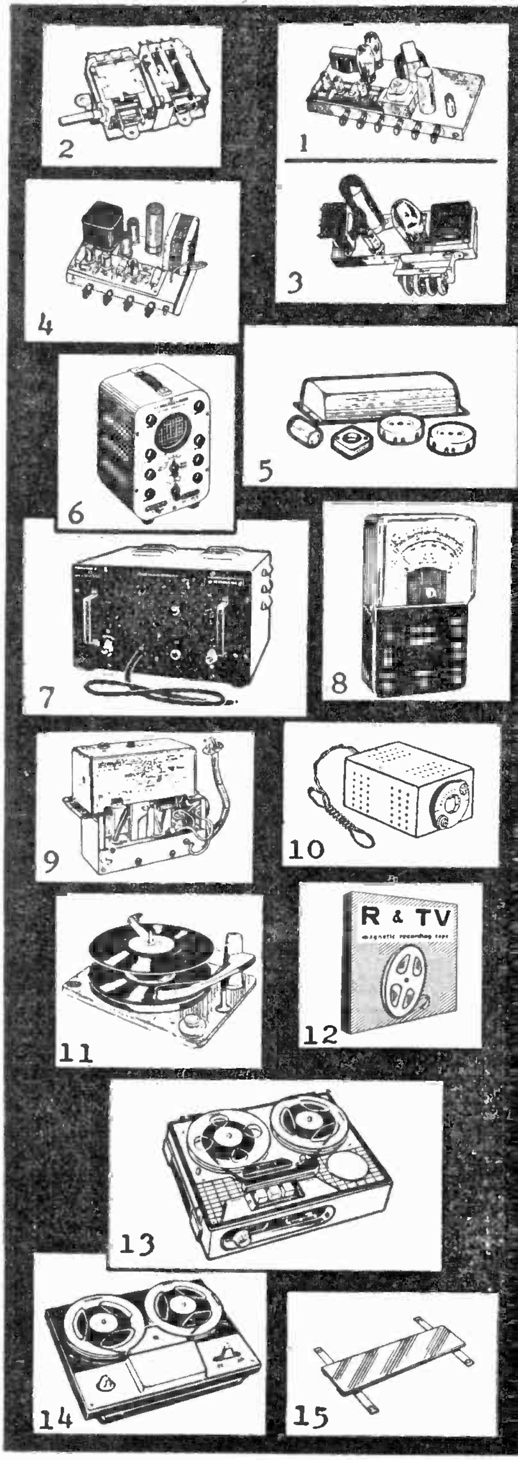
JANUARY 1966

2/-

EXTRA inside!

16-PAGE PULL-OUT BOOKLET

SHORT WAVE DATA



1. **6 VALVE 15 WATT PUSH-PULL AMPLIFIER.** 15 x 7 x 1½in. A.C. Mains 200-250 volts. 4 inputs with controls for same and bass and treble lift controls. Tapped for 3 and 15 ohm speakers. Extra H.T. and L.T. for F.M. Tuner supplies etc., built and tested. **7 gns.** P. & P. 13/6.

2. **CYLDON AM FM PERMEABILITY TUNERS FOR ALL TRANSISTOR OPERATION.** Size 2½ x 2¼in. approx. By famous manufacturer. A.M. I.F. 470 Kc/s. F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1620 Kc/s-525 Kc/s. F.M. coverage 108 Mc/s-88Mc/s. Circuit diagrams 2/6. FREE with Tuner, 1st, 2nd and 3rd A.M. I.F.'s, 1st, 2nd, 3rd and 4th F.M. I.F.'s V.H.F. Osc. choke, A.M. I.F. trap. All the above are the R.F. end of an A.M./F.M. receiver car radio etc. The above items **£2.10.0.**

3. **AMPLIFIER KIT.** 3 to 4 watt Amplifier Kit. Comprising chassis 8¾ x 2¼ x 1in. Double wound mains transformer, output transformer, volume and tone controls, resistors, condensers etc. Valves 6V6, ECC81 and metal rectifier. Circuit 1/6, free with kit, **29/6** plus 4/6 P.&P.

4. **8-WATT 5-VALVE PUSH-PULL AMPLIFIER & METAL RECTIFIER** Size: 9 x 6 x 1¾in. A.C. Mains, 200-250v. 5 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent total distortion. Separate bass and treble lift control. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. **£3.19.6.** P. & P. 8/-.

5. **40W FLUORESCENT LIGHT KIT** incorporating GEC Choke size 8½ x 1¾ x 1¾in. 2 bi-pin holders, starter and starter holder, **11/6.** P. & P. 4/6. Similar to above: **80W Fluorescent Light Kit** incorporating GEC choke size 11¾ x 1¾ x 1¾in. 2 bi-pin holders, starter and starter holder. **17/6.** P. & P. 5/6.

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

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

8. **POCKET MULTI-METER.** Size 3¾ x 2½ x 1¼in. Meter size 2¼ x 1¾in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts. 0-15, 0-150, 0-1,000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test prods battery and full instructions. **42/6.** P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

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

10. **POWER SUPPLY KIT** in metal case, size 3¾ x 2½ x 2in. incorporating mains transformer, rectifier and condensers. 230/250 A.C. mains Output: 9v., 10mA. **10/6** plus 3/- P. & P.

11. **B.S.R. MONARCH UA14 WITH FULL FI HEAD,** 4-speed, plays 10 records, 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12½ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with full Fi turnover crystal head. **£5.19.6.** P. & P. 7/6.

12. **FIRST QUALITY PVC TAPE**

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

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

13. **MAYFAIR 5-TRANSISTOR TAPE RECORDER**
    Capstan-driven, battery operated, 7½ and 3¾ i.p.s. Precision made Push-button controls. High quality 2¾in. speaker. Push-pull circuit. Output: 400 mw. Frequency response: 200-7,000 kc/s. Fast rewind, Up to 1 hour twin track playing time. Automatic erasing for re-recording. Dimensions: 8in. x 11in. x 3¾in. Weighs only 7lbs. **£11.11.0** plus 7/6 P. & P.

14. **BSR TAPE DECK**
    AC 200/250v, tape speed 3¾ twin track. **£5.5.0** P. & P. 7/6.

15. **GEC FLAT HEATER ELEMENT 500 w.**
    Can be used for wash boilers, washing machines, etc. Five or six elements can be used in parallel to give 2500/3000 watts. Size 5½ x 1¼, copper enclosed. 2/6 each, P. & P. 1/-. 4 or more Post Paid.

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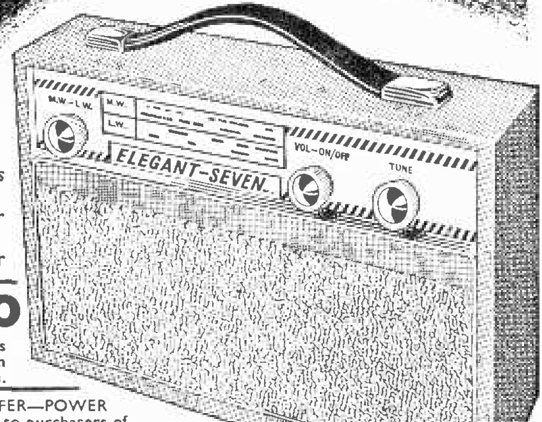
SPECIAL OFFER! FROM R. & T.V. LTD.

Elegant Seven Mk II



COMBINED PORTABLE & CAR RADIO

4in. SPEAKER *The Radio with the STAR features*

- ★ 7-transistor superhet. Output 350mW.
- ★ Grey wooden cabinet, fitted handle with silver coloured fittings. Size $12\frac{1}{4} \times 8\frac{1}{2} \times 3\frac{1}{2}$in.
- ★ Horizontal tuning scale, size $11\frac{1}{4} \times 2\frac{5}{8}$in. in silver with black lettering.
- ★ All stations clearly marked.
- ★ Ferrite-rod internal aerial.
- ★ I.F. neutralisation on each stage 460 kc/s.
- ★ D.C. coupled output stage with separate A.C. negative feed back.
- ★ All components, ferrite rod and tuning assembly mounted on printed board.
- ★ Operated from PP9 battery.
- ★ Full comprehensive instructions and point-to-point wiring diagrams.
- ★ Fully tunable over medium and long waveband.
- ★ Car aerial socket. Full after-sale service.
- ★ Printed circuit board, back printed with all component values.

ONLY **£4.4.0**

Plus 6/6 P. & P. Parts list & circuit diagram 2/6. FREE with parts.

SPECIAL OFFER—POWER SUPPLY KIT to purchasers of "Elegant Seven" parts, incorporating mains transformer, etc. A.C. mains 200-250v. Output 9v. 50mA. 7/6.

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MARTIN AUDIOKITS & RECORDAKITS

F.M. TUNER UNITS Nos. 15, 16 and 17 .... Cash **£12.17.6**
Or Dep. 51/6 and 12 m. pymts. of 18/10 .... (H.P. Price £13.17.6)
TRANSISTORISED AMPLIFIER with 5 position input selector, pre-amp and con trols, 10 watt amplifier and Power Pack
For 3 Ohm Speaker. Cash **£14.5.0**
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All above include Front Panels, Knobs and Instructions.
TWO TRACK RECORDAKIT AMP. (Valve) **FOR STUDIO DECK**, 6 valves, controls, self powered .... Cash **£11.11.0**
Or Dep. 47/- and 8 m. pymts. 25/6 .... (H.P. Price £12.11.0)
COLLARO STUDIO DECK 3 speed latest Two Track Cash **£10.19.6**
Or Dep. 44/- and 8 m. pymts. 24/6 .... (H.P. Price £12.0.0)
COMPLETE KIT with case, spkr., tape and mic. ... Cash **£29.19.6**
Or Dep. 120/- and 12 m. pymts. 44/- .... (H.P. Price £32/8/0)
FOUR TRACK AMP. as above .... Cash **£12.12.0**
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COMPLETE KIT with case, spkr., tape and mic.
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Or Dep. 136/- and 12 m. pymts. 49/10 .... (H.P. Price £36.14.0)
TAPE PRE-AMP for Studio Deck, self powered.
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Or Dep. 34/- and 6 m. pymts. 25/8 .... (H.P. Price £9.9.0)
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Or Dep. 39/- and 6 m. pymts. 28/4 .... (H.P. Price £10.9.0)
We are leading stockists for all Martin Constructional Kits.

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ARMSTRONG 221 10-10 watts Stereo, Mag PU and Filter
Cash **£33.15.0**
Or Dep. 135/- and 8 m. pymts. 49/6 .... (H.P. Price £36.9.0)
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ARMSTRONG 227 MONO 10W amp. with AM/FM .... Cash **£36.15.0**
Or Dep. 147/- and 12 m. pymts. 53/10 .... (H.P. Price £39.13.0)
ARMSTRONG 227 STEREO as above with Stereo Amp.
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ARMSTRONG 226 STEREO as above, but Mag. P.U. Filter.
Cash **£61.0.0**
Or Dep. 260/- and 12 m. pymts. 88/- .... (H.P. Price £65.16.0)
Teak Cases for all Armstrong Units **£3.10.0**
ROGERS CADET Mk. 3 10-10 watt Stereo Amp. Mag. P.U.
Cash **£29.10.0**
Or Dep. 118/- and 12 m. pymts. of 43/3 .... (H.P. Price £31.17.0)
CASE MODEL ROGERS CADET Mk. 3 .... **£3.0.0** extra
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Or Dep. 198/- and 12 m. pymts. of 72/7 .... (H.P. Price £53.9.1)

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FANE 122/10 Heavy Duty 12in. 20 watt .... Cash **£5.5.0**
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Or Dep. 47/6 and 8 m. pymts. 25/9 .... (H.P. Price £12.13.6)
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Or Dep. 70/6 and 12 m. pymts. 25/8 .... (H.P. Price £18.18.6)

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GARRARD SRP10 Mono .... Cash **£5.10.0**
GARRARD Model 1000 Mono .... Cash **£7.10.0**
GARRARD Model 2000 Mono Large Table .... Cash **£8.10.0**
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GARRARD Model 3000 Stereo Lightweight arm .... Cash **£11.11.0**
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GARRARD AT60 Less cart.: Heavy table .... Cash **£13.0.0**
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GARRARD LAB80 Push button oper., less cart. ... Cash **£27 10.0**
Or Dep. 110/- and 12 m. pymts. of 40/4 .... (H.P. Price £29.14.0)
GARRARD 401 Transcription Table. No arm ...... Cash **£32.10.0**
Or Dep. 130/- and 12 m. pymts. 47/8 .... (H.P. Price £35.2.0)
GOLDRING G66 Mono Single Player .... Cash **£11.11.0**
Or Dep. 47/- and 8 m. pymts. 25/6 .... (H.P. Price £12.11.0)
GOLDRING GL58 less cart.: Heavy table, single play Cash **£17.1.0**
Or Dep. 69/- and 12 m. pymts. 24/11 .... (H.P. Price £18.8.0)
GOLDRING GL70 trans.: Unit with arm, less cart ... Cash **£29.18.6**
Or Dep. 120/6 and 12 m. pymts. 43/9 .... (H.P. Price £32.5.6)
Leaflets available upon receipt of 6d. stamp.

SURBITON PARK RADIO LTD.

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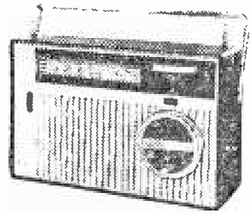
LASKY'S RADIO

Offer the Finest Value and HOME CONSTRUCTORS

We wish all our customers old and new the Compliments of the Season and cordially invite you to select your Gifts from our huge selection of bargains.

THE "SKYROVER" RANGE



GENERAL SPECIFICATION

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

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

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

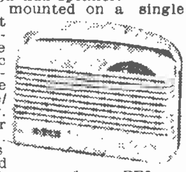
NEW—The SKYROVER Mk III

Now supplied with redesigned cabinet, edgewise controls, black and chrome plastic cabinet. Size 10 x 6½ x 3¾in. with carrying handle.
Can now be built for **£8.19.6** Post 5/-
H.P. Terms: 27/- dep. and 11 months at 15/9. Total H.P. Price £10.0.8.

The SKYROVER DE LUXE

Tone Control Circuit is incorporated with separate Control. In a wood cabinet, size 11½ x 6½ x 3in., covered with a washable material with plastic trim and carrying handle. Car aerial socket fitted.
Can now be built for **£10.19.6** Post 5/-
H.P. Terms: 33/- dep. and 11 mths at 19/2. Total H.P.P. £12.3.10

The "REALISTIC" Seven

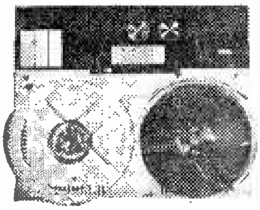


★ 7-Transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board. ★ Full medium and long wave cover. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3½in., Blue/Grey or all Grey. ★ Socket for car aerial. ★ I.F. frequency 470 Kc/s ★ Ferrite rod internal aerial. Operates from PP9 or similar battery. ★ Full data supplied All coils and I.F's etc. fully wound ready for immediate assembly. An outstanding receiver.
Can be built for **£5.19.6** Post 4/6.
PP9 Batt. 3/9. Data and instructions separately 2/6. Refunded if you purchase the parcel. All parts sold separately.

REALISTIC Seven DE LUXE

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

The Very Latest MAGNAVOX-COLLARO 363 TAPE DECKS



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

LASKY'S PRICE with ½ track heads **£10.10.0**
LASKY'S PRICE with ¼ track heads **£13.19.6**
Carriage and packing 7/6 extra

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

Give a Lasky's Gift Voucher

The ideal gift for Christmas and all those other special occasions. Any value in multiples of 10/6 (min.) upwards.
Special Christmas Offer— Vouchers worth more than you pay! e.g. 1 Guinea Voucher for £1—10/6 Voucher 10/- etc.
You save money and give pleasure with a Lasky's Gift Voucher.

TRANSISTORS new & guaranteed

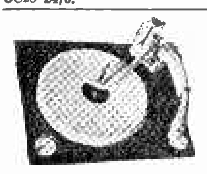
GET 81, GET 85, GET 86, 2/6; 873A, 874P, 3/6; OC45, OC71, OC81D, 4/6; OC44, OC70, OC76, OC81 (match pair 10/6) 5/6; AF117, OC75, OC200 6/6; OC42, OC43, OC73, OC82D 7/6; OC201, OC204 15/-; OC205, OC206 19/6; OC28 24/6.

TRANSFILTERS BY BRUSH CRYSTAL CO.

TO—01B 465 kc/s. ± 2 kc/s.
TO—01D 470 kc/s. ± 2 kc/s.
TO—02B 465 kc/s. ± 1 kc/s.
TO—02D 470 kc/s. ± 1 kc/s.
TF—01B 465 kc/s. ± 2 kc/s.
TF—01D 470 kc/s. ± 2 kc/s.

7/6 EACH Post 6d.

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



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

UA14 4 speed mains model £4.9.6
UA16 4 speed mains model £4.19.6
UA16 9v. battery model £5.19.6
UA20 4 speed mains model £5.19.6
Add 5/- carriage and packing on each

INTERNATIONAL TAPE

Famous American Brand—Fully Guaranteed

		s.	d.
3in.	Message tape, 150ft.	3	6
3in.	Message tape, 225ft.	4	11
3in.	Message tape, 300ft.	7	6
3¼in.	Triple play, 600ft., Mylar base	15	0
4in.	Triple play, 900ft. Mylar base	17	6
5in.	Double play, 1,200ft., Mylar base	15	0
5in.	Long play, 900ft., Acetate base	10	0
5in.	Standard play, 600ft., PVC base	8	6
5in.	Triple play 1,800ft., Mylar base	35	0
5¾in.	Double play, 1,800ft., Mylar base	22	6
5¾in.	Long play, 1,200ft., Acetate base	12	6
5¾in.	Standard play, 850ft., PVC base	11	6
5¾in.	Triple play, 2,400ft., Mylar base	45	0
7in.	Standard play, 1,200ft., Acetate base	10	0
7in.	Standard play, 1,200ft., Mylar base	12	6
7in.	Long play, 1,800ft., Mylar base	19	6
7in.	Double play, 2,400ft., Mylar base	25	0
7in.	Long play, 1,800ft., Acetate base	15	0
7in.	Triple play, 3,600ft., Mylar base	58	6

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

GOODMANS OF ENGLAND CROSSOVER UNITS

XO/750 HALF SECTION CROSSOVER. For use with bass and treble speakers. 15Ω imp. to crossover at 750 c.p.s. Rated at 25 watts (British). In wood case 6½ x 4½ x 4in. New and unused.

LASKY'S PRICE **29/-** Post 2/6.

STEREOPHONIC FILTER. This is a frequency divider/mixer for use with a Stereo amplifier. Its function is to combine the bass frequencies up to 300 c.p.s. into a single bass speaker for both channels and to divide the frequencies above 300 c.p.s. into two separate mid/top range speakers. It can also be used as a 300 c.p.s. crossover for a mono system. 15Ω imp. Rated at 25 watts (British). In wood case 10 x 4½ x 3in. New and unused.

LASKY'S PRICE **19/6** Post 2/6.

SINCLAIR MINIATURES

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

THE MICRO-6 pocket radio 59/6
THE SLIMLINE pocket radio 49/6
THE X-20 Amplifier £7.19.6
Ready built and tested £9.19.6
THE X-10 Amplifier £5.19.6
Ready Built and Tested £6.19.6

See our Practical Wireless November '65 advertisement for details.

U.H.F. TUNERS

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

LASKY'S PRICE **79/6** Post 5/6.

GORLER UT 340 FM/VHF TUNING HEART

Permeability tuned—covering 87 to 108 Mc/s For use with one ECC85 valve. In metal case, size 3 x 2½ x 1⅛in. Circuit supplied.

LASKY'S PRICE **19/11**
ECC85 valve 9/- extra. Post 2/-

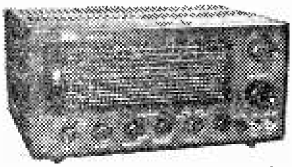
LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

Service in Great Britain to both & HI-FI ENTHUSIASTS

TAPE RECORDERS . RECORD PLAYERS . AMPLIFIERS ETC.
COMPLETE MONO/STEREO SYSTEMS TO YOUR SPEC.

LASKY'S RADIO

NEW COMMUNICATION RECEIVERS MODEL KT 320 KIT



Supplied in sub-assemblies for easy building. Covers range from 540 Kc/s to 30 Mc/s. Ham Band is provided with a scale for direct reading and can also be band spread, 9 valves. Facilities: A.N.L., A.V.C. and M.V.C. Q Multiplier also serves as B.F.O. H.F. stage and two I.F. stages ensure high sensitivity and selectivity (all coils and I.F.s are supplied pre-aligned). 2 Aerial Sockets. Stand-by position for use with a transmitter S meter fitted. 200-250v, A.C. mains. Steel cabinet, grey crackle finish. Size 15 x 8 x 10in. Dial 12 x 4in. All parts new and fully guaranteed. Complete with full construction data and operating manual.

LASKY'S PRICE 25 GNS. POST FREE

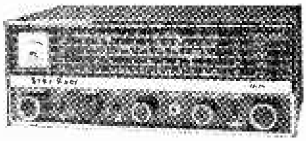
Also available ready built and tested 29 gns.
H.P. Terms available.

MODEL HE30 Still a few available—as advertised June '65.

LASKY'S PRICE 33 GNS.

H.P. Terms available.

MODEL HE40



Covers medium wave band and 1.6-4.4 Mc/s., 4.5-11.0 Mc/s., 11.0-30.0 Mc/s. in separate switched band spread ranges. Controls include B.F.O. Sensitivity, A.N.L. Receiver—Stand-by Switch, Tone Switch, S-Meter. For 200-250v. A.C./D.C. Internal loop and telescopic antennae fitted. Valve line-up: 12BE6, 12BA6, 12AV6, 50C5, and metal rectifier. Size 13½ x 8½ x 5½in. Instruction manual included. No Kits available.

LASKY'S PRICE 19 GNS. POST 10/-

H.P. Terms £4.0.0. dep. and 1_ months at £1.12.0.
Total H.P.P. £21.12.0.

MODEL HE80 14-valve super sensitive communication receiver.

Freq. range 540 Kc/s—30 Mc/s. and 144-146 Mc/s. Dual conversion on 2 metres, with extra R.F. stage. Single R.F. stage, two I.F. stages on all other bands. B.F.O. and Q-multiplier circuits. Improved A.N.L. and voltage regulated powerpack. "S" meter band spread on amateur bands, large illuminated dial with logging scale. All controls fitted. Output for speaker and phones. Valve line-up: 4 x 6AQ8, 3 x 6BA6 2 x 6BE6, 1 x 6BL8, 6AL5, 6AQ5, 6CA4, and OA2. Steel case 17 x 7½ x 10in. For 200/250v, A.C. mains. Brand new with full instruction manual. No Kits available.

LASKY'S PRICE 59 GNS. POST FREE

H.P. Terms £12.19.0 dep. and 11 monthly payments of £4.18.0. Total H.P.P. £66.17.0.

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All supplied complete with personal earpiece, battery and carrying case. Fully guaranteed—ready to use. POST FREE.

BOY'S 2 TRANSISTOR In attractive plastic case. Size only 4in. x 2¼in. x 1in. Fitted 2¼in. speaker. Socket for personal earpiece. Uses PP3 battery. Tunable over full medium waveband. **LASKY'S PRICE 35/-**

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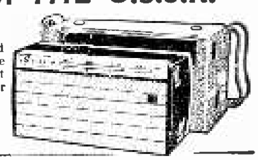
THE "TRANSWAVE" DE LUXE TWO WAVEBAND RADIO

8 Sony transistors give super sensitive reception over the full Med. and Long wavebands. Internal ferrite and detachable chrome telescopic aerials. 2½" p.m. speaker. Smart black plastic cabinet with metal trim—size 6¾ x 3¾ x 1½in. Uses 3 pen light batteries. Complete with leather case and shoulder strap. earpiece and batteries. Post 2/6. **LASKY'S PRICE 99/6**

3 WONDERFUL SETS FROM THE U.S.S.R.

THE "SELGA" 7 TRANSISTOR RADIO



High sensitivity circuit gives excellent reception over full Med waveband and powerful volume. P.M. speaker. Uses PP3 type battery. Black and ivory plastic cabinet size 7 x 4 x 2in. Socket for external aerial. Complete with solid hide case and shoulder strap. earpiece and battery.

LASKY'S PRICE £5.9.6 Post 2/6

THE "SOKOL" 7 TRANSISTOR TWO BAND RADIO

Super quality receiver covering the full Med. and Long wavebands with exclusive rechargeable battery which can be recharged from any 110/250v. A.C. mains supply. Also operates on PP3 type dry battery. P.M. speaker. Ivory and black plastic cabinet 6 x 3½ x 1¾in. Socket for external aerial. Complete with real leather case, rechargeable battery and charger, dry battery and earpiece.

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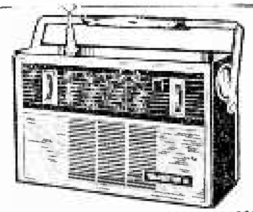

Extremely well designed and made receiver covering the Long, Med and Short wavebands. The Short waveband has switched band spread on 13m., 16m., 19m., 25m., 31m. 41m. bands. Internal ferrite rod and telescopic aerials. Sockets for external aerial and earth and gram. pick-up. Strong cream and black plastic cabinet with carrying handle—size 10 x 7½ x 3½in. Uses six U2 type batteries (supplied).

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PORTABLE 'SCOPE, Model OS-2. ★ Improved performance facilities and modern styling. ★ 'Y' bandwidth 2 c/s to 3 mc/s. ★ Automatic lock-in sync. ★ Mumetal C.R.T. shield. ★ P.C. Board. ★ Switched EXT/INT 'Y' plate connections. Size 5" x 7⅞" x 12" deep. Weight 9¾lb. Send for full specification.
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BERKELEY Slim-line LOUDSPEAKER SYSTEM. ★ Now from Heathkit, a loudspeaker kit with a fully finished walnut cabinet. ★ A 2 speaker system. ★ Modern, slim-line styling. ★ 30 c/s to 17 kc/s. ★ Only 7¾" thick. ★ Use it horizontally or vertically. ★ Stand it on the floor or in your bookshelf.
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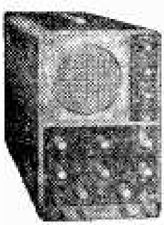

10-12U

5in. OSCILLOSCOPE Model 10-12U. Laboratory quality at utility oscilloscope price. Wide band amplifiers essential for T.V. servicing. F.M. alignment, etc. T/B covers 10 c/s-500 kc/s in 5 ranges.
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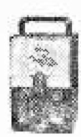

V-7A

DE-LUXE 6in. VALVE VOLTMETER. Model IM-13U. Similar spec. to model V-7A but with improved accuracy. Larger meter. Unique gimbal mount.
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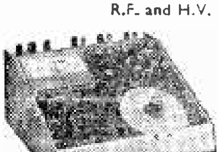
R.F. and H.V. probes available as extras.



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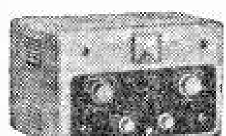
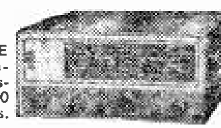
AMATEUR TRANSMITTER. Model DX-100U. Covers all amateur bands 160-10M. 150 w. d.c. input, self contained with power supply. Modulator, VFO
Assembled £104.15.0 **£79.10.0** Kit



DX-40U

AMATEUR TRANSMITTER Model DX-40U. Covers 80-10 m. Power inputs 75 w. C.W.; 60 w. peak C.C. phone. Output 40 w. to aerial. Prov. for VFO.
£33.19.0 Kit
Assembled £45.8.0



COMMUNICATIONS TYPE RECEIVER RG-1. A high performance low cost receiver for the discriminating listener. Freq. cov. 600 kc/s-1·5 Mc/s and 1·7 Mc/s to 32 Mc/s. Send for details.
£53.0.0 Assembled **£39.16.0** Kit

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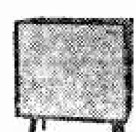
HI-FI SPEAKER SYSTEMS



COTSWOLD STANDARD MODEL
Acoustically designed enclosure "in the white" 26 x 23 x 15½in., 12in. bass speaker, elliptical middle speaker, 2in. pressure unit. Covers 30-20,000 c/s.
Complete kit with all controls.

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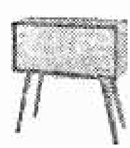
A minimum floor space model for the smaller room. 26in. high x 16½in. x 14in. deep. Similar performance to standard model.
Price either model **£25.12.0** Kit



SSU-1 SYSTEM
A practical solution to the problem of a moderately priced speaker suitable for Stereo Mono amplifiers where the equipment has to be compact. Two speakers, balance control, ducted port reflex cabinet.
Horizontal or vertical (with matching legs).
Incl. P.T. **£12.12.0** Kit

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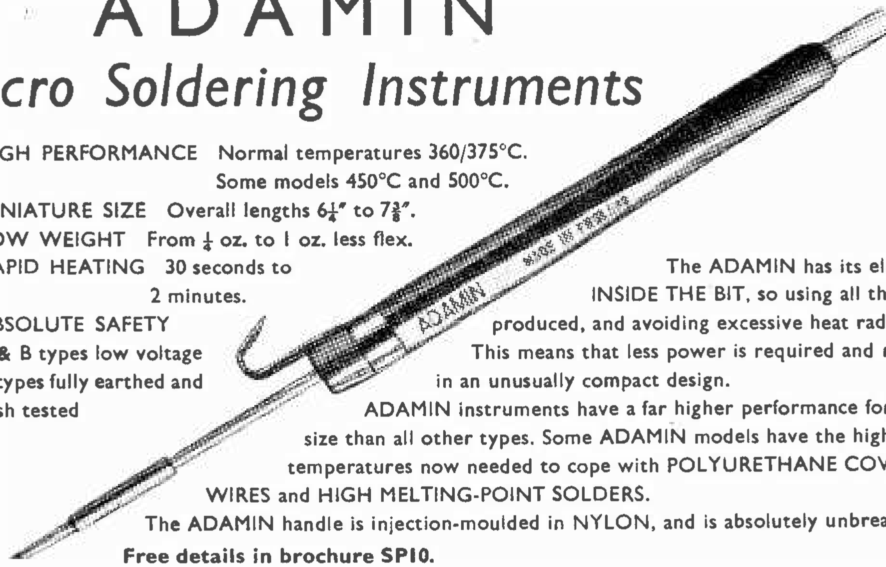
Micro Soldering Instruments



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ADAMIN instruments have a far higher performance for their size than all other types. Some ADAMIN models have the higher bit temperatures now needed to cope with POLYURETHANE COVERED WIRES and HIGH MELTING-POINT SOLDERS.

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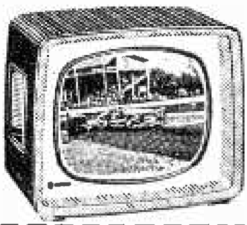

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Personal collection or Insured Carr. 14in. 20/-; 17in. 30/-.

AERIALS. BBC/ITA combined Loft and room aerials—from 25/- BBC2/UHF and colour aerials—from 29/6. SEND FOR FREE LIST.

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17in.—35/- Most makes and types available. **14in.—15/-**
Guaranteed good picture. Carriage 5/- extra.

ONE YEAR GUARANTEED TUBES

21 in.	**99/6**
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100% REGUNNED Add 10/- or old tube. All 110°—99/6 plus 30/- refundable on old tube. Carr. 10/6. 14in. Slimline 17 & 19 in. — overseas postage 30/-.

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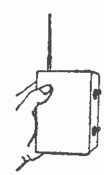
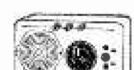


THE SIG-GEN. A versatile Signal Injector, something no constructor should be without. This ingenious device generates an audible signal through the Audio and RF ranges. With variable output. Telescopic Probe. Pocket size slim line case measures 4¾ x 3¼ x ¾in. Complete set of parts with full instructions, 19/6. P. & P. 1/6.

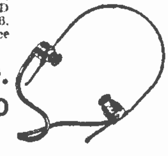
TUNING CONDENSERS. Air spaced fine quality German manufacture with slow motion drive 0.0005. With oscillator section. BRAND NEW Only 6/6. P. & P. 1/6.

1200mW TRANSISTOR AUDIO AMPLIFIER. Designed to give high quality at low cost. This superb amplifier uses 4 transistors including a special power type operating from a 12v. battery. Variable input impedance. Matches directly into 25-35 ohms loudspeaker. Special gain control circuit can also reduce noise to a minimum. All parts including transistors, printed circuit board, etc. 32/6. P. & P. 2/6. Easy build plans free with set of parts. 6x4in. 35 ohm Speaker 12/6. P.&P. 1/6.



QUICK CHECK TRANSISTOR TESTER. Checks gain of RF and Audio Transistors. Also checks for noise level and duds. All parts ready to be assembled in attractive grey case with red grille complete with Dial, Knobs, and 2½in. Speaker. Simple assembly instructions free with set of parts. 39/6. P. & P. 3/6.

CYLDON PERMEABILITY TUNERS. By famous manufacturer. Full MW coverage. Fitted coupling coil oscillator coil, ferrite slugs and slow motion tuning with cursor, etc. GIVE AWAY PRICE 10/- P. & P. 1/6. Switched type 2/6 extra.



HEADPHONES. Sonotone HS30 High Fidelity Headphones. Made by famous American manufacturer. Approx. 150 ohms impedance for direct matching into most transistor circuits. BRAND NEW in original sealed cartons 15/-. P. & P. 1/6. Matching transformers for higher impedance 2/6 extra.

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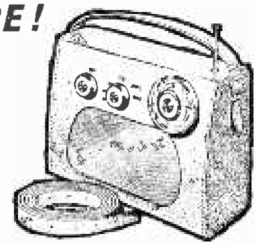
See facing page for other items

Why NOT BUILD ONE OF OUR PORTABLE TRANSISTOR RADIOS...

BACKED BY OUR SUPER AFTER SALES SERVICE

All components used in our receivers may be purchased separately if desired. Parts price lists and easy build plans available separately at prices stated. Overseas post 10/-.

FIRST FOR QUALITY, PERFORMANCE & PRICE!



NEW ROAMER SEVEN Mk IV

7 WAVEBAND PORTABLE OR CAR RADIO

Amazing performance and specification ★ *Now with PHILCO MICRO-ALLOY R.F. TRANSISTORS*

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

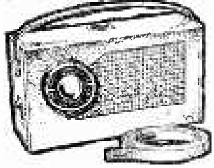
Covers Medium and Long Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room filling volume from rich toned heavy duty "Celestion" speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M & L waves and telescopic aerial for S Waves. Real leather look case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

★ **EXTRA BAND FOR EASIER TUNING OF PIRATE STATIONS etc** Total cost of parts now only **£5.19.6** P. & P. 5/6
Parts Price List and easy build plans 3/- (FREE with kit)

MELODY SIX

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

● 8 stages—6 transistors and 2 diodes



Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6½ x 3½ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

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POCKET FIVE

● 7 stages—5 transistors and 2 diode

Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5½ x 1½ x 3½in. (Uses 1289 battery available anywhere).

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Total cost of all parts now only **42/6** P. & P. 3/-.

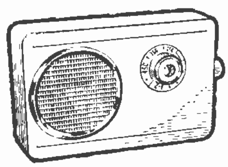
NEW ROAMER SIX

NOW WITH PHILCO MICRO-ALLOY R.F. TRANSISTORS
● **6 WAVEBAND ! !**

X8 stages—6 transistors and 2 diodes

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

★ **EXTRA BAND FOR EASIER TUNING OF LUX, ETC.**
Parts Price List and easy build plans 2/- (FREE with kit) Total cost of all parts now only **£3.19.6** P. & P. 3/6



New TRANSONA FIVE

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

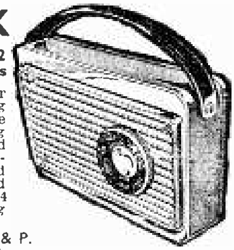
● 7 stages—5 transistors and 2 diodes

Fully tunable over Medium and Long Waves and Trawler Band. Incorporates Ferrite rod aerial, tuning condenser, volume control, new type fine tone super dynamic 2½in. speaker etc. Attractive case. Size 6¼ x 4½ x 1½in. with red speaker grille. (Uses 1289 battery available anywhere.)

Total cost of all parts now only **42/6** P. & P. 3/6 *Parts Price List and easy build plans 2/- (FREE with kit)*

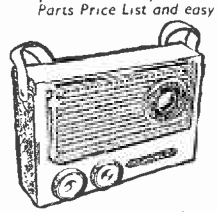
TRANSONA SIX

● 8 stages—6 transistors and 2 diodes



This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille. Size 6¼ x 4½ x 1½in. (Uses PP4 battery available anywhere.) Carrying strap 1/- extra.

Total cost of all parts now only **59/6** P. & P. 3/6.
Parts Price List and easy build plans 1/6 (FREE with kit)



SUPER SEVEN

● 9 stages—7 transistors and 2 diodes

Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 R.F. Stages, push-pull output. 3in. speaker (will drive large speaker). Size 7½ x 5½ x 1½in. (Uses 9v. battery, available anywhere.)

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RADIO EXCHANGE CO

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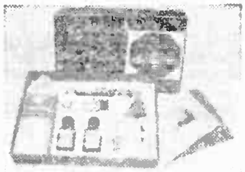

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250-0-250v. 70mA, 6.3v. 2a, 0-5-6.3v. 2a	17/9
350-0-350v. 80mA, 6.3v. 2a, 0-5-6.3v. 2a	21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a	21/9
250-0-250v. 100mA, 6.3v. 3.5a, C.T.	19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	28/9
300-0-300v. 130mA, 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier	35/9
300-0-300v. 100mA, 6.3v. 4a 0-5-6.3v. 3a	28/9
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350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	29/9
350-0-350v. 150mA 6.3v. 4a, 0-5-6.3v. 3a	38/9
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425-0-425v. 200mA, (6.3v. 4a Twice), 5v. 3a	59/9
450-0-450v., 250mA, 6.3v. 4a, C.T. 5v. 3a	69/9

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

MIDGET MAINS TRANS 2½ x 2½ x 2½in.

250v. 60mA, 6.3v. 2a	13/9
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Standard Pentode 5,000 Ω to 3 Ω	5/9
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Push-Pull 8 watts, EL84, or 6V6 to 3 Ω or matched to 15 Ω	9/9
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Push-Pull 10-12 watts, 6V6 or EL84	18/9
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Push-Pull Mullard 510 Ultra Linear	29/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, EL34 etc.	49/9

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

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

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FANE HEAVY DUTY HI FI SPEAKERS 12" 20 watt. Type 122/10. Only 5 Gns.

R.S.C. POWER PACK, 39/9. Louvred metal case only 8 x 5½ x 2½in. Stove enamelled. For 200-250 v. A.C. mains. Output at 4 pin plug and socket 250 v. 60 mA, fully smoothed at 6.3 v. 2a. Suitable for power requirements of almost any Pre-amp. or Radio Tuner.

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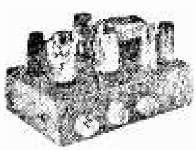
AUDIO FIDELITY 10in. 15 WATT HI-FI LOUDSPEAKERS Heavy cast construction. Dual cone. Smooth frequency response 40-15,000 c.p.s. Really outstanding performance Exceptional value at **5 GNS.**

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

SCOOP PURCHASE OF HIGH QUALITY RECORD CHANGERS **11 GNS.**
Brand new Garrard 3000 LM. Very latest model. Normal Retail price approx. £12.15.0. Heavy Turntable and lightweight pick-up arm. High fidelity Stereo/Mono cartridge. Fully guaranteed. Carr. 5/6

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



A highly-sensitive 4-valve quality amplifier for the home small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest High-fidelity Pick-up heads in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 dB down 15 dB of Negative Feedback is used. H.T. of 300v. 25mA and L.T. of 6.3v. 1.5a. is available for the supply of a Radio Feeder Unit or Tape-Deck pre-amplifier. For A.C. mains 200-230-250v. 50 c/s. Output for 2-3 ohms speaker Chassis is not alive. Kit is complete in every detail with fully punched Gold Hammer finished chassis, point-to-point wiring diagrams and instructions. Exceptional value **£4-15-0** or assembled ready for use 25/- extra, plus 3/6 carr., deposit 22/6 and 3 monthly payments of 22/6 (total £6.15.0) for assembled unit.

R.S.C. SUPER 15 HI-FI AMPLIFIER | R.S.C. SUPER 30 STEREO AMPLIFIER

FULLY TRANSISTORISED 200-250v. A.C. Mains Operation.
OUTPUT 10 WATTS R.M.S. into 15 ohms.
OUTPUT 15 WATTS R.M.S. into 3-4 ohms.
Maximum Instantaneous Peak Power Output 28 watts.
PRINTED CIRCUIT CONSTRUCTION. LATEST MULLARD TRANSISTORS AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV, Microphone 4.5 mV. Tape Head 2.5 mV, Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to -14dB at 10 Kc/s.
BASS CONTROL: +12dB to -15dB at 50 c/s.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s 0.29%. **HUM LEVEL:** -75dB.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. **9½ Gns.** Carr. 10/-
If preferred printed circuit can be supplied with parts soldered in and tested for 21/- extra.
Or unit factory built and tested, with our usual 12 months guarantee. **12½ Gns.** Carr. 12/6
Or Deposit £2 and nine monthly payments 27/9. Total £14.9.9.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS. *Send S.A.E. for leaflet.*

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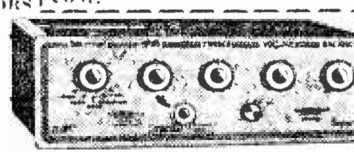


IMPORTANT NOTE. Rated output figures are given in R.M.S. and not speech and music or I.H.F.M., otherwise we could obviously quote much higher outputs.

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits Close tolerance Ganged Pots. Matched Components.
CROSS-TALK: —52dB at 1,000 c.p.s.
CONTROLS: 5 position Input Selector, Bass Control, Treble Control, Volume Control Balance Control, Stereo/Mono Switch, Tape Monitor Switch, Mains Switch.
INPUT SOCKETS (Matched Pairs) (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone
Operation of the Input Selector Switch assures appropriate equalisation.
Rigid 18 s.w.g. Chassis. Size approx. 12" Wide, 3" High, and 8" Deep.
Attractive Fascia Plate and Matching Knobs. Neon Panel Indicator.
Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon) CURRENTLY AVAILABLE. REGARDLESS OF THE COST, SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. **18 GNS.** Carr. 12/6
If required printed circuits can be supplied with appropriate components assembled, soldered and tested for 2 gns. extra.
Terms: Deposit 6 gns. & 9 monthly payments 36/6 Total £22.14.6.
Or unit completely assembled ready for use. **23 GNS.** Carr. 15/-
Or Deposit £4.4.3 and 9 monthly payments 49/9. Total £26.12.0.

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

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

SUITABLE for "MIKE", GRAM., RADIO OR TAPE. INTENDED FOR THE HOME OR STUDIO BUT SUITABLE FOR LARGE HALLS OR CLUBS

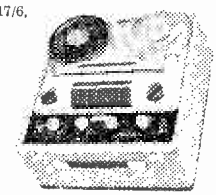
FREQUENCY RESPONSE ±2dB. 30-20,000 c.p.s.
HUM LEVEL 65dB down.
SENSITIVITY: 5 millivolts maximum.
HARMONIC DISTORTION (each channel) 0.2%.

★ Four-position tone compensation and Input Selector switch.
★ Will amplify direct from Tape Heads.
★ Stereo/Mono switch so that peak monaural output of 28 watts can be obtained.
★ Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls.
★ Neon panel indicator.
★ Handsome Perspex Frontplate.

Based on a current Mullard design and employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. Send S.A.E. for leaflet.

Output transformers are high-quality sectionally wound to required specification. Output matchings for 3 and 15 ohm speakers on each channel. Complete set of parts with point-to-point wiring diagrams and instructions, **13 Gns.** Carr. 12/6. or Facto y assembled, tested and supplied with our usual 12 months guarantee for **18 Gns.** or DEPOSIT 57/- and 9 monthly payments of 39/10 (total £20.15.6). A protective wooden cabinet covered in a pleasing shade of leathercloth and fitted carrying handles and feet can be supplied for 59/6 extra. Carr. 5/6. Terms: DEPOSIT 6/9 and nine monthly payments 6/9 (Total 67/6).

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

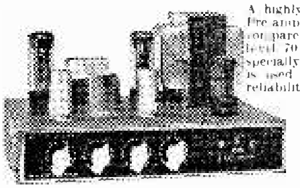


REALISM AT INCREDIBLY LOW COST. CAN BE ASSEMBLED IN AN HOUR

Incorporating the latest Collaro Studio Tape Transcriptor. The Audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable Carrying Cabinet tastefully covered in two contrasting shades of Rexine and Vynair. Size 14¼ x 15 x 8¼in. high and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS: Deposit 4 gns. and 12 monthly payments of 42/- (Total 28 Gns.)**

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

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



A highly sensitive Push-Pull high output unit with self-contained Pre amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 dB down. Frequency response ± 3dB 30-20,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE.** The unit is designed for **CLUBS, SCHOOLS, THEATRES DANCE HALLS** or **OUTDOOR FUNCTIONS**, etc. For use with Electronic **ORGAN, BASS, LEAD OR RHYTHM GUITAR, STRING BASS**, etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for **RADIO FEEDER UNIT.** An extra input with associated vol. control is provided so that two separate inputs such as Gram and "Mike" can be mixed, 200-250v. 50 c/s. A.C. Mains output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. **11 Gns.** Carr. 10/-. Supplied factory built with EL34 output valves and 12 months' guarantee for 14 Gns. If required perforated cover with carrying handles can be supplied for 19/9. Send S.A.E. for leaflet, also speaker. **Terms: DEPOSIT 45/-** and 9 monthly payments of **32/4** (Total **16 Gns.**)

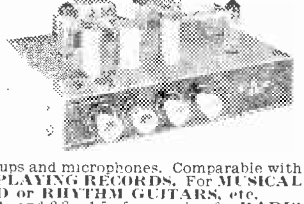
INTEREST CHARGES REFUNDED

on H.P. and CREDIT SALE Accounts settled in 6 months.

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 Collaro Tape Deck and Hi-Fi amplifier, suitable almost any Tape Deck. S.A.E. for leaflet. 9½ Gns.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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



Two input sockets with associated controls allow mixing of "mike" and gram., as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ±3 dB 30-20,000 c/s. Six negative feedback loops. Hum level 60 dB down. ONLY 23 millivolts input required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs for **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, LEAD or RHYTHM GUITARS, etc. OUTPUT SOCKET** with plug provides 300v. 30mA. and 6.3v. 1.5a for supply of a **RADIO FEEDER UNIT.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohms speaker. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/6 extra). If required louvred metal covers with 2 carrying handles can be supplied for 15/9. **TERMS ON ASSEMBLED UNITS: DEPOSIT 33/3** and 9 monthly payments of **24/1** (Total **£12.10.0**). Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Mikes, etc.

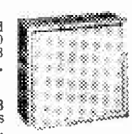
R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER

A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. Ganged Bass and Treble Control give equal variation for "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. Full constructional details and price list 2/6. **8 Gns.** Carr. 10/-. Or supplied factory assembled with 12 months' guarantee for £11.7.6. **Terms:** Deposit 2 gns. and 9 monthly payments of 24/2 (Total £12.19.6).

GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2/3 ohm speaker. For 200-250v. A.C. mains. Size 11¾ x 2¼ x 2¾in. Volume and Tone Controls with Switch. Only **59/6**

Always in Stock at keen prices SINGLE and AUTO RECORD PLAYING UNITS, PICK-UPS, CARTRIDGES, MICROPHONES, CABINETS VALVES and COMPONENTS TOO NUMEROUS TO LIST

12in. 10 WATT HIGH QUALITY LOUDSPEAKER



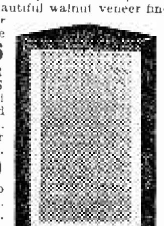
In walnut veneered cabinet. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only **£4.19.6** Carr. 5/6. Terms: Deposit 11/3 and 9 monthly payments of 11/3 (Total £5.12.6).

12in. 20 WATT HI-FI LOUDSPEAKERS IN CABINETS. Size 18 x 18 x 10in. Finish as above. **£7.19.6** Terms: Deposit 17/9 and 9 monthly payments of 17/9 (Total £8.17.6). Carr. 8/6.

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

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

R.S.C. STANDARD BASS REFLEX CABINET. For 12in. loudspeaker acoustically lined and ported Size 20 x 14 x 13in. Beautiful walnut veneer finish. Recommended for use with Audiotrine Speaker System. **£5.19.6**

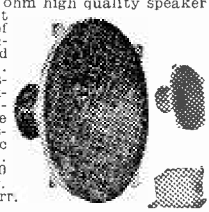


AUDIOTRINE CORNER CONSOLE CABINETS Strongly made. Beautiful polished walnut veneered finish. Pleasing design. **JUNIOR MODEL.** For up to 8in. speaker. Approx. 20 x 11 x 8in. **49/9**

STANDARD MODEL. To take up to 10in. speaker. Size 27 x 18 x 15in. **5 Gns.** Carr. 7/6.

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

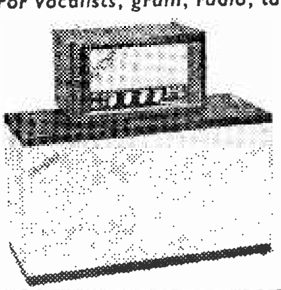
AUDIOTRINE HI-FI SPEAKER SYSTEMS Consisting of matched 12in. 12,000 line, 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. **£4.19.9** Carr. 5/-. Or Senior 20 watt, £6.19.6. Carr. 7/6.



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 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.

4 Jack Socket inputs and two independent Volume Controls for simultaneous use of up to 4 pick-ups or 'mikes'.

★ Separate cabinets fully covered in contrasting tones of Rexine/Vynair with gold trimming for speakers and amplifiers.

★ Separate Bass and Treble Controls giving 'Boost' and 'Cut'.

Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at more than three times the cost.

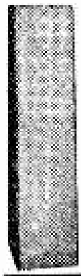
49 Gns. Or deposit £7.16.0 and 12 monthly payments of 81/6 Total 54 Gns. Carr. 25/-

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

R.S.C. (MANCHESTER) LTD

Addresses Page 749

R.S.C. COLUMN SPEAKERS



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

Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in.

12½ Gns. Carr. 10/-. Or deposit £2 and 9 monthly payments of 27/9 (Total £14.9.9).

Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. **19½ Gns.** Carr. 15/-. Or deposit of 3 gns. and 9 mthly pymts of 43/2 (Total 21½ gns.).

TRANSISTORISED SOUND MIXER

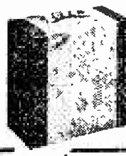
Enables mixing of up to 4 standard jack inputs, i.e. mic., tape, gram, tuner, etc., into single output. Compact and completely self-contained, uses standard 9 volt battery **49/9**

Full Range of FANE and GOODMANS Speakers in Stock and all types 'Mikes'. Credit terms if required.

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

A highly efficient unit incorporating massive 15in. high flux loudspeaker specially constructed to withstand heaviest load conditions. Rating 25 watts. Individual bass and treble controls give ample 'Boost' and 'Cut'. Two jack socket inputs separately controlled. Cabinet is of substantial construction and attractively finished in two contrasting tones of Rexine and Vynair. Size approx. 24 x 21 x 13ins. Send S.A.E. for leaflet. **29½ Gns.** Carr. 17/6. Or deposit £4.14.6 and 12 monthly payments of 49/- (Total 32½ gns.).

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



High-fidelity push-pull output. Separate bass and treble "Cut" and "Boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Loudspeaker is a heavy duty flux 12in. 20 watt model with cast chassis. Cabinet is covered in contrasting shades of Rexine/Vynair. Size approx. 18 x 18 x 8in. Only **19½ Gns.** Carr. 12/6, or DEPOSIT 3 Gns. and 12 monthly payments of 32/6 (Total £22.13.0). S.A.E. for leaflet

30 WATT HI-FI AMPLIFIER
FOR LEAD, RHYTHM BASS GUITAR and for VOCAL or INSTRUMENTAL GROUPS

A Four Input, two volume control Hi-Fi unit with separate Bass and Treble 'Cut' and 'Boost' controls. Designed for vocal or instrumental groups. For Bass, Lead or Rhythm Guitar. Mullard or Brimar latest type valves. Housed in strong Rexine covered cabinet with twin carrying handles. Attractive black and gold Perspex fascia plate. For 200-250 v. A.C. mains. Output for 3 or 15 ohm speakers. Send S.A.E. for leaflet.

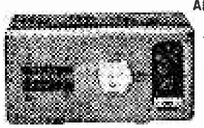
17 GNS. Carr. 12/6. or Deposit £3 and 9 monthly payments of 37/-. (Total £19.13).

R.S.C. G5 AMPLIFIER

4 watt high quality output. Incorporating high flux 12in. 10 watt loudspeaker. Sensitivity 40 mv. High impedance jack input. Handsome cabinet (size 14 x 14 x 7in. approx.) finished in Rexine/Tygan. 200-250v. A.C. mains. Suitable for Lead or Rhythm Guitar in home or small club etc. **£9.19.6** or Deposit 30/9 and 9 monthly payments of 22/3 (Total 11 Gns.). Carr. 7/6.

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

All for A.C. Mains 200-250 v., 50cs



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

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

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders Grommets, panels. Heavy Duty Clips, circuit. Carr. 3/6

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

HEAVY DUTY CHARGER KIT
6/12 v. 6 amps., variable output

Consisting of Main Transformer 0-200-230-250 v.; F.W. (Bridge) Selenium Rectifier; Ammeter, Variable Charge Rate Selector Panels, Plugs, Fuses, Fuseholder and circuit. Carr. 5/6 **59/9**

SELENIUM RECTIFIERS F.W. (BRIDGED)

6/12v. 1a. 3/11; 6/12v. 3a. 9/9; 6/12v. 6a. 15/3; 6/12v. 2a. 6/11; 6/12v. 4a. 12/3; 6/12v. 10a. 26/9; 6/12v. 15a. 35/9.

COMPLETE POWER PACK KIT

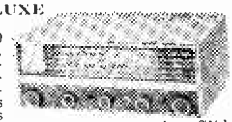
Consisting of Mains Trans., Metal Rectifier, Double electrolytic smoothing choke, chassis and circuit. For 200/250 v. A.C. mains. Output 250 v. 60 mA. 6.3 v. 2a **19/11**

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

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

TANNOY RE-ENTRANT LOUDSPEAKERS. For outdoor or Factory use, 8 ohms, 8 watts **27/6** Plus 4/6 carriage

COMMUNICATION RECEIVERS
RX 60 DE LUXE 4 BAND



220/240v. 50/60 c.p.s. A.C. mains operation. Frequencies covered 1600 Kc/s to 30 Mc/s continuous. Incorporates 5in. speaker. Slide rule tuning dial 'S' meter. Internal ferrite aerial for medium wave. Telescopic whip aerial 58in. 10 section for short waves. Fitted sockets for optional outdoor aerial. Headphones. external speaker socket. Other features are electrical bandspread tuning. Noise limiter, A.V.C., B.F.O., stand by switch. Size approx. 12½ x 5½ x 8¼in. Handsome crackle finished metal cabinet. Brand new with full instructions manual Usual guarantee. Carr. 10/-. **19 Gns.**

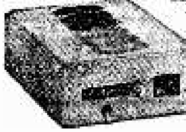
HI-FI 12 WATT AMPLIFIERS

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

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

R.S.C. BABY ALARM or INTER-COMM KIT. Complete set of parts with diagrams, etc. Housed in two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250v. A.C. mains. Fully isolated. Controllable at both units. An intercomm. of this class would normally cost £20-£30. Only 89/6, carr. 5/-. Ready for use, 6 gns.

R.S.C. BATTERY TO MAINS CONVERSION UNITS. Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supply 1.4v and 90v where A.C. mains 200-250v. 50 c/s is available. Suitable for all battery portable receivers requiring 1.4v. and 90v. Complete kit with diagram 39/9 or ready for use 46/9



JASON FMT1 V.H.F./F.M. Radio Tuner design. Total cost of parts including valves, tuning dial, escutcheon, etc. **£6.19.6**

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner (specially suitable for use with our Amplifiers). Delayed A.V./C. Controls are Tuning, W/Ch. and Vol. Only 250v. 15mA H.T. and L.T. of 6.3v. 1 amp required from amplifier. Size approx. 9 x 6 x 7in. high. Simple alignment procedure. Point-to-point wiring diagrams, instructions and priced parts list with illustrations, 2/6. Total building costs £5.5.0. S.A.E. for leaflet.

12in. 25 WATT HEAVY DUTY LOUDSPEAKERS

Famous make. Normal price approx. £12. **£7.19.9** Limited number. Fully guaranteed. Carr. 10/-

LINEAR TREMOLO PRE-AMP UNIT

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

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

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

12" R.A. DUAL CONE SPEAKERS 8 watt 3 ohm each **39/9**

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- Transistor Experiments
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- Basic Amplifier
- Basic Oscillator
- Basic Rectifier
- Signal Tracer
- Simple Counter
- Time Delay Circuits
- Square Wave Generator
- Morse Code Oscillator
- Simple Transmitter
- Electronic Switch
- Photo-electric Circuit
- Basic Computer Circuit
- Basic Radio Receiver
- A.C. Experiments
- D.C. Experiments

The full equipment supplied comprises; valves, transistors, photo-tube, modern type chassis board; printed circuit board; full range resistors, capacitors and inductors; transformers; potentiometers; switches; transistors; valves; all hardware, wiring and every detail required for all practical work *plus* CATHODE RAY OSCILLOSCOPE for demonstrating results of all experiments carried out. All practical work fully described in comprehensive PRACTICAL MANUALS. Tutor service and advice if needed.

This complete practical course will teach you all the basic principles of electronics by carrying out experiments and building operational apparatus. You will learn how to recognise and handle all types of modern components; their symbols and how to read a completed circuit or schematic diagram. The course then shows how all the basic electronic circuits are constructed and used, and HOW THEY ACTUALLY WORK BY USING THE OSCILLOSCOPE PROVIDED. *An application is given in all the main fields of electronics, i.e. Radio; control circuits; computers and automation; photoelectrics; counters, etc., and rules and procedure for fault finding and servicing of all types of electronic equipment.*

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PRACTICAL WIRELESS

JANUARY 1966
VOL 41 NO 707

BEGINNING AND END

AN interesting fellow was Janus. A principal divinity in Roman mythology, he was primarily the god of All Doorways and, being blessed with two faces, could observe both the interior and exterior of a house. This handy physiognomical duality also enabled him to obtain the jobs of god of Beginnings and god of Departure. He also played an important role in the creation of the world. The first month of the year—Januarius—bore his name. In fact, a very versatile and busy lad.

Even so, he also held the position of god of All Means of Communication and it is a sobering thought that if we were still in the days of the Roman Empire he would not only be Minister of Transport and Postmaster General, but President of the RSGB and Governor-General of the BBC.

We shall never know what he would have thought about the RAE, the virtues of SSB or the prospects of 14 Mc/s DX, but we can be sure he would have quickly dealt with pirate radio stations, licence dodgers, Party Political Broadcasts and other ills of our time. He might even have got together with his buddy Jupiter (President of the Board of Trade) and banned the import of 27 Mc/s walkie-talkies!

Reluctantly returning to earth let us, like the double faced Janus, simultaneously look backwards and forwards by thanking you all for your interest during the past year and wishing you

A Happy Christmas and Successful New Year from the Editor and Staff.

CONTENTS

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world. The FEBRUARY ISSUE WILL BE PUBLISHED ON JANUARY 6th

M.W.—D.X.

I FEEL I must compliment you on an excellent article called "M.W.—D.X." in the November issue of PRACTICAL WIRELESS. This is just the kind of text to encourage DX'ers against the streams of, "What's the point? . . . Why bother? . . . So what? . . ." people who just can't understand why we should stay up to 0400 for a few μV's from New York.

A. Peake.

Great Yarmouth,
Norfolk.

Batteries Offer

ABOUT this time last year, you printed in PRACTICAL WIRELESS my offer of free h.t. batteries. You may be interested to know that the response was very good. I despatched 109 to 71 applicants and still get the odd letters from people who have been reading back numbers. I had to turn down a further 20 requests as I had exhausted my supplies. However, the main purpose of this letter is to make an offer of 6V dry batteries. The size is approximately 5in. x 4½in. x 2¼in. and the weight 3¼lbs. Each battery contains eight cells wired in series/parallel to give 6v, and they can easily be rewired for 3 or 1·5V operation. Connection is by PVC covered wires. I can most easily send these in batches of four at 6s. post. (5s. 6d. plus 6d. packing). Please send Postal Orders and do not cross.

These batteries are ex-U.S. Forces, thrown away due to the elapse of the makers' life expectancy. However, they are really as good as new. One person who tried one of these told me that it ran his transistor set for 14 months.

H. Humphries.

Old Rectory,
Gazeley, Newmarket,
Suffolk.

Mr. Methven Please

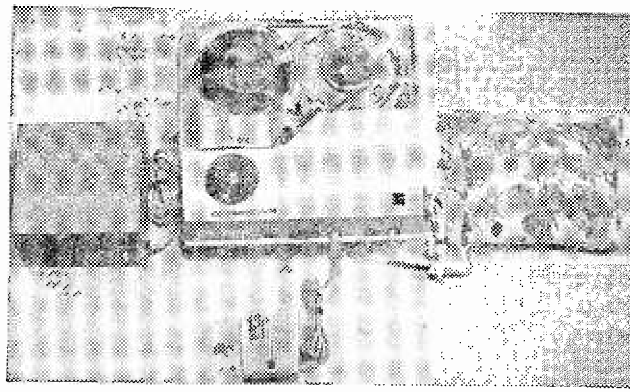
I WONDER if Mr. Methven (June 1965 issue. page 148) would get in touch with me, please, as I would like to communicate with him.

H. Seaton.

The Presbytery,
Foundry Hill,
Hayle,
Cornwall.

NEWS AND..

SLEEP-LEARNING EQUIPMENT



A number of researchers in America have laid great claims to the sleep learning method. It is particularly useful when a large number of facts have to be committed to memory, such as formulae, foreign languages etc.

The four simple basic requirements are a tape recorder, time switch, under-pillow speaker and a genuine desire to learn.

If you possess the latter requirement, then the first three can easily be obtained from R.C.S. Products, Ltd., 11 Oliver Road, London, E.17. £4 5s. 0d. buys the time switch with 14 day Swiss movement. The modified tape recorder complete with mic. and pre-recorded conditioning tape costs £23, and the pillow speaker 27s. 6d. The complete outfit may be obtained from R.C.S. Products at a cost of £29 10s.

PRACTICAL WIRELESS AND PRACTICAL TELEVISION FILM SHOW

The P.W. and P.TV. Filmshow is to be held on February 4th, 1966. For more details see the notice on page 783.

MASTERTAPE CHRISTMAS GIFTS

Mastertape (Magnetic) Ltd., announce that with every reel of Mastertape purchased over the Christmas period an empty spool of equivalent size will be provided free of charge.

The full reel and the empty spool will be packed together in a sealed polythene bag attractively over-printed with a Christmas motif.

BRITISH ELECTRONICS FOR AMERICAN AIRCRAFT

More British electronic equipment has been ordered by the Ministry of Aviation for the R.A.F.'s American Lockheed C-130 Hercules long-range transport aircraft.

Marconi Sixty Series transistorised airborne radio communications and navigation aids which are to be fitted, are already standard equipment in the majority of aircraft currently flying with the R.A.F.

Equipment specified includes the AD260 v.h.f. navigation system and the AD360 automatic direction finding system. The AD260 provides full v.h.f. navigation facilities and provides the instrument landing outputs used in the automatic landing system in the BEA Trident and also in the BOAC VC-10 aircraft. The AD360 is the standard Marconi airline automatic direction finding system. It features fully automatic crystal controlled tuning which was pioneered by the Company, and is still only available in Marconi ADF's.

..COMMENT

EQUIPMENT FOR UK3 SATELLITE

UK3, the first all-British satellite, is being designed and built by the Guided Weapons Division of the British Aircraft Corporation.

At the Glenrothes, Fife, plant of Hughes International (UK) Ltd., microglass diodes are welded on to printed circuit boards to be used in the telemetry ground equipment of the project. These diodes form part of the microminiaturisation of the decoding matrices used in the telemetry ground equipment.

EMBOSSED PLASTIC CALLSIGN PLAQUES

We have received from F. W. Harris & Co. Ltd., Town Hall Chambers, Lydney, Gloucestershire, a specimen callsign plaque. Inch-high letters are heat embossed into the white plastic background which measures 4in. x 2in.

The plaque, which is washable and easily drilled for fixing, costs 3s. inclusive. A free-standing version is priced at 4s.

CIVIL SERVICE RADIO SOCIETY

The Civil Service Radio Society will be pleased to welcome members of H.M. Civil Service and associated organisations to their meetings at the Science Museum, South Kensington. The meeting on 7th December featured films on amateur radio, and on the 21st there will be an informal meeting and a Christmas party. For further details, please contact the Secretary, Mr. G. Lloyd-Dalton, 2 Honister Heights, Purley, Surrey, or H. E. Reeve, G3JXZ, 284a Barking Road, East Ham, London, E.6.

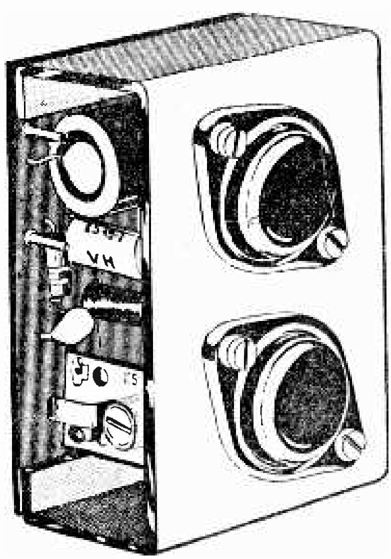
SOLID STATE AMPLIFIER

Messrs. Henry's Radio Ltd., 303 Edgware Road, London, W.2., are fast making a name as being one of the transistor people as far as the constructor is concerned.

Their latest offering is a ready built audio amplifier with a frequency response 30 c/s to 16kc/s. The sensitivity is 6 mV into 1kΩ for a push-pull output of 5W r.m.s., 10W peak with less than 1% distortion.

Despite the output, and the six transistors plus diode, the unit measures only 2⅞in. x 2in. x 1½in. and is available ready built and tested at £3 19s. 6d. plus 2s. post and package.

It uses a transformerless design, with outputs for 3, 4 or 5Ω speakers. An optional mains unit is available at 54s., and for the hi-fi enthusiasts, a full-function pre-amplifier at 79s. 6d.



more News and Comment on page 784

To Make, or To Buy?

WHEN reading the 'Editorial' and 'News and Comment' in the December 1965 issue of PRACTICAL WIRELESS, I felt that one point had been missed; the factor of technical advances in radio.

When most Amateurs were building their own equipment, the circuits and techniques were very elementary compared with the complexity of knowledge and highly advanced techniques of today. In the old days very good results were possible with simple equipment, since this equipment was norm. Today, however, one has to build modern first-class equipment to compete with the commercial product. This requires a great deal of knowledge and skill of the sort which is available to the professional. For the Amateur who does not earn his living in the radio or electronic industry these techniques are sometimes felt to be far too difficult to master, and who is to blame him for buying the commercial article?

B. Otter.
Durham City.

Thank-you Letter

IN reply to the request for the "Regency" blueprint which you kindly published for me, many readers sent copies. Some even enclosed the relevant issues of PRACTICAL WIRELESS, and one gentleman not only sent these but also enclosed the "Citizen" blueprint with the oscillator section completely wired and tested!

Will you through the medium of your columns thank all readers who helped me?

J. Owens.
Dolgellau,
N. Wales.

Correspondent Wanted

I AM interested in most branches of electronics. I would like to correspond with anyone who has the same interests and who is about the same age as myself (17).

David Higgins.
3 Woolgreaves Drive.
Milnthorpe.
Wakefield.

COVER SUBJECT

Push-Pull ELL80 Amplifier

3 VALVES ★ 8 WATTS

ALTHOUGH it uses only three valves and a minimum of other components this amplifier has an output of 8W and will reproduce records and radio programmes, etc., at high quality.

The Circuit

Referring to Fig. 1 it will be seen that the output stage employs only one valve, ELL80, which contains two pentode assemblies with a common cathode. Although rather expensive at present it is not unduly so when it is remembered that it takes the place of two and eliminates the problem of finding a matched pair of valves for the conventional push-pull circuit. The valve has a slope of 6mA/V and with 250V on anodes and screens and a bias resistor of 180Ω it provides a power output of 8·5W in return for a signal of 24V peak grid to grid. The signal currents through the two halves of the valve cancel out at the common cathode and the bias resistor does not have to be by-passed. Resistor R14 is included in the supply to the screens to ensure that, taking into account the voltage drop in the output transformer primary, the screen voltage will not exceed that at the anode.

The optimum load for the ELL80 is 11,000Ω. The specified output transformer is advertised for use with 6V6 or EL84 output valves but the manufacturers state that it is designed for a load of 10,000Ω and it is therefore suitable for the ELL80.

by V. E. HOLLEY

Phase Inversion

The valve V2 is a double triode, ECC83, one half of which is used to provide the two signals of opposite phase required by the output stage. Allowing for the decoupling provided by resistor R11 and capacitor C10 the supply voltage to the stage is 245V and with a total load of 200kΩ (R12+R13) the valve has an output capability of 27V r.m.s. This meets the requirement of the output stage with something in hand.

It will be noted that the cathode of V2b is about 120V above earth, which permits the grid to be directly coupled to the anode of V2a, so saving a coupling capacitor, grid and bias resistors. With this circuit the voltage across R13 is a little higher than that at the anode of V2a, thus providing working bias for the valve, a state of affairs which is automatically maintained irrespective of variations in supply voltage, etc. A further advantage is that direct coupling eliminates phase shift at extreme frequencies, which can be troublesome when feedback is applied over several stages as it is in this amplifier.

Heavy negative current feedback due to the large un-bypassed cathode load gives excellent linearity but the gain, as might be expected, is low, 0·9 each side or 1·8 times overall. For full loading the inverter therefore requires a signal of

$$\frac{24}{1 \cdot 8} \text{ or 14V approximately.}$$

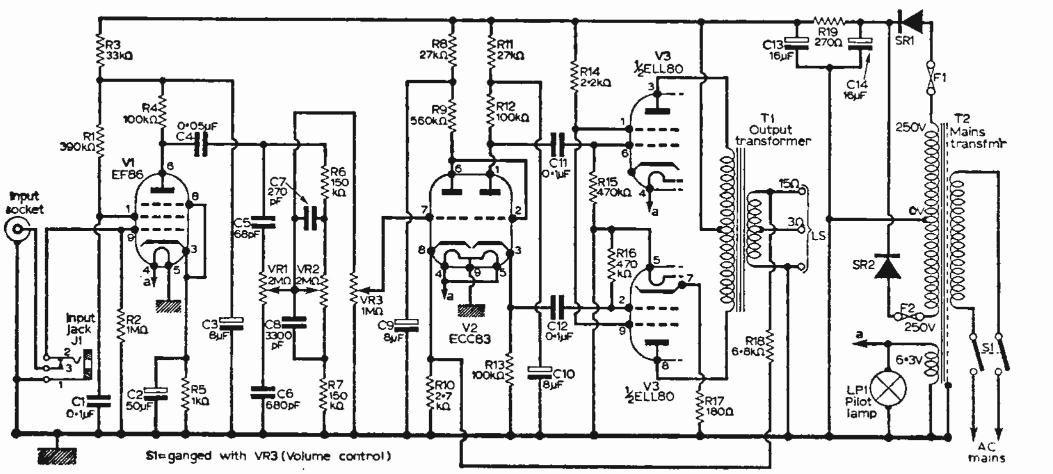


Fig. 1: Circuit diagram of the amplifier.

Voltage Amplifier

This signal is provided by V2a arranged as a conventional resistance coupled amplifier with decoupling provided by resistor R8 and capacitor C9. The bias resistor R10 is not by-passed, which saves a component and provides a convenient point for the injection of negative voltage feedback derived through resistor R18 from the secondary of the output transformer. This feedback compensates for deficiences in the transformer, reduces harmonic distortion and improves loudspeaker damping.

The values of resistors R10 and R18 are so chosen that in parallel they provide the correct bias for the valve, while in series they cause the desired percentage of the output voltage to be fed back. It will be seen that V2a operates with both current and voltage feedback and consequently with excellent linearity.

Preamplifier and Tone Controls

The gain of the amplifier from the grid of V2a onwards is insufficient for most purposes, especially when the losses due to the introduction of tone controls are taken into account. A fairly high gain preamplifier stage is therefore needed.

The valve V1, in a conventional resistance coupled circuit with anode load of 100kΩ, gives a stage gain of 120 times. A gain of 180 can be had here by increasing R4 to 220kΩ, R1 to 1·2MΩ and R5 to 2kΩ, but if this is done the signal handling capacity of the valve will be reduced and it will be necessary to replace the grid resistor R2 by a 1MΩ potentiometer so that overloading with large inputs can be avoided.

With the circuit of Fig. 1 overloading will not occur with any normal gramophone or radio tuner input. The radio signal input is taken from a coaxial socket through the closed circuit jack J1 to the grid. Insertion of the jack plug disconnects the radio input and connects any other desired input.

The preamplified signal from V1 is fed into a Mullard-type tone control network consisting of the potentiometers VR1 and VR2 and their associated resistors and capacitors and thence to the volume control VR3, which incorporates the mains switching. Insertion of the controls at this point in the circuit ensures that they are not liable to electrostatic hum pick-up and that any noise voltages originating in the first stage are reduced along with the signal when the volume is turned down. The values of the capacitors C5, C6, C7 and C8 gave a good range of control in the prototype but tone control is very much a matter of individual preference and the capacitor values can be varied as desired.

COMPONENTS LIST

Resistors (all ½w. unless otherwise stated)

R1	390kΩ	
R2	1 MΩ	
R3	33kΩ	
R4	100kΩ	
R5	1kΩ	
R6	150kΩ	
R7	150kΩ	
R8	27kΩ	
R9	560kΩ	
R10	2·7kΩ	
R11	27kΩ	
R12	100kΩ	Matched or 1%
R13	100kΩ	
R14	2·2kΩ	
R15	470kΩ	Matched or 1%
R16	470kΩ	
R17	180Ω 2w.	
R18	6·8kΩ	
R19	270Ω 1w.	
VR1	2MΩ log. (Treble)	
VR2	2MΩ log. (Bass)	
VR3	1MΩ log, with switch.	

Valves

V1	EF86, B9A base.
V2	ECC83, B9A base.
V3	ELL80, B9A base.

Capacitors (350v. working unless otherwise stated)

C1	0·1μF
C2	50μF 25v. electrolytic
C3	8μF electrolytic
C4	0·05μF
C5	68 pF
C6	680 pF
C7	270 pF
C8	3,300 pF
C9	8μF electrolytic
C10	8μF electrolytic
C11	0·1μF
C12	0·1μF
C13	16μF electrolytic
C14	16μF electrolytic

Transformers

Mains 250-0-250v. 80 mA. 6·3v. 2 amp.
Output Push-pull, 10/12 watts, 6V6 or EL84 to 3 and 15 ohms. R.S.C. (Manchester) Ltd.

Rectifiers

SR1, SR2—Silicon, BY100 or similar

Fuses

F1, F2 150 mA.

Indicator Lamp

6·3v.0·3 amp. and holder.

Miscellaneous

co-axial socket, closed circuit jack socket, aluminium for chassis, mains cable and plug, 22 s.w.g. tinned copper wire, sleeving, hardware, etc.

Power Supply

The amplifier requires an h.t. supply of 75mA at 265V under full load conditions and 2A at 6·3V for the valve heaters and indicator lamp. This is provided by a double-wound mains transformer and two silicon rectifiers, SR1 and SR2. Fuses are included to protect the transformer winding in event of a rectifier breakdown. The reservoir capacitor is virtually C14+C13; resistor R19 has little smoothing effect and is included only to reduce the h.t. line voltage to the required figure of 265V. Each of the earlier stages is provided with separate decoupling and smoothing, while in the output stage hum is almost completely cancelled out by push-pull operation. What little is left is very effectively suppressed by negative feedback and cannot be detected 12in. from the speaker.

There is, of course, no reason why a valve rectifier should not be used if preferred and the fuses F1 and F2 need not then be fitted. The onlv requirements are that the valve should be capable of passing the required current and that a heater supply for it is available on the mains transformer. The advantage of the silicon rectifiers is that they do not generate heat, which is a consideration if the amplifier is to be installed in a cabinet with limited ventilation.

Construction

The amplifier is constructed on a chassis of 16 s.w.g. aluminium sheet, 12in. x 5in. x 1½in., details of which are shown in Fig. 2. This allows plenty of room for everything, simplifies the construction and wiring and enables the constructor to make use of some of the older and bulkier components from the spares box. The wiring, for which 22 s.w.g. tinned copper covered with sleeving is suitable, is shown in detail in Fig. 3.

Note that in this diagram the positions of the components are approximate and the wiring has been opened out to make the connections clear. In construction all wiring should be kept to a reasonable length, particularly in the early stages, and if this is done no screening will be necessary anywhere in the amplifier. The positioning of the components is not critical.

Components

If silicon rectifiers are used the h.t. voltage will come on before the valves are warmed up and ready to receive it and all capacitors except C2 must therefore be 350V working.

The accuracy of balance in the inverter stage depends entirely on the values of the resistors R12 and R13. Close-tolerance components are not necessary but the two must be balanced as closely as possible to ensure that their values are identical. Alternatively 1% resistors can be used. These remarks apply also to resistors R15 and R16 in the output stage. The wattage rating for resistors is given in the components list.

Testing

First check that the valves are in the correct positions. The connections to V2 and V3 are such that if the valves are accidentally transposed a dead short will appear on the h.t. line. Next check with a meter on a high-resistance range between C14 and chassis to see that there are no shorts. The lead carrying the positive voltage from the meter battery should be applied to C14, when a large deflection should be observed, dropping back slowly to a reading of 1MΩ or more as the capacitors become charged from the meter battery. Now connect a speaker and apply power. If as the valves warm up there is instability, reverse the connections from the output transformer primary to the ELL80 anodes to make the feedback negative.

The following voltages should be found at the points indicated using a 20,000 o.p.v. meter. Any substantial departure from these figures should be investigated.

C3	to chassis	230V
C9	,, ,,	255V
C10	,, ,,	245V
C13	,, ,,	265V

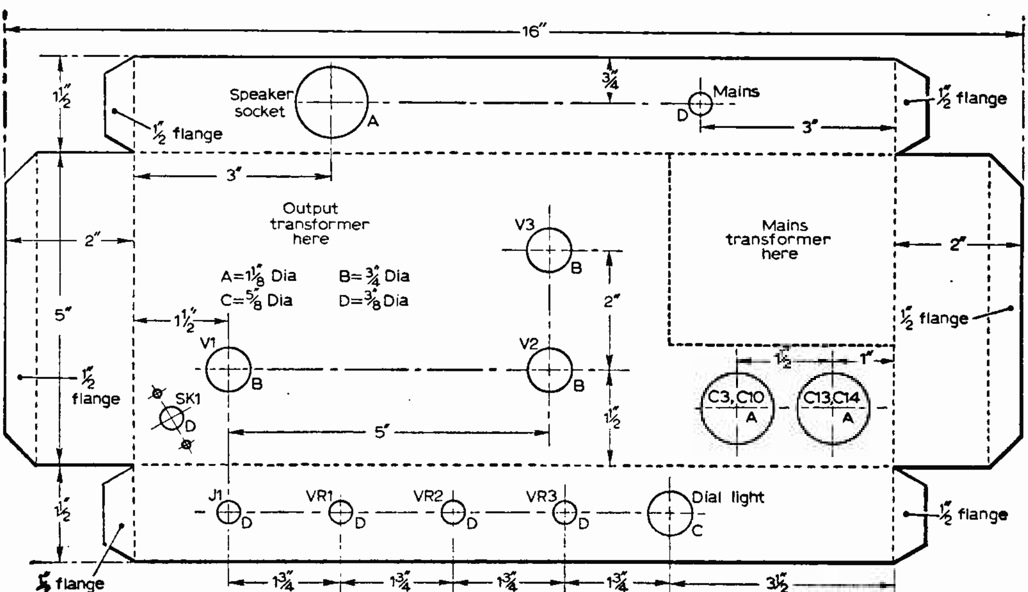


Fig. 2: Chassis drilling dimensions.

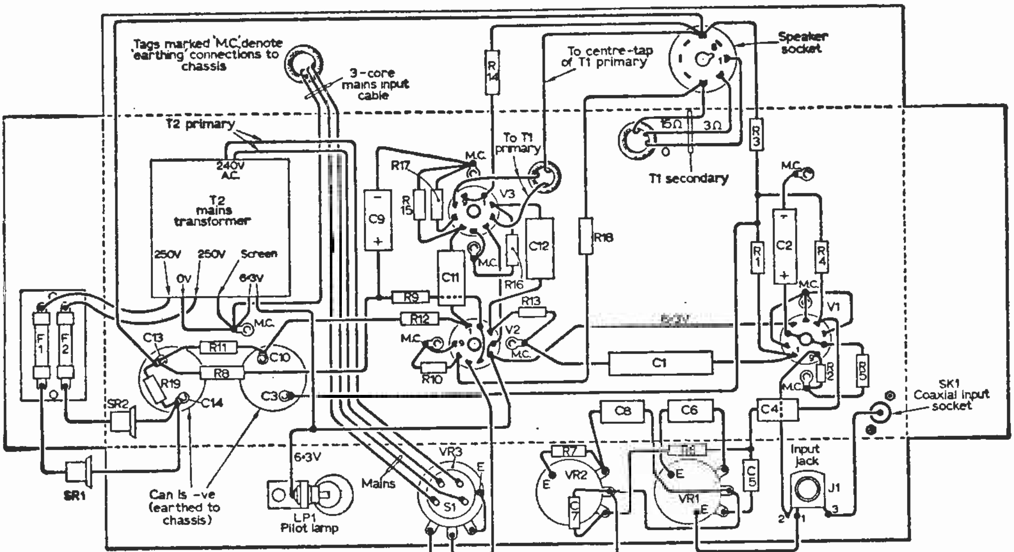


Fig. 3: Wiring diagram of the amplifier—underside view.

V3	anodes and screens	255V
V1	cathode	1·8V
V2a	,, ...	1·4V
V2b	,, ...	122V
V3	,, ...	12·2V

Operation

A good amplifier is of little use without a good speaker and it is equally important that the speaker should be suitably housed. The prototype gave excellent results with an 8in. column speaker fitted in a 9in. glazed ceramic drainpipe. Domestic objections to the pipe can be overcome by painting it with metallic paint. Another point to note is that while the tone controls have a good range they cannot be relied upon to compensate for large deficiencies in the input signal. The output from a pick-up, for instance, must be corrected for recording loss if the best results are to be achieved. ■

UNDERSTANDING F.M.

by W. Groome

RADIO is a progressive hobby. Sooner or later you will turn to frequency modulation for high quality, interference-free reception and will want to build your PW design with an understanding comparable with your knowledge of amplitude modulation. The main difficulty seems to be that of visualising the behaviour of the carrier and this impedes the study of the discriminator. Despite technical and mathematical proof most of us like to have a mental image of what goes on; we like to "get the picture" first and then proceed to advanced details. In this article much of the picture is aimed at your imagination, but there is no childish simplification and nothing that will conflict with any contemplated further study.

The basis of all signalling is change. Something must wave, wag, flash, flicker, hoot—there must be some noticeable or detectable change of a normally steady state. A radio carrier alternates at a high frequency but can be said to have a steady state when the frequency and radiated power are constant, producing—by rectification in the receiver—an unvarying voltage. It is easy to appreciate that changes in the transmitted power will produce corresponding changes in the rectified voltage and that such changes can follow the waveform of the audio signal.

This is amplitude modulation, with which we can take the carrier frequency for granted (as we do with most dependable things) and regard the easy relationship between carrier amplitude changes and rectified signal amplitude changes. With frequency modulation the carrier power is constant; the waveform and dynamic range of the audio signal are represented by changes of carrier frequency. Here lies one of the problems. The audio signal begins in the studio as a current or voltage varying in amplitude and it must emerge at some stage of the receiver in the same form. How can these changes of energy be conveyed by a carrier of constant power? A quick answer, which we shall develop later, is that they are not *conveyed*, they are *represented*. Another question arises from a glance at transmitter characteristics. How can we relate carrier frequency swings as wide as 150kc/s with the frequency and amplitude of audio signals in the region under 20kc/s?

Here I call upon your imagination. Fig. 1 represents the dial of a receiver. It is calibrated vertically in kc/s and has a pointer driven by the usual knob (not shown). A certain frequency is marked at the middle of the scale (f_c) and others are shown by the amount by which they are higher or lower than f_c. The receiver is selective and has a visual indicator (not shown) to tell you when a carrier is tuned in.

Imagine that a carrier has been located at f_c but it seems wayward; it is drifting and you have to retune. Still it drifts and as you manipulate the knob to follow it the pointer is driven up to +30kc/s, then you have to tune downwards to follow the carrier to f_c and then further down as far as −30kc/s. Here it drifts up again until the pointer finally returns to f_c.

Let us check what happened. The carrier drifted by a large amount — from f_c up to +30kc/s, then down to f_c and beyond to —30kc/s, finally returning to f_c. One whole cycle of change. Yes, just one cycle of change. Despite all the kc/s your pointer moved up and down in only one cycle, and if you like to go over it again in imagination you will find that the pointer movement agrees well with the rise and fall of a sine wave. You will also realise that the pointer, following deviations of frequency, had a certain *amplitude* of movement, which suggests the possibility of such conversion although not normally by a mental-mechanical process!

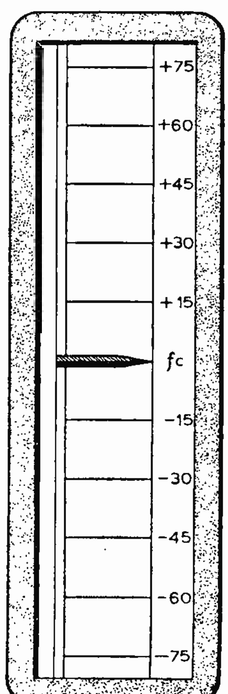


Fig. 1: You can follow the explanation of frequency deviation with this diagram.

If the response of the imaginary receiver is broadened to cover the entire bandwidth of 150kc/s a frequency meter scaled as in Fig. 1 can indicate the deviations directly without knob-twiddling. Now we watch the pointer go through the same change of plus and minus 30kc/s five times in one second. If the pointer had a pen over a moving band of paper the five cycles would be recorded as in Fig. 2.

Rolling the paper back for one further imaginary experiment we find that the deviations are much wider—the pointer swings 60kc/s each way instead of 30kc/s—but still at the same rate of five cycles per second. These are drawn in broken line in Fig. 2.

From all this it is clear that the *rate* of change

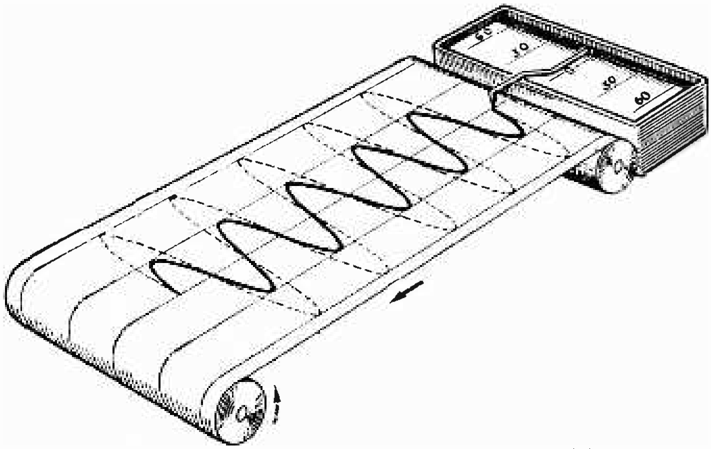
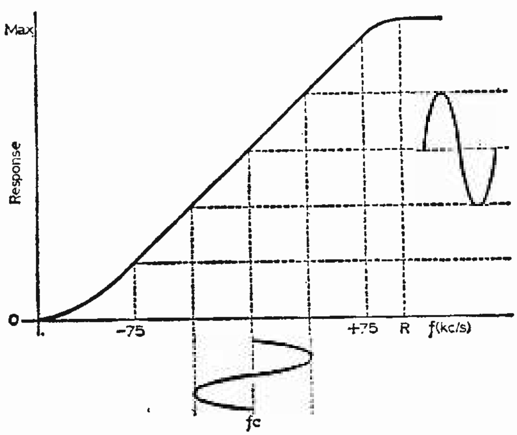


Fig. 2 (above): Carrier frequency deviations converted into modulation wave form.

Fig. 3 (below): Slope of LC circuit produces amplitude modulation from frequency modulated carrier.



of carrier frequency is the modulation frequency (five cycles per second in our slow-motion picture, audio frequencies in reality) while the *amount* of deviation represents the amplitude. Unlike the a.m. signal, frequency modulation does not transmit real amplitude changes ready-made. It represents them, it provides their patterns, it supplies signal designs from which the receiver must re-create the amplitude changes of audio tones. There must be built into the receiver some means of "knowing" what the frequencies "mean", some way of recognising that it must supply amplitude changes of voltage or current as instructed by the swinging carrier.

A tuned LC circuit does "know" this, for it is inherently frequency-sensitive, having a response that is maximum at the resonant frequency but falls away gradually to frequencies on either side. Fig. 3 shows one side of the kind of response we would like to have. A carrier arriving with constant amplitude will suffer varying losses as its frequency swings between the resonant peak and the point of lowest response, and will therefore emerge with an amplitude modulation. An ordinary a.m. detector will then demodulate the amplitude changes and lose the residual (and now unwanted) f.m. content in its r.f. filter.

This arrangement, the "slope" detector is merely a mis-tuned a.m. circuit. The straight slope of Fig. 3 is not attainable in practice and the normal curve brings serious distortion. For this reason, and because the degree of off-tuning is critical, the arrangement is rarely used.

If we broaden the response of a tuned transformer sufficiently it will no longer be frequency-sensitive within the flat bandwidth and will therefore fail to act as a slope detector. It will, however, be phase sensitive.

There is some difficulty in describing the action of phase discriminators without assuming the reader is familiar with the nature and effects of phase relationships. The subject is worthy of an article to itself but for the present we must settle for the statement that phase means the positions of a.c. cycles in time. For example, two trains of cycles may have the same frequency but the cycles of one may commence earlier or later than those of the other. Their result would depend on the amount (expressed in angular degrees) of "lead" or "lag".

The Foster-Seeley discriminator works by comparison of a signal after it has passed through two routes, of which one introduces phase shift and the other does not. In Fig. 4 the direct route via capacitor C1 produces no phase shift. The transformer secondary conducts it equally to the diodes for rectification and it appears in opposition across the total load R1 R2. In the absence of aid or opposition from elsewhere the two outputs would cancel.

In addition to this reference the signal also arrives via the tuned transformer with changes of phase dependent upon frequency. At the central, resonant frequency it is a quarter of a cycle ahead of the reference signal at one diode—it leads by

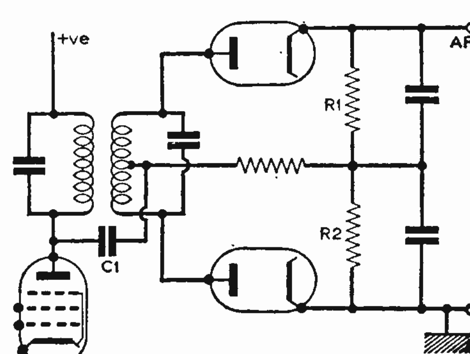


Fig. 4: Foster-Seeley discriminator.

90°—and at the other it lags by 90°. It can be shown by vector diagram that this combination in exact quadrature produces diode inputs greater than those of the reference signal alone, but they are still equal and therefore the diode outputs still cancel. This condition exists only for the resonant frequency. At all other frequencies the phase of the tuned transformer signal changes increasing the angle at one diode input and decreasing it equally at the other. The balance that produced equal aid to the reference signal is now disturbed and the total signal is now shared unequally between the two diodes. The rectifier outputs cannot cancel but must leave a difference. This difference voltage, varying as changing phase angles bring changing unbalance, is the a.f. signal.

The circuit is sensitive to amplitude modulation (which for practical purposes includes interference) and must therefore be preceded by a limiter. This is usually an over-driven i.f. stage which clips the tops and bottoms of the carrier waves to a uniform level, removing interference "spikes" in the same process.

This additional stage can be eliminated by re-arranging the circuit to make the diodes serve the dual roles of rectifiers and dynamic limiters. Fig. 5 shows a simple version of the ratio detector, the most popular system today. Although the reference signal is derived from the tertiary transformer winding instead of via a capacitor the signal conditions are much the same as in the Foster-Seeley circuit as far as the rectifiers. The diodes, you will notice, are connected to make their outputs additive across the load instead of subtractive. As the unbalance produced by phase shifts brings an increased input to one diode and an exactly corresponding decrease to the other the sum of the two outputs is always the same. The difference voltage is therefore due to the changing ratios by which the diodes contribute their shares to the total sum, and can be taken as an a.f. signal across either of the capacitors C2 C3 or either of the resistors R1 R2.

We have established the total diode-to-diode voltage as being (ideally) constant, and it can be

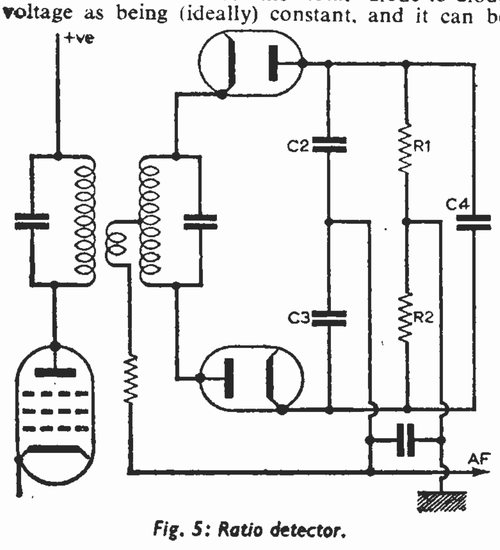


Fig. 5: Ratio detector.

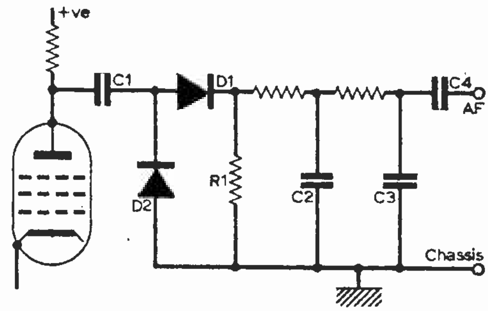


Fig. 6: Pulse-counter discriminator.

stabilised by a large capacitor C4, which charges to a level set by the average carrier amplitude and also absorbs some of the spurious signals that may be riding above the carrier. The diodes are tied to this steady bias and variations of carrier strength (and these include interference that "lifts" the carrier level) change the working points, varying their resistance inversely with the changes of carrier level. The diode resistance damps the tuned circuit, therefore a rise of carrier amplitude is countered by heavier damping and is unable to attain more than about 15% of its true worth.

The ratio detector is now seen to be a phase discriminator in which unbalanced diode output resulting from the phase shifts of frequency deviations in a tuned transformer provide an a.f. signal by their voltage differences and, by their sum voltage, a bias that enables the diodes to serve also as dynamic limiters. Although limiting is less effective than that of a separate stage it is adequate for most ordinary needs, and is achieved with economy.

Both discriminators depend upon accurate alignment of tuned transformers and upon the maintenance of this alignment once it has been attained. The conversion of frequency deviations to phase-shifts, thence to diode unbalance and difference voltages is reasonably accurate and distortion is variously claimed as being between 1% and 3%, which is below the standard required for transmitter monitoring and certain other high quality needs. For such purposes there is a system which gives a more direct and linear conversion of frequency deviations to a.f. voltages. The system is aperiodic—it has no tuned network—therefore the alignment problem does not exist and there is no long-term deterioration of the performance.

The receiver gives each carrier cycle a fixed value and adds them to obtain an output that is continuously proportional to their number. At the higher deviations the number of carrier cycles per given small period of time is obviously larger than the number arriving with the lower deviations and in an additive circuit these varying numbers of cycles will produce varying voltages. These constitute the a.f. signal. To give each cycle the same value regardless of frequency the carrier (i.e., i.f.) sine waves are converted into pulses, and this can be achieved in a simple overdriven limiter stage. In Fig. 6 clipped waves from the preceding limiter are passed through the differentiator network C1 R1 through diode D1 which passes pulses of one

—continued on page 783

on the Short Waves

MONTHLY NEWS FOR DX LISTENERS

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

The Broadcast Bands—by John Guttridge

ON November 7 most international stations introduced their winter schedules. Details of some of these are amongst this month's information.

Japan: *Nippon Hoso Kyokai* (Radio Japan, Tokyo) is using new frequencies for some General Service transmissions in English and Japanese. Between 1200 and 1730 9,505/9,560/11,815 are used. The 1800 and 1900 transmissions are on 9,505/9,560/9,605. From 2000—2030 9,560/9,605/15,195 are used.

Philippines: *Far East Broadcasting Co.* (Box 2041, Manila) replaced 15,385 by 11,850 for the 2330—0100 section of its English transmission on December 1. This transmission is also carried on 17,810. Other portions of the English service with new frequencies are 0830—0900 9,715/11,920/15,440/15,300/17,810 and 0900—1145 15,440/17,810. Full QSL.

Ryukyu Islands: *Voice of America* relay on Okinawa, can be heard in London until 1600 on 7,235 in Chinese. Station identification is given at 1600 in English.

Australia: *Radio Australia* (P.O. Box 428G, G.P.O., Melbourne) now transmits in English to British Isles from 0815—0915 on 9,570/11,710.

Canada: *Canadian Broadcasting Corporation* (P.O. Box 6000, Montreal) now uses 15,320/11,720 for the 1055—1315 segment of its European Service.

U.S.A.: *Voice of America* (U.S. Information Agency, 330 Independence Avenue, S.W., Washington 25, D.C.) now has following European English schedule: On 1,196 Munich 0400 0430, 0500—0730, 1600—1830, 2200—2345; 3,980 Munich 0300—0700, 1400—2345; 5,965 Tangier, 5,995 Greenville, 7,200 BBC and 7,250 0300—0730; 5,995 Tangier 1630—2245; 6,040 0500—0730; 7,205 Thessaloniki 1500—2300; 9,540/9,740 0430—0730; 9,760 1430—2245; 9,565/9,710 1900—2245; 11,760 1800—2215; 15,205 Greenville 1400—2215; 15,290 Tangier 1400—1800; 15,295 0600—0730; 17,780 Greenville 1400—1800.

Radio New York Worldwide (4 West 58th Street, New York City 19, N.Y.) has following new English schedule: 1200—1400 15,290 or 15,295/17,710 (plus 15,385 Saturdays and Sundays); 1400—1500 17,845/15,440 (plus 15,385 Saturdays and Sundays); 1500—1900 17,845/15,440/17,730; 1900—2000 15,440/11,970/17,845/17,730; 2000—2100 15,440/11,970/11.880/17,730; 2100—2145 11,970/9,740 or 9,570/11,880/17,730/15,440; 2145—2200 9,740 or 9,570/11,725 or 11,790. A new QSL card is now being issued. The Dx programme is now at 1330 and 2130 on Saturdays.

Cuba: *Radio Habana* (Apt. Postal 7026, Habana) transmits to Europe in English from 2010—2040 on 11,735.

Mexico: *Radiodiffusora Comerciales* (Quemada 40, Col. Narvarte), can be heard during the evening over XEWW on 15,110 with interference from Radio Iran on 15,112.

Netherlands Antilles: *Trans World Radio* (Bonaire), has been heard with English test transmissions at 0140 on 11,825; 1430 on 11,820 and 1825 on 15,180.

Brazil: *Radio Farroupilha* (Rua Vigario José Inacio 263, Porto Alegre, Rio Grande do Sul) has been heard as early as 1900 with excellent signal over ZYU60 on 15,335.

Austria: *Osterreichischen Rundfunk* (Wien IV, Argentinierstrasse 30a) transmits to Europe from 0500—2200 on 6,155; 0900—1900 7,245; and 0600—1700 on 9,770.

Bulgaria: *Radio Sofia* (Sofia) has an English transmission to Africa from 1905—1930 on 11,715/15,320.

Denmark: *Radio Denmark* (Shortwave Department, Radio House, Copenhagen V) has now returned to 15,165 for its transmission from 0900—1000.

France: O.R.T.F. (116 Avenue du Président Kennedy, Paris 16) has English for the U.K., Monday—Saturday on 6,175 at 2000—2015.

Germany: *Deutsche Welle* (Bruederstrasse 1, Postfach 344, 5 Köln) has now brought its Kigali, Rwanda, 250kW relay into full service. English transmissions are 0630—0715 on 11,905; 1215—1300 17,765; 1745—1830 17,805; 0430—0500 6,045; 1015—1045 9,735; 1545—1615 9,695. The new schedule for English programmes transmitted from Julich, Germany, is 0300—0340 5,980/7,175; 0845—0940 17,845/11,925/15,275; 2110—2200 5,980/7,175; 1550—1620 7,175/9,735; 0645—0715 9,605/11,785/15,275; 1015—1030 11,930/15,280/17,870; 1555—1630 9,610/11,890; 0130—0250 6,075/9,640; 0500—0540 6,145/9,735; 1510—1550 9,545/9,640/11,795. A new QSL card is being issued.

Greece: *Radio Athens* (Mourozi Street 16, Athens) may be heard on 9,605 during its 1030—1300 transmission except for 1045—1100 when there is a special transcription broadcast for North America on this channel from Deutsche Welle. Although all programmes from Athens are in Greek, the station (a rare catch) may be identified by its flute and bell interval signal.

Holland: *Radio Nederland Wereldomroep*, P.O.B. 222, Hilversum, how has six English transmissions (daily except Sundays). Details are 0730—0820 9,715/11,730/11,790 and 19m.b.; 1430—1520 17,810/15,425/6,020; 1900—1950 9,590/6,020 and 25m.b.; 2000—2050 19,25 and 31m.b. and 6,020; 2100—2150 9,590/6,085; 0130—0220 9,600 (Bonaire relay). Happy Station programmes on Sunday are 0600—0720 11,730, 9,715; 0730—0850 9,525/11,970 and 19m.b.; 1030—1150 9,710/5,980/6,020; 1430—1550 17,810/15,425/6,020; 1800—1720 19 and 25m.b.; 1900—

2020 11,730/9,590/6,085; 2030—2150 6,020 and 25, 31m.b.; 2200—2320 15,220/9,715.

Portugal: *Radio Lisbon* (Rua Sao Marcal 1A, Lisbon) has the following new English transmissions 0300—0345 5,975; 0730—0815 and 0815—0900 7,130/9,645; 2015—2100 6,025/7,225.

Switzerland: *S.B.C.* (3000 Berne 16) has completely new schedule. English to the U.K. is now at 1145—1315 on 9,665/11,865. Full details of the other English transmissions will be given next month.

Thanks this month go to John Sawyers (Ilford), J. W. Smith (Anstruther), Roy Patrick (Derby), Brian Burling (Rotherham), R. J. S. Gilchrist (Bristol), Radio New York Worldwide, S.B.C., and the International Short Wave Club.

The Amateur Bands—by David Gibson G3JDG

ANOTHER excellent month for the DX fans, especially on the h.f. bands. Twenty-one "megs" has opened with a real vengeance at times and the majority of logs received this month were for this band.

Yours truly was operating in the "Jamboree on the Air" event using the call G3GJX/A from Leverstock Green. At 0700 hours 21Mc/s proved a hive of industry and no trouble was experienced in raising JA stations in Tokyo and Osaka. It must be confessed that this was with 400W p.e.p. of s.s.b. to a two-band cubical quad.

My best on 20m from the home QTH was VK3ATN. Imagine my feelings when an s.w.l.'s report contained the same call—only the s.w.l. was using a t.r.f.! Brethren I am choked.

If you hear 3A2DA then you are listening to a pirate. **Geoff Haynes**, the real 3A2DA, would like any reports on this call. Time, band, etc. Geoff's address is Sans Nom, Fir Tree Road, Leatherhead, Surrey.

The L.F. Bands

Eighty looks very promising for the winter months. **James Brown** (Llandaff), 19 set, a.t.u. dipole, reports hearing some 20 W stations and 23 VE's, including VEØMS//MM (Baffin Is.). Others heard include K2GO, UA2KAN, ZB2AO, ZD8HL, 4X4AS, 7X2AH. **Peter Hickey** (Pinner), t.r.f. hooked K2KPM, K8HIR, TI2IO (Costa Rica), VE1IE, W—2ZPO, 3WJO, 3WPG, 4BW, YV5BMR ZL2BCG, ZL4LM, all around 0600 hours G.M.T. **A4238.** QTH unknown: RX107+PR30, 132ft long wire running SE/NW, DL, EA, HA5, HB9, HV1 (Vatican City), LX1, LZ, OH, OK, ON, SM, VE, VO, W4/P, YU, YV, 4U1, all on sideband. **D. M. Howarth** (Bolton), PCR3, 20ft vertical on 7Mc/s, DJ, LA5, OK, ON, PAØ, plus two nice ones, SV1CC, VK5VA.

14Mc/s and Higher

Dennis Goh using a transistor receiver with the P.W. add on b.f.o. raised DU, JA, KA, KG6, VK, VS6, VS9, XW8, 9M6. Not DX to him because Dennis is in Singapore. **Chris Freeman** (Nuthall), HE80+PR30, a.t.u. ground plane, CN8, FM7 (Martinique), FP8 (St. Pierre and Miquelon), KG4, LA2/MM, OD5, UI8, VK3, VK4, VP7, YS1, ZD8, 4X4, 5Z4. **Dave Hidmore** (Belper), HE40, dipole, CN8, CR4, CR6, EP2, FG7, HI8, HK, IØ, K7/VO2, KZ5, LU, OD, PY-1, 2, 5, 7, SVØ, TG9 (Guatemala), VP6, VP9, XE, YV3, ZB. All these logs are for 20 and the last 14Mc/s report comes from **Bernard Hughes** (Worcester), 840C+Codar preselector, dipole, KL7, KX6 (Marshall Is.), MP4 SVØ, UA9, VP9, VK-2, 3, 4, YV, ZL. **Stephen Beal** (Muswell Hill), P.W., May, 1964, t.r.f. 66ft long wire, 21Mc/s, AP3 (Pakistan), OD, SV, UB, VE, VP2 (St. Vincent), K1, W-1, 2, 3, ZB2, 4X4. **S. Barnes** (Newthorpe), PCR2, 30ft long wire, W-1, 2, 3, 4, 8, 9, K-2, 4, WA, WB, 4X4. **A. Smith** (Highbury Barn), HE30, Joystick, G3, K1 OD5, UA3, VE3, W-1, 3, 8, 9, Ø, 6W8 (Senegal).

28Mc/s

Paul Baker (Pontypool), HE30, 45ft long wire plus 14ft whip, CR6CZ, CR7FR, DJ, DL, GW5XN, I1, K2, LU1DAB, SM, SV1DB, W2AZD, ZS1BV, 9G1DM, 9J2DL. **R. Iball** (Worksop), SX28+PR30, 80ft long wire end fed with 35ft coaxial, CR7FR, CR7IZ, ZS1BV, ZS2CB, ZS2ND, ZS6MM. **Christopher Clarke** (Farnham), 10-valve s/het, 33ft wire around picture rail, CR7, CT1, DJ, DL, EA, ET3, G's, I1 LU, OD5, OE, OH, SV1, UQ2, VK2NN, W1, YV5, ZC4, ZS1, 5A1, 7X2, 9J2, all a.m. or s.s.b.

In General

Listen to the low end of 160 for W1BB/1. On 20m phone KW6 (Wake Is.), KM6 (Midway Is.), KJ6 (Johnson Is.), KR6 (Okinawa), all very active. K1ZBR/MM is the U.S.S. Calcaterra cruising around the Antarctic, whilst a VK9 is reported operating from Papua Territory.

One piece of news perhaps not generally known is the RSGB news bulletin broadcast on Sunday mornings. The London area has a transmission on 3·6Mc/s at 0930 hours.

The Severn area at 1000, Belfast 1015, North Midlands 1030, North West England 1100, South West Scotland 1130, North East Scotland 1200. All these on 3·6Mc/s.

For the two metre enthusiasts the news is also broadcast on Sunday mornings as follows:—145·1Mc/s 0930 beaming North from London. 145·1Mc/s beaming West from London. 145·8Mc/s 1015 beaming South from Belfast. 145·3Mc/s 1030 beaming North West from Sutton Coldfield. 145·3Mc/s 1100 beaming South West from Sutton Coldfield. 145·5Mc/s 1130 beaming North from Leeds. 145·5Mc/s 1200 beaming East from Leeds.

That's it for this year. Thanks to all who sent in logs. Please keep them coming. Best 73, Mri Christmas es cuagn next year.

AERIAL TUNERS

HAM FEATURE

by R. F. Graham

A TUNER is essential with some aerial systems and optional with others. It may offer some of the following benefits:

Increased receiver signal strength.
Proper loading of a transmitter.
Reduced harmonic output.
Transformation from an unbalanced (coaxial) circuit to balanced feeders.
Multi-band working with an aerial otherwise unsuitable.
Use of whips or very short wires.

Increased signal strength and proper loading are often a matter of securing an impedance match between aerial or feeder and receiver or between transmitter and aerial or feeder. This is easily arranged for the impedances likely to be encountered.

Reduction of harmonic output may be incidental with the use of the tuner for other purposes or may be sought to alleviate television interference. Transformation from unbalanced to balanced feeders is necessary when working a transmitter pi-output into balanced feeders—that is, open wire tuned or untuned lines and 300Ω, 75Ω and similar twin-lead feeders. The balanced system may also reduce TVI or BCI. The change from twin balanced feeders to coaxial feeder may also be needed for best working of a receiver not having twin or dipole aerial sockets.

For multi-band working with the usual types of aerial a tuner is almost essential. It allows best results from a simple wire.

As the tuner often matches impedances (Z) it is sometimes called a Z-match. In general any tuner can be made to perform satisfactorily with any aerial, receiver and transmitter if the inductance and capacity values are suitable. The construction and components can be varied enormously with no significant change in results.

Fig. 1 shows the method adopted to investigate tuners used with various aerials and transmitters. The transmitters had pi-output (unbalanced coaxial) circuits of usual type. A standing wave bridge indicates what is happening between transmitter and tuner but is otherwise often relatively unimportant. The r.f. meter indicates aerial current. A useful field strength indicator is a pick-up aerial very remote from the transmitting aerial with diode rectifier and giving readings through a long, buried feeder, a microammeter being visible from the operating position.

It was generally found that field strength was the same with *any* tuner provided it was correctly adjusted. Also that the standing wave ratio on a short coaxial line from the transmitter to the tuner might have no significance from the point of view of maximum radiated signal strength. (This is expected because the transmitter pi-tank can handle high standing waves.) It was also noted that maximum field strength coincided with maximum aerial current through the r.f. meter provided nothing was done to change the feed point impedance. So tuning for maximum aerial current corresponds to tuning for maximum radiated signal strength.

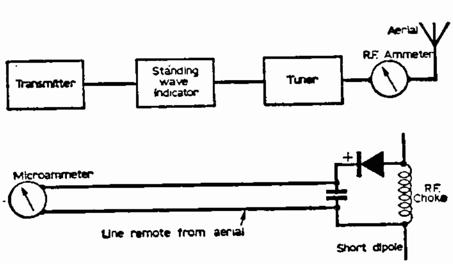


Fig. 1: Equipment to test tuner and coupling efficiency.

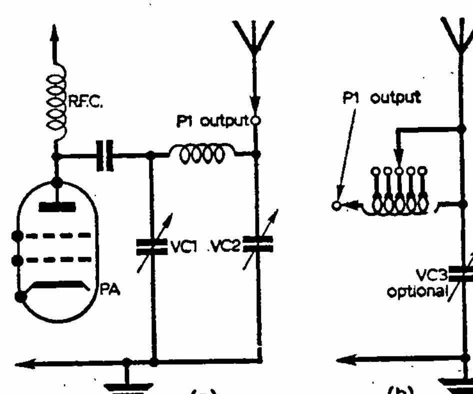


Fig. 2: Operating directly from the transmitter.

Single Wire Feed

The end of the aerial or its downlead is the feed point with an end-fed aerial. In the simplest possible system the aerial is taken directly to the transmitter pi-tank (Fig. 2a). This allows correct loading of the p.a. only if the aerial presents an impedance within the pi-tank range.

TABLE

Band	Coil	Capacitor	Purpose
160	40 turns. 20swg. 1½in. dia. Link 11 turns.	300pF	Fig. 7A, 7B.
80	26 turns. 16swg. 2½in. dia. 3½in. long. 3-turn link	150pF 150+150pF	Fig. 4, 5A Fig. 5B, 8
40	7 turns each side centre tap of above	150 or 100pF 150+150pF	Fig. 4, 5, 6 Fig. 5B, 8
20/15	3 turns each side centre tap of above	100 or 50pF or 100+100pF	Fig. 4, 5, 6
10	7 turns. 14swg. 1½in. dia. 2in. long. Link 1 or 2 turns	50pF or 100+100pF	Fig. 4, 5, 6
80	28 turns. 14swg. 4½in. dia. 4in. long	—	Base loading 10ft. Whip Fig. 7C
80/40/ 20/15/ 10	26 turns. 18swg. 2½in. dia. 3½in. long. Clip tap any turn.	150pF optional.	Fig. 2B
80/40/ 20/15	30 turns. 26swg enam. side by side. ¾in. dia. Tapped at 3, 5, 7, 12 and 20 turns.	150pF	Receiver only Fig. 4, 5, 7B
80/40/ 20/15/ 10	30 turns. 14 swg. 2½in. dia. Clip tap any turn	Optional in parallel, 150pF for 80, 50pF for 40/10	Whip or short wire. Fig. 5A, 7C
80/40	30 turns. 14swg. 4in. dia. 5½in. long. Tapped 7 turns each side centre	200+200pF or 100pF	Fig. 5, 6
20/15	14 turns. 14swg. 2in. dia. 3in. long. Tapped 4 turns each side centre	100+100pF or 50pF	Fig. 5, 6

If the aerial is resonant at the working frequency the impedance is resistive because current and voltage are in phase. The impedance $Z=V/I$ (voltage divided by current). Fig. 3 shows the distribution of current and voltage on a $\lambda/2$ (half-wave) aerial. At each end current is small and voltage high. At the centre current is large and voltage small. Therefore the end impedance is high and the centre impedance is low. Typically the end impedance may be some thousands of ohms while the centre impedance is about 70Ω. If the aerial is a $\lambda/2$-wave fed at X, the feed impedance into which the pi-tank must operate is high. If the aerial is $\lambda/2$ and the feed point is Y, then the impedance is low. At intermediate lengths such as Z the impedance has some intermediate value.

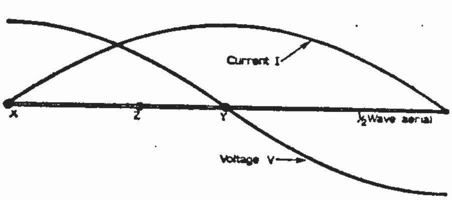


Fig. 3: Distribution of current and voltage on an aerial.

When the aerial is not resonant at the working frequency its feed point has capacitive or inductive reactance. If the reactance and impedance values fall within the range of the pi-tank, then the transmitter can be loaded directly into the aerial, Fig. 2a.

The usual pi-output circuit can be adjusted to work into impedances from about 50 to 300 or 500Ω, actual limits depending on component values. Therefore a transmitter will quite often work into a random length of wire. If the impedance falls outside the range of the pi-tank, the transmitter cannot be loaded correctly, and if the feed impedance is high the voltage across VC2 is large, and it may spark over, especially on modulation peaks.

If difficulty arises with a given length, the addition of a loading coil Fig. 2b may cure this. Tappings allow the feed point impedance to be adjusted until the pi-tank can operate into it successfully. The variable capacitor VC3 (additional to aerial capacity) is optional. It allows fine adjustment with few tappings, coil and capacitor forming an L network.

The use of this type of tuner will allow any ordinary pi-tank to work into any aerial length from a few feet up to long wires which are many multiples of a λ/2. It is thus quite a convenient circuit to employ.

Parallel Tuned Circuits

An end-fed aerial or single wire feeder can be worked from a parallel tuned circuit (Fig. 4). L1 is a coupling link, usually two or three turns, connected by coaxial feeder to the pi-tank. L2 is tuned to the working frequency by VC1. Point X or point Y is earthed. The aerial tapping is near earth on L2 for low impedances and far from earth (near the coil top) for high impedances. Almost any impedance can be fed, the tapping being moved from the earthed point a turn or so at a time until correct loading is obtained.

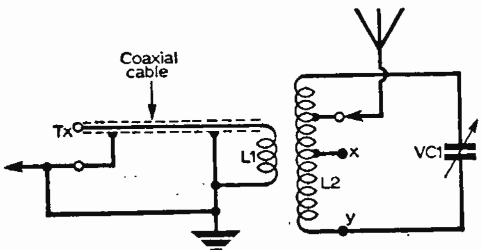


Fig. 4: Parallel tuner for end-fed aerials.

Fig. 4 has the advantage that L1 is grounded to the transmitter chassis and the p.a. h.t. can never reach the aerial, even if the anode blocking capacitor failed. L2 tuned by VC1 gives some suppression of harmonics.

The use of a tapped coil, L1 in Fig. 5a, gives similar results. With medium and high power the voltage across VC1 will be very high. Fig. 5b has the advantage that the voltage across sections of the two-gang capacitor VC2a and VC2b is halved. Point X may be earthed instead of the coil centre tap. If X in Fig. 4 or Fig. 5b is earthed the link is wound on the centre of the main coil.

With receivers the same circuit can be used. Adjustment is then for maximum signal strength. Where the aerial impedance was a bad match for the receiver input impedance at some frequency the tuner may increase signal strength some S points at this frequency.

Single wire feeders include the end of Marconi (λ/4) and end-fed Hertz (λ/2) aerials and the downlead of systems such as the Windom. All random length end-fed aerials also terminate in a single feed point.

Coaxial to Balanced Feeder

Most transmitters have a coaxial output socket. This can be transformed to balanced feeder by using a tuner as in Fig. 6. L1 and L2 can be the same as in Fig. 4 or 5. If the single capacitor VC1 in Fig. 4 is used it should be operated through an insulated extension. The two-gang capacitor (Fig. 6) helps to maintain balance.

The twin feeder may be 75Ω flat twin, 300Ω flat twin or an open wire line. The coil centre tap Y may be earthed or the capacitor at X. The feeder taps are near Y for low impedance and farther from Y for high impedance. With an open wire tuned line having high impedance the feeders may be connected to the ends of the coil.

A λ/2 centre-fed dipole can be used in this way with a balanced twin feeder instead of having a coaxial feeder from the pi-tank. Harmonic output is reduced and the balanced system may help avoid TVI.

Series Tuning

Low-impedance feed points can be handled by tappings near the earthed point of a parallel tuned coil. For very low impedances the tapping becomes critical and may be awkward. So series tuning is then often employed.

This is quite popular with a λ/4 Marconi and similar short aerials. The capacitor VC1 in Fig. 7a is in series with the coil L2. L1 is a coupling link from the transmitter. Using a tap on L2 b gives similar results. The aerial is series tuned against ground and a good earth is required for best results.

It will be seen that the circuits in Figs. 4 and 5 can be used for series tuning by placing the capacitor in series with the main coil. Series tuning is often employed on 160m where it is impracticable to erect a λ/2. Whips and short aerials can be fed by this means. The capacitor may sometimes be omitted, Fig. 7c. The tapping positions are then more critical as there is no other means of adjustment.

When a Zepp or tuned doublet is used and has a low impedance feed point, series tuning is often used (Fig. 8a). The centre tap Y may be earthed. One capacitor is sometimes omitted. Occasionally the coil is divided by cutting the centre turn and a single capacitor is placed here, Fig. 8 (B). This maintains the balanced system with a single capacitor. A coaxial line can also be fed by series tuning (C, Fig. 8).

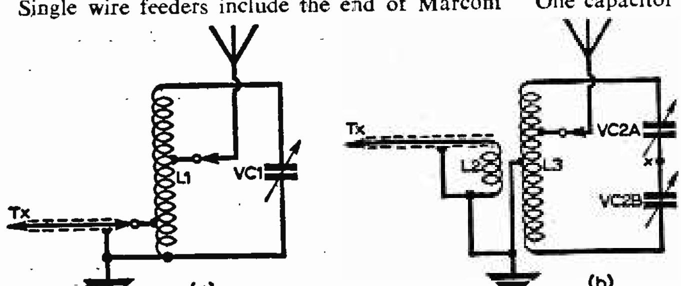


Fig. 5: Alternative systems of coupling and tuning.

Other Circuits

Most tuners are derived from the circuits given. The coil may have tappings for multi-band operation. Tests made with an efficient 80m coil, tapped for 15 and 20m, showed no measurable

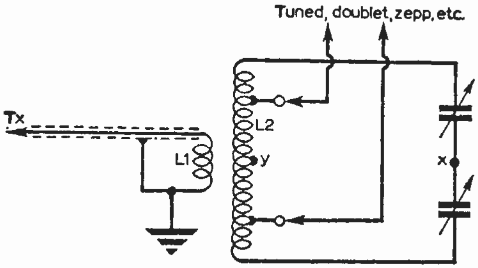


Fig. 6: Coupling to twin feeders.

loss in signal strength compared with a coil wound for 15 and 20m only.

In any of the circuits a capacitor is sometimes included in series with the link so that the reactance of this may be tuned out.

Various particular circuits are seen and aim to avoid band switching or secure some other advantage. One is shown in Fig. 9a. VC1 and VC2 allow series tuning of L2, VC3 being set at minimum. If parallel tuning is required VC3 is used. Another circuit is that at B. VC3 and VC4 are in series across L3, L4 being high impedance at this frequency. When the frequency is that covered by L4, VC4 is effectively in parallel with VC3, the few turns of L3 having little effect. The aim is to cover two or more bands without switching. In general the circuits shown earlier give at least equivalent results.

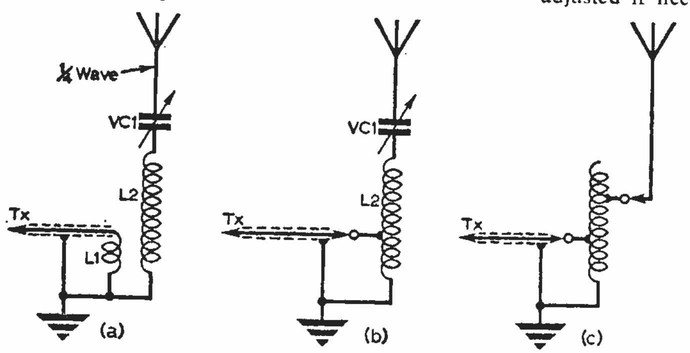
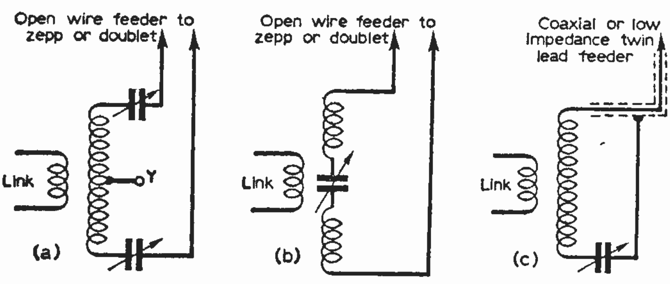


Fig. 7 above): Series tuning for Marconi aerials.

Fig. 8 (below): Circuits using series tuning.



Practical Construction

For receiving only, receiver-type coils and variable capacitors may be used. A 100pF or 200pF air-spaced variable capacitor and coil having about 30 turns of 22 s.w.g. wire will allow coverage of 15 to 80m bands in most cases. It is necessary either to use bare wire with spaced turns or to provide tappings so that clips can be attached at several points. Using the circuit in Fig. 5a one clip may be used for aerial, one for receiver and one to short turns on L1 to allow the required band to be reached by VC1. Other circuits may be used in the same way.

For transmitting with other than low power the coil must be of generous size, wound with stout wire. Many surplus self-supporting and similar coils are satisfactory. An Eddystone ceramic 2½ x 5in. former is obtainable which takes up to 26 turns of 12 s.w.g. wire and is suitable for 10-80m with power up to 150W. For 160m more turns will be required, but power is low, so a solenoid of cotton or enamel covered wire is often used.

With series tuning receiver-type variable capacitors may be used as voltages are low here. These capacitors spark over with other than low power in parallel tuned circuits, so components with spacing similar to that found in the transmitter pi-tank anode position are necessary. The capacity is often not too important as larger values to hand may be fitted.

Some typical coils and capacitor values are given in the table. Any reasonable s.w.g. and coil size can be satisfactory, the number of turns being adjusted if necessary. Coils should be efficient—self-supporting or on low-loss formers and of large diameter and stout wire.

The simplest method of construction is a flat baseboard, carrying coil and variable capacitor. Clips on short leads will allow capacitors to be in series or parallel as wanted. An obvious development is to add a multi-way switch to give band selection. For Fig. 2b a single pole 12-way switch is suitable. Other circuits can use a two-pole, five-way switch for five bands, tappings being soldered to the coil. Components may be housed in any convenient cabinet. For coaxial input a coaxial socket allows the transmitter to be connected, using a short length of 75Ω or similar cable equipped with plugs.

Adjustments

For receiving only, adjustments are directed towards securing the best signal strength. A tuning or signal strength meter should be fitted to the receiver if not present. Adjustments can be

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CV77	5/-
CV102	1/-
CV103	4/-
CV4004	7/-
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CV4015	5/-
CV4025	10/-
CV4046	40/-
CV4049	6/-
CY31	6/6
D1	1/6
D41	6/-
D61	6/-
D77	3/3
DA30	12/6
DAF96	6/-
DD41	4/-
DET5	8/-
DET20	2/-
DET25	15/-
DF73	5/-
DF91	3/-
DF92	3/-
DF96	6/-
DK92	6/6
DK96	6/6
DL92	5/-
DL93	6/-
DL94	5/9

DL96	6/-
DL810	8/-
DL819	15/-
E80F	23/-
E88CC	12/-
E90CC	10/-
E1148	2/6
E1266	50/-
E1415	30/-
E1524	12/6
EA50	1/-
E173	7/-
EABC80	5/9
EA91	3/6
EAF42	8/-
EB34	1/6
EB91	3/-
EBC23	6/-
EBC41	7/-
EBC81	5/-
EBF80	5/-
EBF83	7/6
EBF89	6/9
EC52	4/-
EC53	12/6
EC70	4/-
EC90	2/-
EC91	3/-
ECC81	4/-
ECC82	5/-
ECC83	6/-
ECC84	5/6
ECC85	6/6
ECC88	9/-
ECC91	4/-
ECF82	7/-
ECH42	8/-
ECH81	5/-
ECH83	7/6
ECL80	6/-
ECL82	7/6
ECL83	10/-
ECL86	10/-
EF36	3/4
EF37	7/-
EF40	8/-
EF50	2/6
EF52	6/-
EF53	4/6
EF55	8/-
EF71	7/6
EF72	5/-
EF73	5/-
EF74	4/-
EF80	5/-
EF81	6/-

EF85	4/6
EF86	6/6
EF89	5/-
EF91	2/9
EF92	2/-
EF95	5/-
EF183	8/-
EF184	8/-
EHT1	300/-
EL32	3/9
EL34	10/-
EL36	5/-
EL38	17/6
EL41	7/-
EL42	8/-
EL50	8/-
EL81	8/-
EL83	6/3
EL84	5/-
EL85	8/-
EL91	4/6
EL95	5/-
EL360	20/-
EM80	6/-
EM81	7/6
EM84	6/3
EN31	10/-
ESU74	80/-
ESU208	6/-
EY51	5/6
EY86	6/6
EY91	3/-
EZ40	6/6
EZ41	6/6
EZ80	5/6
EZ81	3/6
F/6057	5/-
F/6061	5/-
F/6063	4/-
FW4/500	6/6
FW4/800	8/6
G1/236G	9/-
G1/370K	20/-
G50/2G	5/-
G180/2M	15/-
GM4	45/-
GZ32	10/-
GZ34	10/-
H63	7/-
HK54	22/6
HL2K	2/6
HL23	6/-
HL23DD	5/-
HL41	4/-
HVR2	9/-

K3A	30/-
KT8C	22/-
KT32	8/-
KT33C	6/-
KT44	5/9
KT63	4/-
KT66	12/9
KT67	15/-
KY76	8/6
KT88	20/-
KTW61	4/6
KTW63	2/-
KTZ41	6/-
KTZ63	5/-
M8100	9/-
M8142	12/-
M8161	7/-
MH4	5/-
MHLD6	10/-
ML6	6/-
N78	15/-
NE17	7/-
OB3	7/-
OC3	5/-
OD3	5/-
OZ4A	5/-
PCC84	5/-
PCC85	7/-
PCC89	10/-
PCF80	6/6
PCF82	6/6
PCF84	6/-
PCL81	9/-
PCL82	7/-
PCL83	8/3
PCL84	7/-
PCL85	8/6
PCL86	9/-
PEN25	4/6
PEN46	3/-
PEN200A	3/-
PL36	7/6
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PL81	7/-
PL82	5/-
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PT25H	7/6
PT25M	7/6
PX4	14/-
PX25	9/-
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PY80	5/6
PY81	5/6
PY82	5/-
PY83	6/-
PY800	6/6
PZ1-35	9/-
PZ1-75	12/-
QP21	6/-
QP25	5/-
QP230	5/-
QS95/10	5/6

QS150/15	10/-
QS1202	8/-
QV04/7	8/2
R3	8/-
RG4/1250	60/-
RK72	6/-
SL30P	15/-
SL30	12/6
SP2	8/6
SP41	1/6
SP61	1/6
SP210	3/6
STV280/40	12/6
SU2150A	10/-
S11G12	10/-
T41	6/6
TDOX-20	70/-
TP22	5/-
TP25	15/-
TT11	5/-
TT15	35/-
TTR31	45/-
TZ0520	4/-
TZ20	16/-
U81	30/-
U12/4	8/-
U17	5/-
U18	6/-
U25	11/-
U27	8/-
U52	4/6
UABC80	6/-
UBC41	6/-
UBF80	5/6
UBF89	6/6
UBL21	11/-
UCC85	6/6
UCH42	8/-
UCH81	6/-
UCL82	8/-
UCL83	10/-
UF41	7/-
UF89	6/-
UL41	8/-
UL84	5/6
UU5	7/-
UU9	8/6
UY21	7/6
UY85	5/-
V1120	4/-
V1507	5/-
V1924	20/-
VMP45	12/-
VP23	3/-
VP133	9/-
VR99	8/-
VR105/30	5/-
VR150/30	5/-
VU33A	4/-
VU39	6/-

VX3256	4/-
VX8122	5/-
VX8124	5/-
W21	5/-
W118	8/-
W119	8/-
X66	7/6
X118	8/-
X145	8/-
Y63	5/-
Y65	4/-
Y66	8/-
YF	1/-
Z800U	20/-
Z801U	10/-
1A3	8/-
1A5GT	5/-
1B22	30/-
1C5GT	6/-
1D8GT	6/-
1E7G	7/6
1F2	3/-
1G6GT	6/-
1L4	2/6
1LA6	6/-
1LC6	7/-
1LH4	4/-
1N21B	4/-
1N43	4/-
1N70	4/-
1R4	5/-
1R5	3/6
1S4	5/-
1S5	4/6
1T4	2/-
2A3	5/-
2A5	6/-
2B26	8/-
2C26	7/-
2C26A	3/-
2C34	2/6
2C43	12/6
2C45	22/6
2C46	30/-
2C51	12/-
2D21	5/-
3A4	4/-
3A/108A	20/-
3A/46J	35/-
3A/167/M	25/-
3B7	5/-
3B24	5/-
3D6	4/-
3E29	50/-
3Q4	6/-
3Q5GT	7/-
3S4	4/-
3V4	5/9
3X2	3/-
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4D1	4/-
5A173G	5/-
5A174G	5/-
5B251M	25/-

5B254M	40/-
5B255M	35/-
5R4GY	9/-
5T4	7/-
5U4G	4/6
5V4G	8/-
5X4G	8/6
5Y3G	4/-
5Y3GT	5/-
5Y3WGTB	9/-
5Z4G	6/6
5Z4GT	8/-
6AB6	4/-
6AC7	2/-
6AG5	2/6
6AG7	6/-
6AH6	10/-
6AJ7	3/-
6AK5	5/-
6AK7	6/-
6AL5	3/-
6AL5W	7/-
6AM5	2/6
6AM6	4/-
6AQ5	7/-
6AQ5W	9/-
6AS6	4/-
6AS6W	9/-
6AS7G	20/-
6AT6	3/6
6AU6	7/-
6AX4	8/-
6B7	6/-
6B8G	2/6
6BA6	4/-
6BA7	5/-
6BE6	4/3
6BJ7	7/-
6BQ7A	8/-
6BR7	9/-
6BW6	9/-
6C4	2/-
6C5G	2/6
6C5GT	6/-
6C6	4/-
6C6G	3/-
6C8G	3/-
6CH6	4/6
6C21	80/-
6CL6	9/-
6D6	3/-
6E5	6/-
6F5G	5/3
6F5GT	5/9
6F6G	4/-
6F7	6/-
6F8G	6/6
6F12	4/6
6F13	5/-
6F14	5/-
6F32	4/-
6F33	3/-
6G6G	2/6
6H6M	1/6

6J4WA	10/-
6J5	6/-
6F5G	2/-
6J6	3/6
6J6W	6/-
6J7G	5/-
6J7M	8/-
6K6GT	5/6
6K7G	2/-
6K7GT	4/9
6K8G	3/-
6K8GT	8/3
6K8M	6/6
6L5G	6/-
6L6GA	7/6
6L6M	11/-
6L7G	4/-
6L34	4/6
6LD20	5/9
6N7	6/-
6N7G	5/9
6Q7G	6/-
6R7	5/6
6SA7	7/-
6SA7GT	6/6
6SK7GT	4/-
6SC7	7/-
6SC7GT	5/-
6SFGT	5/6
6SH7	3/-
6SJ7	5/-
6SJ7GT	5/6
6SJ7G	6/6
6SK7	4/6
6SL7GT	5/6
6SN7	3/6
6SQ7GT	6/-
6SS7	2/-
6U4GT	9/6
6V6G	5/-
6V6GT	7/6
6V6M	8/-
6X4	3/6
6X5G	5/-
6Z5GT	5/3
6Y6G	6/-
6-30L2	10/-
6Z4	5/-
7B7	7/6
7C5	10/-
7C6	7/-
7C7	6/-
7H7	7/3
7Q7	7/-
7V7	5/-
7Z4	4/6
8D2	2/6
9D2	3/-
9D6	3/6
12A6	2/6
12AH7	5/-
12AH8	11/-
12AT7	4/-
12AU7	5/-
12AX7	6/-

12AY7	10/-
12BA6	5/-
12BE6	7/-
12BH7	7/-
12C8	3/-
12H6	2/-
12J5GT	2/6
12J7GT	6/6
12K7GT	2/-
12K8M	10/-
12Q7GT	3/3
12SA7	7/-
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	5/-
12SK7GT	3/-
12SNTGT	5/9
12SR7	5/-
12Y4	2/-
12L7	7/-
15D2	6/-
19E2	15/-
19G3	10/-
19G6	9/-
19G7	5/-
19H1	6/-
19M1	5/-
20P4	13/-
21B6	9/-
25L6GT	5/-
25Y5	6/-
25Z4G	6/6
25Z5	7/6
25Z6GT	8/6
25D7	6/-
30	5/-
30C15	9/6
30F5	8/6
30FL1	10/6
30P19	15/-
30PL1	8/-
3516GT	7/-
35T	17/6
35W4	5/-
35Z3	8/-
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35Z5GT	6/-
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38	4/-
41MP	4/-
44A/160N	30/-
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53A	7/6
57	6/-
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59	6/-
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81	9/-
82	8/-
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446A	8/-
703A	30/-
705A	10/-
715B	60/-
717A	3/-
724A	15/-
801	6/-
803	22/6
807	8/-
808	8/-
811	17/6
813	60/-
815	35/-
829A	30/-
829B	50/-
830B	4/-
832A	45/-
832	15/-
833A	£12
843	5/-
866A	14/-
884	10/-
954	4/6
955	2/6
956	2/-
957	5/-
958A	4/-
1612	5/-
1616	3/-
1319	5/-
1625	6/-
1626	3/-
1629	4/6
2051	5/-
4043C	13/6
4063	8/-
7313C	30/-
5704	9/-
5726	6/-
6060	5/-
6064	7/-
6065	6/-
6080	22/-
7193	1/9
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2 KW ULTRASONIC GENERATOR together with power supply unit for 200-250v. AC. Complete two chassis with interconnecting cables. Frequency 37 to 43 kc/s adjusted by fine control. Peak output 2kw, average output 500w. Completely new with valves and manuals **£65.** Carriage paid U.K.

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

THERMAL PLUS MECHANICAL CIRCUIT BREAKER FOR A.C. & D.C. Current 1 amp. Protects against shorts (instantaneous cut-out at approximately 8 amps) and against overloads: 1·8 amp 30 seconds, 2·1 amp 15 seconds, 2·5 amp 8 seconds. Delayed cut-off may be adjusted to different currents and times. Separate pair of contacts to indicating device. Dimensions 3½ × 1⅝ × $\frac{7}{16}$ in. Price 12/6. P. & P. 2/6.

SEMI-AUTOMATIC BATTERY CHARGER "Baby Esstron". Initial charging rate 3·5 amps DC automatically reducing to 1·5 or lower (depending on specific gravity of battery acid). As the battery receives the charge indication lights indicate visually the high current or when incorrectly connected. Meter incorporated. For 6 or 12v batteries. Mains voltage 200/240v AC. Price £3 P. & P. 4/6.

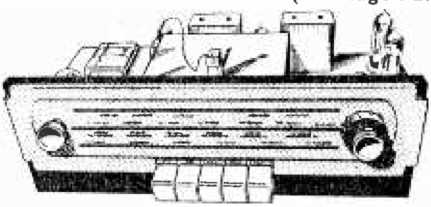
AR88D INSTRUCTION MANUALS, 20/-. P. & P. 2/6.

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

NEW DHR. HIGH-RESISTANCE HEADPHONES. 14/-. P. & P. 1/6.

WIRELESS SET No. 52 (CANADIAN) Complete station consisting of Transmitter. Receiver, supply unit for 12 v. All contained in special carrier. 1·75-16 mc/s in 3 bands. 813 as output valve. 45-75 w. phone and MCW, 70-100 watt CW. M.O. or crystal. Receiver includes crystal calibrator. Tx can be exactly tuned to Rx frequency. Noise limiter. Sidetone. Loudspeaker on receiver with on/off switch. All brand new with accessories. Export. Price on application.

BRAND NEW AM FM (V.H.F.) RADIO GRAM CHASSIS AT £13.13.0 (Carriage Paid)



Chassis size 15 x 6½ x 5¾in. high. New manufacture. Dial 14½ x 4in. in 2 colours, predominantly cream. 200-250v. A.C. only.
Pick-up. Ext. Speaker. Ae., E., and Dipole Sockets. Five pushbuttons—OFF, L.W. M.W., F.M., and Gram. Aligned and tested. O.P. Transformer. Tone control. 1000-1900 M.; 200-550 M.; 88-98 Mc/s. Valves EZ80 rect.; ECH81, EF89, EABC80, EL84, ECC85, 3-ohm speaker required.
9 x 6in. ELLIPTICAL SPEAKER 20/- to purchasers of this chassis.
TERMS: (Chassis) £3.10.0 down and 5 monthly payments of £2.4.0. Cheap Room Dipole for V.H.F. 12/6. Feeder 6d. per yard.
ALTERNATIVE DESIGN. Similar to above chassis. With addition of Shortwave 6-17 Mc/s. Price £15.15.0 (carr. paid). **TERMS:** £3.10.0 down and 6 monthly payments of £2.4.0. Total H.P. price £16.14.0. Circuit diagram 2/6. Carriage to N. Ireland 20/- extra.

2-VALVE GRAMOPHONE AMPLIFIER
Price 37/6 (P. & P. 2/6)

Overall size 4" wide × 5" high × 2½". Volume and tone controls. Mains lead. Screened lead input. With output transformer for 3-ohm. For series connection to Garrard and B.S.R. Autochangers and Players, having 90v. tapping. Valves UY85 and UCL82.
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3-valve Gram. Amp. Board 14" × 7½" (× 2½" overall). UY85, UCC85 and UL84 with Speaker 7" × 4". Price 70/-. (P. & P. 6/-).

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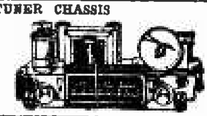
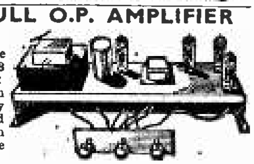


Covering 88-95 Mc/s. Dims. 8 x 6 x 6in. high. Valves ECC85, EABC80 and 2-EF89's with metal rectifier. Mains transformer. Fully wird and tested ONLY £8.17.6 (carr. pa d). Room dipole 12/6. Feeder 6d. per yard.

8 WATT PUSH-PULL O.P. AMPLIFIER
£5.5.0 (6/- Carr.)



200-240 A.C. mains. Bass, treble and vol. controls. EZ80, ECC83 and 2-EL84. Chassis 12 × 3½ × 3½in. With o.p. trans. for 2-3 ohm speaker. Front panel (normally screwed to chassis) may be removed and used as flying panel. With Cream/Black control panel whole length of front chassis.

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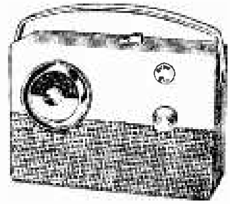
Carr. 5/- each

The SUPER 6
LONG & MEDIUM WAVE TRANSISTOR RADIO



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PLUS 5/- POST **COMPLETE KIT ONLY £4.0.0**
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V.H.F. Pre-amplifier with high signal-noise ratio and gain of at least 3:1 under average fringe area conditions. Metal container 3¼ × 3¼ × 1¾in. high, with strap for eaves, loft or skirting fixing. 9 volt battery operated, using transistor AF114. Covers all British and some Continental stations, 88 to 108 Mc/s. Order with confidence of improved reception. Price 32/6 (3/- P. & P.)

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Packet of 3 coded RF transistors (equivalent of OC44/5) 7/6 post paid. Set of 6 transistors and diode with circuit diagram. Neatly packed in foam-lined box; useful for presentation. 15/- post paid.

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PRINTED CIRCUIT. 4in. x 2¼in. x 1¼in. over transformers. Output for 3-ohm speaker. Suitable for microphone, record player and intercom. 9 volt battery required. Frequency range 100 cps. to 25 Kcps. Push-pull output class B. Instruction sheet provided. Fully wired ready for use. Three types, 200mW 35/-; 500mW 41/-; 1.2W 57/6. (P. & P. 2/6 each).

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on a strong signal in the band, the tuner then being left alone. If tappings are marked or selected with a switch this allows easy resetting for a band in conjunction with a variable capacitor with numbered dial.

The benefit secured from a tuner may be considerable if bad mismatching otherwise exists. Numerous communications receivers have 75Ω coaxial input and, using a circuit like that in Fig. 4, can give a great increase in signal strength with a $\lambda/2$ end-fed aerial. When using the receiver with a Zepp or tuned doublet the tuner is practically essential for maximum results.

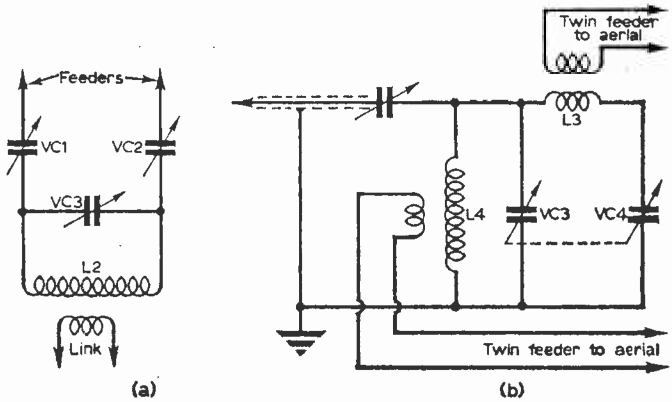


Fig. 9: Two multi-band systems.

With a transmitter several methods of adjustment are possible. One is to load the transmitter into a 75Ω carbon resistor of sufficient power rating, then leave the transmitter tuning as nearly as possible untouched while setting the aerial tuner. Another method, useful with a receiver having 75Ω input, is to adjust the tuner for best receiver signal strength with some station heard in the band, then to load the transmitter into the tuner with its pi-output controls. The same tuner may be in use for both transmission and reception.

Another method is to tune for minimum reflected power, using a standing wave indicator as in Fig. 1. Or the transmitter and tuner may be adjusted for maximum aerial current on the r.f. meter if fitted. If a field strength meter is available this naturally offers a means of tuning up.

It will probably be found that the transmitter pi-tank can be operated into a wide range of impedances which may be available by different adjustments of the tuner. All these may result in a similar radiated signal, though some produce high standing waves on a coaxial line from transmitter to tuner. If this line is short losses are negligible and the transmitter pi-tank can return the reflected power as if operating directly into an aerial. On these grounds the presence of a low standing wave ratio in the position in Fig. 1 indicates power is flowing from the transmitter to the tuner and aerial; but a high standing wave ratio does not mean there is necessarily any measurable loss in radiated signal strength.

The readings of the r.f. meter will depend on frequency, aerial and power and will thus change from one band to another or if modifications are made to the aerial-earth system. However, the meter is useful to check that usual output is obtained and because more current here corresponds to more power radiated provided frequency and aerial-earth system are unchanged.

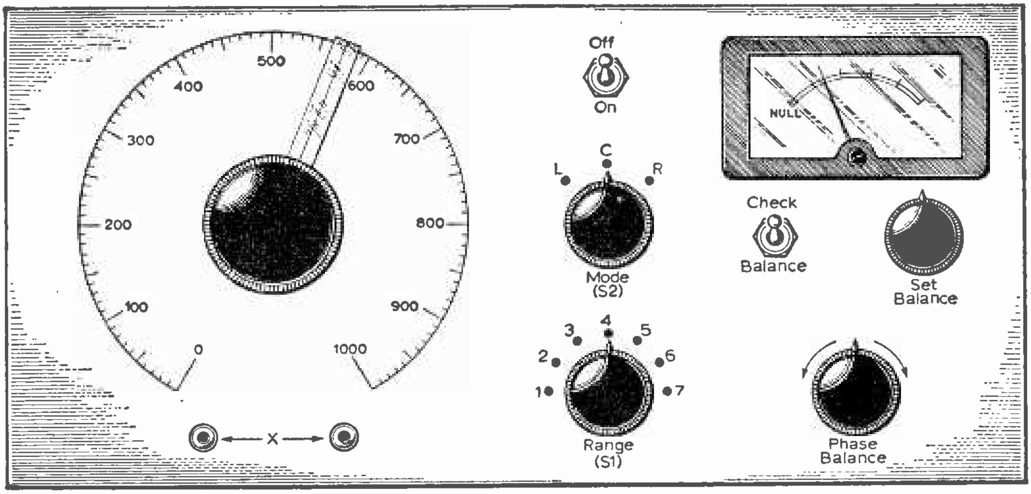
With average wire aerials the length in feet for a $\lambda/2$ at any particular frequency is:

$$\frac{468}{\text{Mc/s.}}$$

The length for a $\lambda/4$ is:

$$\frac{234}{\text{Mc/s.}}$$

It is thus easy to calculate the length needed for a $\lambda/2$ or $\lambda/4$ aerial for any band. ■



A Transistorised L.C.R. Bridge – Part Two
By Mike Fisher

CONSTRUCTION of the basic bridge circuitry is quite straightforward but care should be taken to keep the connecting leads fairly short and a reasonably heavy gauge wire should be used. The inevitable resistance of the circuit wiring will necessitate the adjustment of the 1Ω standard resistor on test. The 0·1μF standard capacitor will be difficult to obtain to a high standard of accuracy but this snag can be overcome by using a normal type of component and adjusting its value by wiring additional capacitors in parallel on test. The procedure for adjusting these two components is as follows:

1Ω resistor. Build the complete bridge unit and calibrate the main balance control by its resistance against a suitable test instrument. If no test instrument is available the dial can be set up by placing 1% test resistors across the "X" terminals and adjusting the bridge to balance. The scale is then marked at the balance point with the appropriate value. This calibration is best carried out on the 0-1,000Ω to 0-100kΩ ranges. When the dial calibration is complete connect a 1% or better resistor of value between 2 and 10Ω across

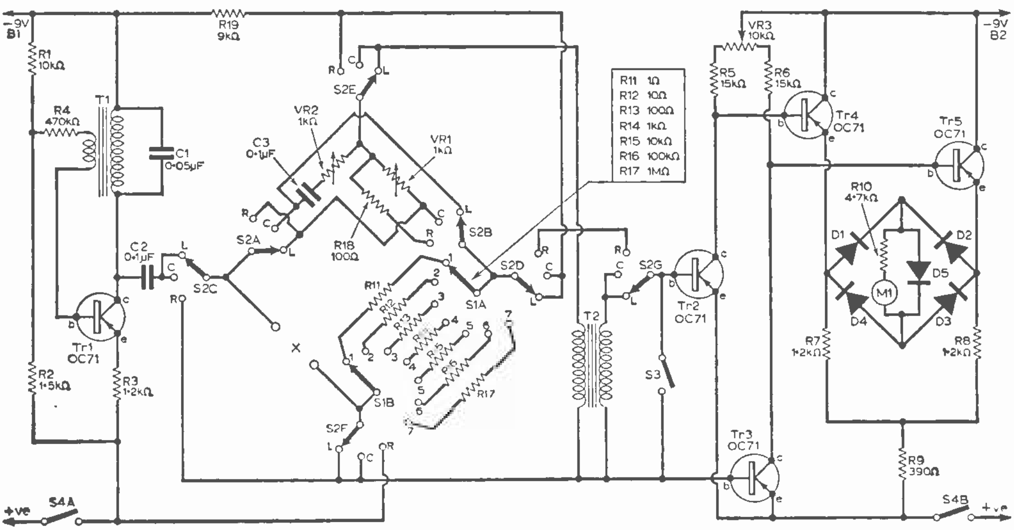


Fig. 10: Circuit diagram of the complete unit.

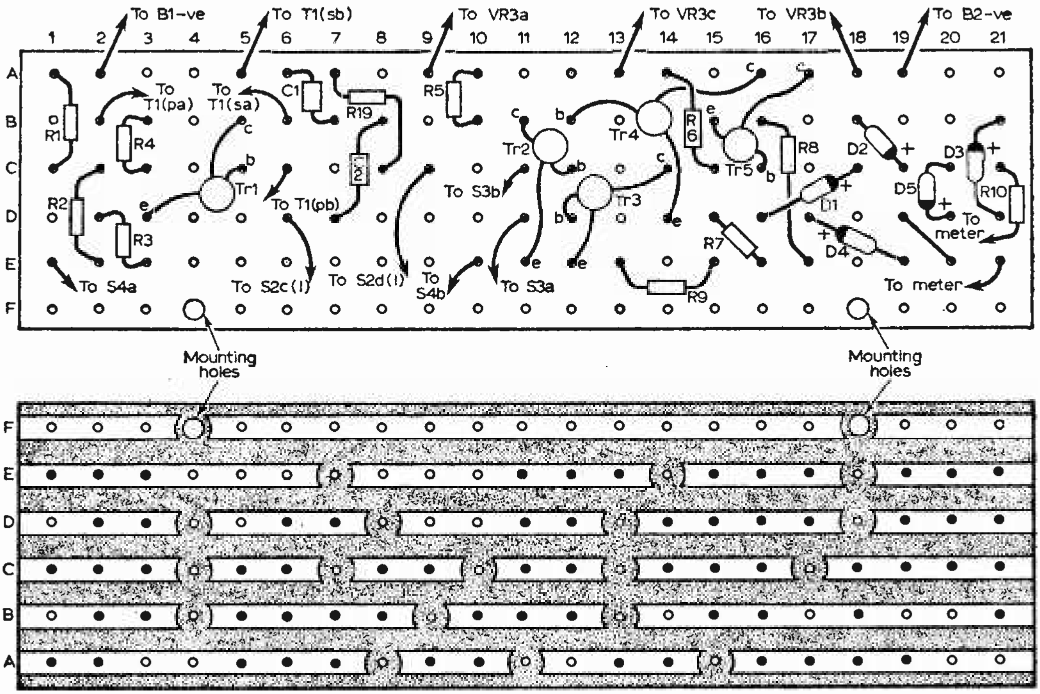


Fig. 11: Component layout of Veroboard circuit.

the "X" terminals, set the range switch to the 0-10Ω range and set the dial to the point at which balance *should* be obtained. The value of the 1Ω standard resistor is then adjusted until a true balance is obtained at this point.

0·1μF standard capacitor. A close-tolerance test capacitor, preferably of either 0·05 or 0·005μF value, is connected across the "X" terminals and the instrument switched to the required range. The dial is set to the point at which balance should be obtained, as above, and the standard capacitor is then adjusted until a balance is obtained at this point. Calibration, etc., is now complete.

The detector circuit. Component values and layout are not critical. OC71 transistors were used for the simple reason that they were at hand but it will probably be found that OC70, etc., types will work quite well in the circuit.

The oscillator circuit. Considerable variation of component values and working voltages is permissible with this circuit: it will continue to function at voltages of less than 1·5V.

The ratio of the transformer seems to be of little real importance. ·3:1 ratio was used on the test circuit but it was found that a far too powerful feedback signal resulted and the 470kΩ resistor to the base of the transistor had to be introduced to stop squegging which resulted. The value of this resistor should be adjusted as follows to suit the particular transformer used (it will probably be found that the circuit will still work even if a transformer with a ratio of 40:1 is used).

Wire up the circuit, leaving the 470kΩ resistor shorted out, and connect the 0·05μF capacitor across the transformer primary (connected as the collector load). A pair of headphones is now connected via a blocking capacitor to the transistor collector and the negative rail. A strong audio signal should be heard. This signal will probably seem to be fairly pure in tone but this may be a delusion caused by the high volume level. The tone frequency should be about 1kc/s; if not the frequency may be adjusted by changing the value of the capacitor in parallel with the primary winding. When this adjustment has been completed a fairly high value resistor should be connected in series with the phones, resulting in a very low volume level to them. It will probably be found that at this low level the frequency of the signal seems to be considerably different from that formerly heard: in fact it may even sound like a motor-boat running at low speed. This is symptomatic of "squegging", caused by too high a feedback factor. The short across the 470kΩ resistor should now be removed. Should oscillation now cease completely reduce the value of the resistor until oscillation starts again. The resistor effectively reduces the magnitude of feedback and it will be found that as the resistor value is increased so the squegging frequently rises until finally, when the correct degree of feedback has been obtained, only the pure tone of the oscillator will remain. It may be necessary to readjust the frequency of oscillation during the setting up.

If it is found to be necessary to use a very high value of R4, such as the 470kΩ shown in Fig. 7, it will be found that the base bias chain, R1 and R2, will have no effect on circuit operation. R1 and R2 can therefore be removed from the circuit. Inspection of the waveform on a scope will show, in the above case, that distortion is taking place; as long as squegging is not taking place, however, the oscillator may still be used to energise the bridge.

It is felt that ideally the transformer T1 should have a ratio of about 20:1 if a pure sinewave is to be obtained from the circuit.

It should be noted that if the above adjustments are not made poor detector response and faulty balance reading may be obtained.

A suitable front panel layout for the instrument is shown in the heading and the final circuit of the complete instrument.

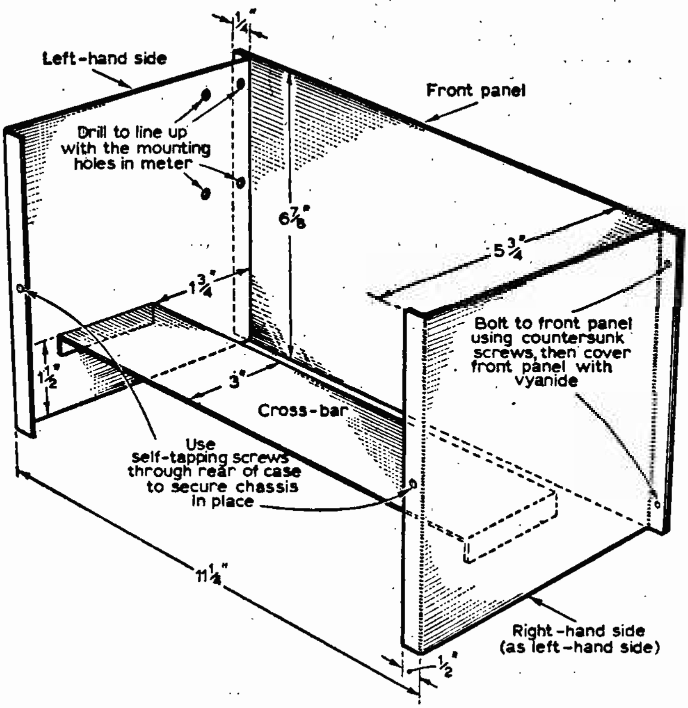
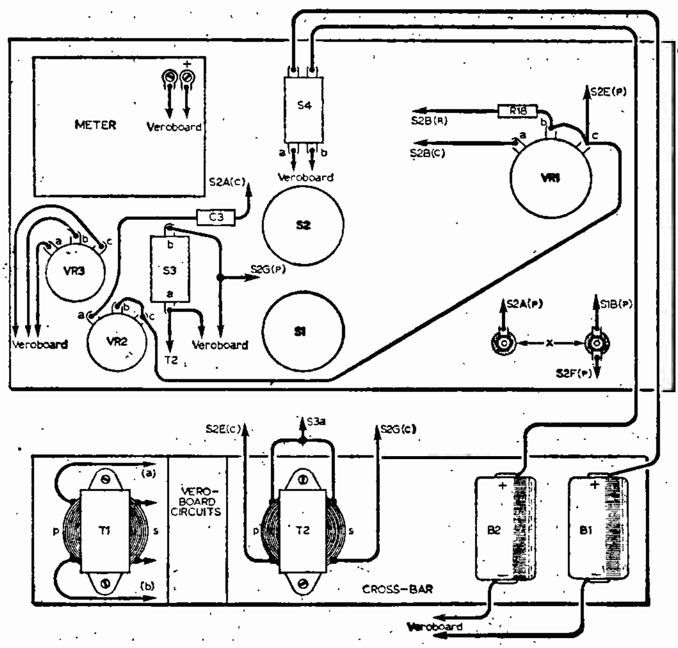


Fig. 12 (above): General layout of metalwork.

Fig. 13 (below): Wiring diagram of front panel etc.



Components List

The 50μA meter is available from Radio and TV Components (Acton) Ltd., price 25s.

If difficulty is experienced in obtaining S1, the two-pole, seven-way switch, an alternative would be a two-pole, ten-way type modified as follows: Drill and tap a 6BA hole in the switch front plate in such a position as to fall between the seventh and eighth position locator recesses. A short 6BA screw can then be inserted in the hole and will act as a stop, reducing the number of available switch positions to seven.

S2 the seven-pole three-way switch, may be adapted in similar fashion from an eight-pole, four-way switch, available from Radio Component Specialists, of 337 Whitehorse Road, West Croydon, price 6s. 6d. Alternatively a Wearite 12-pole, three-way switch, price 7s. 6d. may be used with the five unwanted poles left blank. This switch can be obtained from L. Wilkinson (Croydon) Ltd., Longley House, Longley Road, Croydon, Surrey.

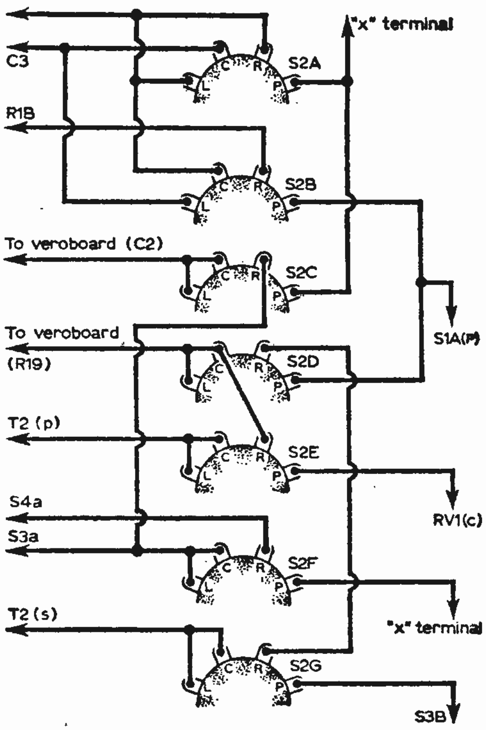
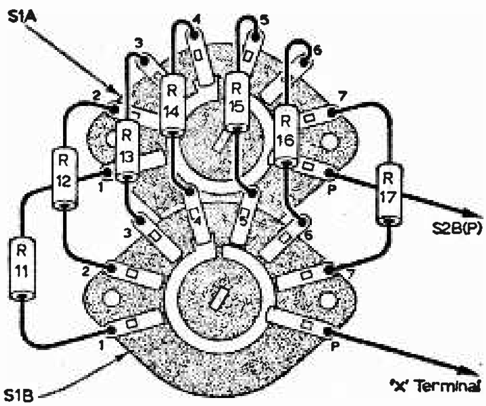


Fig. 14: Wiring of S2 (mode).

Fig. 15: Wiring of S1 (range).



Position of S1 (Fig. 10)	Range L	C	R
1	0–100μH	0–100μF	0–10Ω
2	0–1mH	0–10μF	0–100Ω
3	0–10mH	0–1μF	0–1kΩ
4	0–100mH	0–0·1μF	0–10kΩ
5	0–1H	0–0·01μF	0–100kΩ
6	0–10H	0–1000pF	0–1MΩ
7	1–100H	0–100pF	0–10MΩ

Front Panel and Chassis Assembly

The prototype instrument was designed, from the mechanical point of view, to fit into an instrument case that was available at the time and no effort was made to miniaturise. While it is unlikely that the same mechanical dimensions will be used in any instrument built by the reader the general constructional details used in the proto-

COMPONENTS LIST

Resistors

R1	10kΩ 10%	R11	1Ω	see text
R2	1·5kΩ 10%	R12	10Ω	see text
R3	1·2kΩ 10%	R13	100Ω	see text
R4	470kΩ see text	R14	1kΩ	see text
R5	15kΩ 10%	R15	10kΩ	see text
R6	15kΩ 10%	R16	100kΩ	see text
R7	1·2kΩ 10%	R17	1MΩ	see text
R8	1·2kΩ 10%	R18	100Ω	see text
R9	390Ω 10%	R19	9kΩ 10%	
R10	4·7kΩ 20%			

All resistors ⅛W minimum

Potentiometers:

VR1 1kΩ w/w linear 1% } large diameter
VR2 1kΩ w/w linear 1% } large diameter
VR3 10kΩ Carbon Linear

Capacitors:

C1 0·05μF (see text)
C2 0·1μF
C3 0·1μF 1% (see text)

Semiconductors:

Tr1, Tr2, Tr3, Tr4, Tr5 — Red Spot, OC71, etc.
D1, D2, D3, D4, D5 — Any **Germanium** Diode

Miscellaneous:

T1 20:1 to 3:1 (see text)
T2 1:1 Veroboard $3\frac{1}{4}$ x 1in.
S1 2P 7W
S2 7P 3W
S3 1P 2W self return
S4 2P 2W
M1 0–50μA
B1 9v } Separate batteries must be used
B2 9v }

type may be of interest.

The dimensions of the front panel are $11\frac{3}{4}$ x $6\frac{7}{8}$in. This panel may be cut from sheet aluminium, plywood or hardboard.

The two side members are cut from aluminium, and bolted to the front panel as shown in Fig. 12. The securing screws should be countersunk flush into the front panel. The right-hand side member has the meter bolted to it as shown. Clinch nuts are secured to the rear flanges of the side members and holes cut in the rear of the case to line up with them; the chassis can then be held secure in the case by screws at the rear, leaving the front panel free from unsightly screws.

Resistors R11 to R17 should be soldered directly to the contacts of switch S1. ■

HIGH WATTAGE LOADS

by C. L. Jones, B.Sc.

THE most common types of resistors used in electronics are designed to dissipate a comparatively small quantity of energy. Occasionally higher voltage components are required, for example as "loads" when testing equipment. The problem resolves itself into two categories—that of comparatively small currents at high voltages and that of high current at low voltages.

Low Current—High Voltage

The original need for such a load occurred when the voltage-current curve for a power pack of maximum power output, about 30W (300V at 100mA), was required. A rheostat to cope with this would be expensive and so the circuit given in Fig. 1 was used.

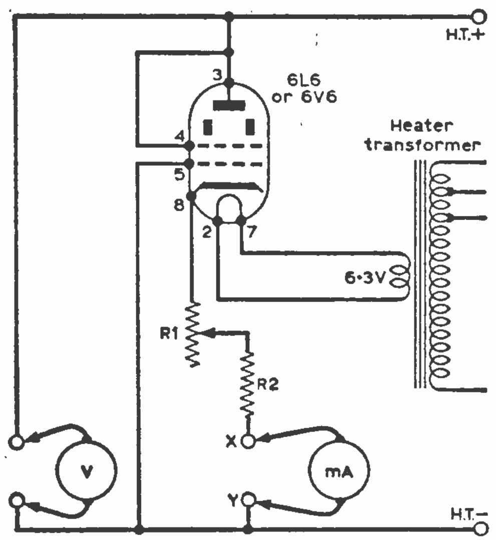


Fig. 1: This circuit eliminates the use of a rheostat. The transformer is optional as heater supplies can be obtained from the transformer under test.

Almost any output valve can be used but the original rig employed a 6L6 which had been discarded because of a broken spigot. The current taken by the valve is varied by means of R1, the fixed resistor R2 limiting the current when R1 is at minimum.

The values of R1 and R2 will depend on the use to which the circuit is put. R1 limits the current when R2 is at minimum. When assessing the value of R2 the following points should be borne in mind:

(a) If R2 is too low then the minimum current taken by the valve is high.

(b) If R2 is too high adjustment of the current is difficult, especially when the current is high.

The maximum current for the valve has been exceeded by as much as 50% but only for short periods. Since valves which are past their best are used the risk is felt to be justified. Readings can be taken very quickly so that prolonged overloading can be avoided.

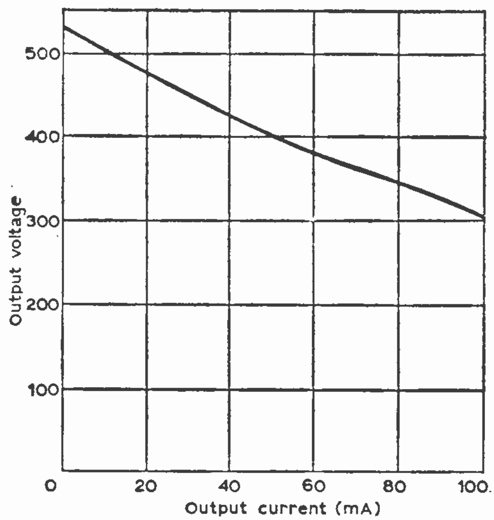


Fig. 2: The graph obtained by using the circuit of Fig. 1.

Fig. 2 shows a graph obtained using the circuit. It could be used to provide data to stabilise the power pack. The power pack in question is used with different pieces of test equipment which are used too infrequently to make it worth while providing each with its own power supply. The test instruments have widely different h.t. requirements and the graph is used to find a suitable resistor to put in series with the supply. Thus each piece of equipment has a built-in h.t. dropper and a decoupling capacitor which enables it to be plugged directly into the power pack and provides additional smoothing.

A second unit has been built employing a 6V6 to test the regulation of a power pack designed to operate an amplifier and a tuner, the latter being switched off when the amplifier is used for records. The effect of switching one load off or on can be determined by setting R2 so that the valve takes the same current as the equipment it is simulating. The circuit can be wired up when required or built into a small self-contained unit. The transformer shown in Fig. 1 is optional as heater supplies can be taken from the transformer under test.

Multi-range meters can be used to measure the current and voltage. They provide a "fixed" load; R2 can be adjusted until the milliameter registers the required current, then the meter can be replaced by a "short" across X and Y.

Details of R1 and R2 are given below but should only be used as a rough guide as the exact current depends on the h.t. voltage and individual requirements may enable more suitable values to be used. The last two columns were determined using the power pack from which Fig. 2 was drawn.

	R1	R2	Min. Current	Max. Current
6V6	100Ω	10kΩ	6mA	130mA
6V6	500Ω	10kΩ	6mA	60mA

The maximum power dissipated by R2 in the case of 6V6 is just over 1W. An old standard size (1½in. diameter) wire-wound potentiometer should be used rather than the more modern miniature type.

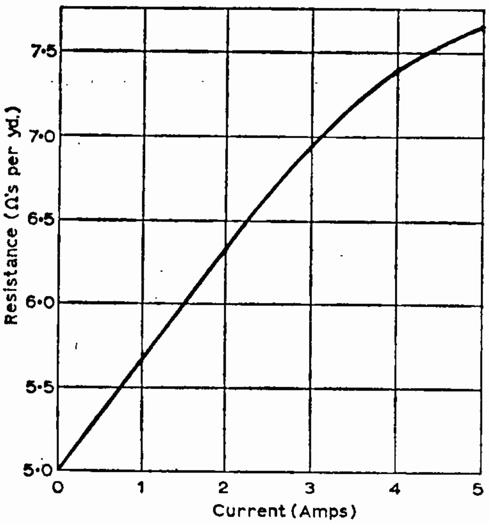


Fig. 3: Graph showing how resistance of metallic conductors increases with rise in temperature.

High Current—Low Voltage

Testing power amplifiers can be a noisy business if the outputs are fed into a loudspeaker, so that dummy loads are required if the family or neighbours are not to be disturbed. Further, if feedback loops are connected the wrong way round sensitive speakers can be damaged, so that some less delicate load is required. Resistors as described below have also been used in series with a power supply when charging small accumulators at a constant current.

There are several different types of "resistance" wire available, each with properties suited to

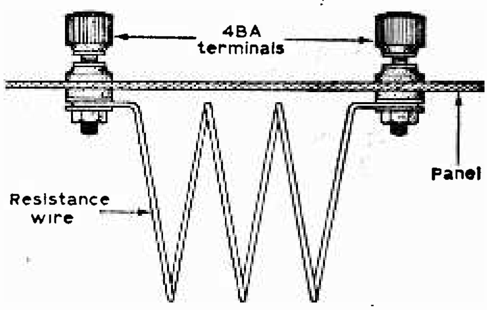


Fig. 4: Method of connecting resistance wire.

particular applications. Convenient sources of resistance wire are electric fire elements, especially the type obtained as tight coils, which are then stretched backwards and forwards over a rectangular ceramic former. A 1kW element of this type is made from about 10yd of 25 s.w.g. "nichrome" wire. This is a nickel-chromium alloy which can stand up to high temperatures. The resistance of this particular gauge of wire is almost exactly 5Ω per yard at room temperature. Thus the length for any particular resistance is easily calculated.

The resistance of metallic conductors increases with increase in temperature and a sample has been tested to determine the heating effect of current passing through it. The results are shown in Fig. 3. The length of wire can be adjusted to give correct resistance at any particular current. For these tests the wire was kept stretched out horizontally and it should be remembered that if it is coiled tightly heating will increase.

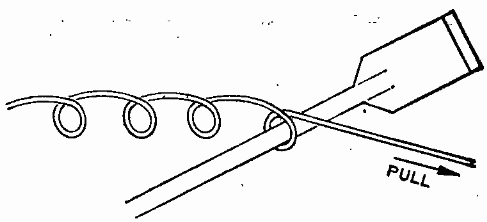
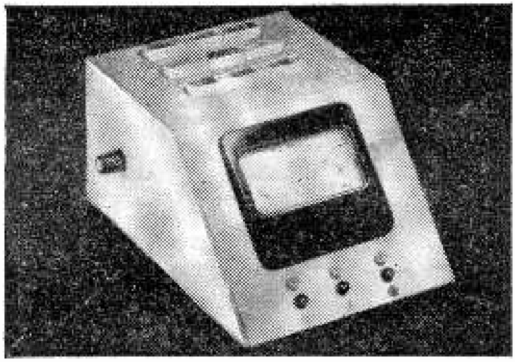


Fig. 5: Method of eliminating "kinks" in wire.

The temperature of the uncoiled wire rises above the melting point of solder with currents as low as 2A, so that connections are best made as shown in Fig. 4. In any case it is difficult to solder this type of wire. The ends of the wire can be clamped between washers under 4BA brass terminals; these help to dissipate the heat generated in the wire. Large diameter coils should be made and if housed in a container this must have well-ventilated sides.

Resistors made in this way are not "non-inductive", but at low frequencies this should not be much of a problem. The wire may be freed from kinks by looping one turn around the shaft of a large screwdriver and pulling the wire as shown in Fig. 5. ■



PUSH—BUTTON MULTIMETER

D. FANSHAWE

THE meter was primarily designed for use in transistor experiments connected with the design of apparatus. It is often required to monitor base and collector currents, and also collector voltage. These three jobs can be done with only one meter provided three switched inputs are available. The total cost of the instrument is around £3.

INPUTS

This meter has three pairs of input sockets on the front panel (marked 1, 2 and 3) and each input can be selected in turn simply by pressing the appropriate input push button.

The basic meter movement is an ex-government meter of 50μA f.s.d., available from one of the advertisers in this magazine, price 25s. The switching is by push-buttons, three banks of three-way units are used. When the meter is being used as a general purpose multimeter, the test leads can be used in any input; but if it is desired to monitor two currents and a voltage in turn, the current inputs should be plugged into inputs 1 and 2. The voltage input should be plugged into input 3. The reason for this is that inputs 1 and 2 are both short circuited when they are not selected so that the circuit under observation will not be broken. Fig. 2 shows the meter being used in this way.

RANGES

The meter ranges are: 50μA; 1mA; 25mA; 500mA; (all d.c.). 1V; 10V; 50V; 500V (all d.c.). 1kΩ; 100kΩ; 10MΩ.

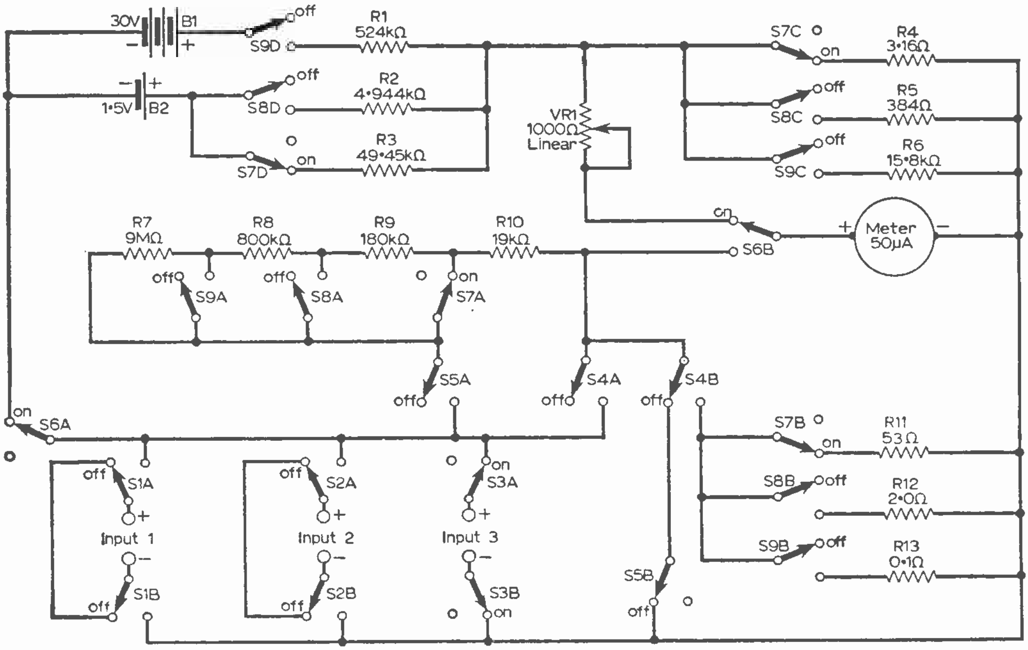


Fig. 1: Complete circuit of the multimeter.

PRACTICAL WIRELESS

*SHORT WAVE DATA

pocket guide

presented with the January 1966 issue

CUT HERE

49m band: During daylight, stations up to about 1,000 miles distant should be well received. During darkness, reception will be excellent for DX stations—in fact during the winter it may be one of the best bands for after-dark reception.

41m band: Similar to 49m but noisier—although both bands will suffer interference due to the extensive use of these bands, particularly after dark.

31m band: This will provide good short distance (up to 1,000 miles) reception during daylight. During darkness, good long distance reception will often be possible, notably during the summer months.

25m band: Excellent for daylight reception of stations up to around 2,000 miles. Late afternoons and early evening will produce long distance reception but it may fade out during hours of darkness, particularly in the winter.

19m band: During hours of daylight this band will produce excellent DX reception from all over the world. Conditions should normally hold up to early evenings, but will then fade out.

16m band: Capable of producing strong DX signals, this band is best between autumn and spring during daylight hours but the summer may be relatively bleak.

13m band: Of little use at present, though the winter may bring a few stations in.

11m band: Until the sunspot cycle swings back there will be very little activity on this band.

Station Information

Various lists of short wave broadcasting stations are available, but the most comprehensive is the *World Radio TV Handbook*, published in Denmark but obtainable in the U.K. through booksellers at 23s. 0d. Apart from a complete listing of stations, it contains notes on programmes, identification and other essential information.

WHEN AND WHERE TO LISTEN

It is impossible to more than generalise in the space available. Conditions may change from day to day, month to month. Generally speaking, the high frequency bands are best during daylight and the low frequency bands during darkness. In any given year, conditions will vary from season to season,

LISTENING TO SHORT WAVE STATIONS

The newcomer to the short wave bands may understandably become rather confused; strange jargon, unpredictable reception, and other frustrations. It is not the intention of this pocket guide to present a treatise on the mysteries of the short wave bands but rather to collect in a handy form much of the basic essential data and reference material useful in day-to-day short wave listening.

The Amateur Bands

Here is a brief summary of what to expect from the amateur bands most likely to be tuned by the newcomer:

1·8Mc/s (160 metres). "Top Band" is used mainly for local communications between stations up to about 100 miles apart during daylight hours but for British Isles coverage after dark. During winter months, European contacts are possible and under very favourable conditions British stations have worked Transatlantic stations and even the Antipodes.

3·5Mc/s (80 metres). This band is favourable for hearing all the British Isles and Europe. During the hours of darkness, particularly in the winter, stations further afield are not uncommon.

7Mc/s (40 metres). Much patience is needed in listening on this band due to interference from broadcasting stations and other intruders. Though basically a "local" band, much longer distant reception is possible, notably on morse, and particularly during the winter after darkness.

14Mc/s (20 metres). The most popular "DX" band of all. It is open for world-wide reception most of the year, though it sometimes "closes" early in the evening during the winter. Sometimes, according to conditions, European stations are heard at outstanding strength.

21Mc/s (15 metres). Potentially a good band for long distance signals, much patience is required. It is best during summer months and when sunspot activity is high. Openings may be of comparatively short duration, but they are often very productive.

28Mc/s (10 metres). Much the same as 21Mc/s. When the band is really "open", stations from all over the world are often heard at remarkable strength; at other times the band may appear to be completely "dead".

General: Space does not permit a comprehensive survey of the various bands but a very good idea of current reception conditions can be obtained from reading the monthly notes *On the Short Waves* published in each issue of *Practical Wireless*.

but an influencing factor is the sunspot cycle. Years of high sunspot activity favour the high frequency bands, years of low sunspot activity (we are in a "trough" at the moment) favour the low frequency bands. Thus, whereas the 28Mc/s amateur band is relatively poor this year, in several years' time it may be excellent. With these reservations in mind, the following notes should be accepted as a *guide* to reception. Times in GMT.

North America/Caribbean

Best times are 1500–2300, peaking in winter around 1800 and in summer around 2030. Western N. America is more difficult but try around 1500–1800 and breakfast time. Broadcasting stations: 19m afternoon, 25m after dark (winter), in summer 19m band is best. Amateurs: 20m most reliable throughout the year—East Coast possible all through the day. After dark, 40 and 75m bands and in winter 1·8Mc/s.

Central America

On broadcast bands, try 49m around dawn, or late night in winter (when the 60, 75m bands may also be productive). Amateur bands: 20m is best bet after dark and around dawn.

South America

Best times are 0900–1100 and 1700–0100. On broadcast bands (except summer) 19m is best for morning period, 25 and 31m evenings. Also try the 60-75m section. In summer, this area is more difficult to hear—25 and 31m is usually best, evenings. Amateur bands: again 20m and 40m after dark. Also 15m early evenings.

Central/South Africa

Best general times are between 1300–2200. On broadcast bands, 19m during daylight hours and 25/31m after dark especially during winter. On amateur bands try 20m around 1700–2000. Usually good when 28Mc/s is "open".

Asia

For S and SE Asia, best times are 1100–1700, starting off with 16 and 19m bands, then 25m. During winter, the best period may hold till around 2100 on 31 and 41m bands. For amateurs, 20m is again about the best bet. Best times for Northern Asia 0600–0900 and again around 2000. The 19m and 25m broadcast bands are best.

The Antipodes

Peak times are 0600–1000, with 1400–1700 and around 2200 during winter. New Zealand is best

Modes of Operation

The main system used by amateurs is amplitude modulation. The beginner will listen mainly to stations using a.m. telephony ("phone") which is receivable in the normal way on any receiver. However, thousands of stations operate on telegraphy (Morse code, "cw"), because (a) the language barrier is reduced owing to the use of internationally understood codes and abbreviations, and (b) under comparable reception conditions a faint c.w. signal can be copied easily whereas a phone signal would be unintelligible. To receive c.w. signals it is necessary to have a receiver with a beat frequency oscillator (b.f.o.) which heterodynes with the incoming signal, thus making it audible. Much of the more exotic DX is heard on c.w., particularly on the lower frequency bands and the newcomer is urged not to overlook the facilities to receive c.w. stations.

To overcome the severe crowding on the amateur bands, various forms of a.m. single sideband telephony are gaining popularity. To receive such transmissions properly, the receiver should have a product detector. Frequency modulation is also permitted, but is not used extensively.

THE HAM LANGUAGE

Callsigns

For identification purposes, every amateur station has a callsign, issued by the licensing authority. This consists of a prefix (establishing the country of origin) followed by a suffix (establishing personal identity). Sometimes a numeral indicates regional significance; for example—VE2AAA is in Quebec, because VE is the Canadian prefix and 2 is the identification for the Province of Quebec.

The competitive element is strong in both listening and transmitting. Most societies issue certificates for DX achievements—mainly on the basis on the number of countries, counties, "zones", etc. The prefix list on pages 10-13 is that currently recognised by our national society, the RSGB, for country "scoring" purposes.

Abbreviations

In order to avoid ambiguity and to save time, the pioneer operators gradually devised a system of codes and abbreviations still used today. These comprise (a) signal reporting systems, (b) the Q Code, (c) general abbreviations. The greatest benefit is felt by c.w. operators who are able to convey intelligent messages to any other station regardless of nationality. In the pages that follow, the basic ingredients of this international "ham language" are outlined.

around 0900–1100. Summer is poor compared with other seasons. Best broadcast bands are 25 and 31m in morning, 31 and 41m in afternoon, and 19m for evening. For amateurs 20m is best, though 40m can be good during winter mornings.

Pacific Area

A difficult area to hear. Best time is between 0600–1100 on the 19 and 25m broadcast bands and 20m amateur band.

Europe/North Africa/Near East

Little need to elaborate as it is possible to hear all these areas almost around the clock.

THE "Q" CODE

One of the ingredients of the "ham language" is the Q Code, adapted from the professional communications code. Each set of symbols can be used as a question or as an answer, or in general context. For example, *QTH?* means "what is your location?" and *QTH London* means "my location is in London". An operator may also say, e.g., in conversation: "My QTH is poor for reception". Here are some of the more commonly used Q signals.

QRA	Full address
QRB	Distance (miles)
QRG	Frequency (kc/s)
QRJ	Weak signals
QRH	Your frequency varies
QRK	Signal strength
QRL	Busy
QRM	Man-made interference
QRN	Atmospheric interference; static
QRO	High power
QRP	Low power
QRQ	Send faster
QRS	Send slower
QRT	Closed down
QRU	Nothing further to say
QRV	Ready to operate
QRX	Wait
QSA	Readability of signal
QSB	Fading
QSL	Acknowledgement of receipt; confirmation of contact
QSO	Contact
QSP	Pass on a message
QSV	Send series of V's
QSX	Listen for
QSY	Change frequency
QSZ	Double sending
QTC	Telegram, message
QTH	Location
QTR	Time check (exact time)

QSL Cards

Two stations which have maintained a two-way contact may exchange "QSL" cards. These prominently display the call sign and contain data on the equipment used and confirmation details of the contact. The QSL card is the proof, normally required in claiming certificates.

Short wave listeners may also attempt to obtain QSL cards from transmitting stations by sending reception reports. But whereas in the early days most amateurs welcomed such unsolicited reception reports the fact must be faced that with such high activity on the bands today most amateurs already know how they are getting out and many SWL reports are virtually useless. In fact many stations will not even send cards to stations they have "worked" unless they are specifically requested.

We would therefore advise prospective QSL collectors to concentrate on sending reports mainly to genuinely unusual stations, such as long distant signals on the harder bands (1·8, 3·5 and 7Mc/s). Also, in any case, it is only courtesy to enclose return postage in the form of reply coupons obtainable from any Post Office.

THE BROADCASTING BANDS

Many broadcasting stations have regular programmes and/or announcements in English; indeed more and more countries are establishing "international" services, with propaganda programmes beamed to all parts of the world. There are, however, a large number of stations which never, or rarely, give English announcements. Some use call signs for identification, though these are being dropped by many broadcasters. Luckily, most of the "local" stations, particularly Latin Americans, still retain the callsign in the prominent station announcements, together with the various station slogans.

Regular readers of *Practical Wireless* can obtain monthly news of broadcast band happenings in the feature *On the Short Waves*. The newcomer may, however, find the following summary of the various bands of great use in learning what to expect.

60 and 75 metres: These bands are used almost exclusively for local regional broadcasting. The 60m band (in fact it ranges from approx. 50-63m) is a happy hunting ground for Latin Americans. Between 50-140m are several "tropical" bands, used for local broadcasting, and there is something of interest all through this range. Reception should be good on these frequencies for several years (being as we are in a period of low sunspot activity) and the Latin Americans should be plentiful during hours of darkness, notably during the winter months. Static interference may be troublesome during the summer.

SIGNAL REPORTING SYSTEMS

Of the various signal codes evolved through the years, the RST system is the only one to have gained universal acceptance.

Readability:

- R1 Unreadable
- R2 Only just readable, and only occasional words heard
- R3 Readable, but with considerable difficulty
- R4 Readable with almost no difficulty
- R5 Perfectly readable

Signal Strength:

- S1 Signals only just perceptible
- S2 Very weak signals
- S3 Weak signals
- S4 Fair signals
- S5 Fairly good signals
- S6 Good signals
- S7 Moderately strong signals
- S8 Strong signals
- S9 Extremely strong signals

Tone:

- T1 Extremely rough note
- T2 Very rough note
- T3 Rough, low pitched note
- T4 Rather rough note
- T5 Musically modulated note
- T6 Modulated note, slight whistle
- T7 Fairly good note, smooth ripple
- T8 Good note, slight ripple
- T9 Pure DC note

(If the note seems to be crystal controlled, an "x" is added, if the note is chirpy, a "c" is added.)

Thus an extremely strong, perfectly readable c.w. signal with a pure d.c. note would be reported as RST 599. On telephony the accepted form is R5 S9, but the same signal could be reported as QSA5 R9 (or Q5 R9) owing to the persistence of an earlier system with a QSA1–5 readability scale and an R1–9 strength scale. Quality of modulation scales have been evolved but are never used.

The readability/strength code can be used for reporting to broadcasting stations, but a better system for this purpose is the **SINPO** code. This has five scales, each of 1 to 5, as indicated by the letters S (Signal Strength), I (Interference), N (Noise, i.e. static), P (Propagation Disturbance, i.e. fading) and O (Overall quality of reception).

The scale for signal strength is: 1—barely audible; 2—poor; 3—fair; 4—good; 5—excellent. The scales for Interference, Noise and Propagation Disturbance are: 1—extreme; 2—severe; 3—moderate; 4—slight; 5—nil. The scale for overall quality is: 1—unusable; 2—poor; 3—fair; 4—good; 5—excellent. Thus, in the SINPO code, a perfectly received signal would be given 55555.

VU	India
VU	Laccadive Is.
VU	Andaman and Nicobar Is.
W	U.S.A.
XE, XF	Mexico
XE4	Revilla Gigedo
XT2	Voltaic Republic
XW8	Laos
XZ2	Burma
XU	Cambodia
XV5	see 3W8
YA	Afghanistan
YI	Iraq
YJ	see FU8
YK	Syria
YN	Nicaragua
YO	Roumania
YS	Salvador
YU	Yugoslavia
YV	Venezuela
YVØ	Aves Is.
ZA	Albania
ZB2	Gibraltar
ZC3	Christmas Is
ZC6	Palestine
ZD3	Gambia
ZD5	Swaziland
ZD7	St. Helena
ZD8	Ascension Is.
ZD9	Tristan da Cunha and Gough Is.
ZE	Rhodesia
ZF1	Cayman Is.
ZK1	Cook Is.
ZK1	Manihiki Is.
ZK2	Niue
ZL	New Zealand
ZL	Auckland and Campbell Is.
ZL	Chatham Is.
ZL	Kermadec Is.
ZL5	see CE9
ZM6	Samoa
ZM7	Tokelau (Union) Is.
ZP	Paraguay
ZS1, 2, 4, 5, 6	South Africa
ZS2	Prince Edward and Marion Is.
ZS3	S.W. Africa
ZS8	Basutoland
ZS9	Bechuanaland
3A	Monaco
3V8	Tunisia
3W8	Vietnam
4M	Venezuela
4S7	Ceylon
4U1ITU	I.T.U. Geneva
4W1	Yemen
4X4	Israel
5A	Libya
5B4	Cyprus
5H3	Tanganyika
5N2	Nigeria
5R8	Madagascar
5T5	Mauretania
5U7	Niger Republic
5V	Togo Republic
5W1	W. Samoa
5X5	Uganda
5Z4	Kenya
6N	see HL
6W8	Senegal Republic
6Y5	Jamaica
7G1	Guinea Republic
7Q	Malawi
7X2	Algeria
8J1	See CE9
8Z	see HZ
8Z4	Saudi Arabia/Iraq Neutral Zone
8Z5	Saudi Arabia/ Kuwait Neutral Zone
9A1	San Marino
9G1	Ghana
9H1	Malta
9K2	Kuwait
9K3	Saudi Arabia/ Kuwait Neutral Zone
9L1	Sierra Leone
9M2, 9M4	W. Malaysia
9M6, 9M8	E. Malaysia
9N1	Nepal
9Q5	Congo
9U5	Burundi
9X5	Rwanda

AMATEUR ABBREVIATIONS

In order to save time, the pioneer operators gradually evolved a series of abbreviations which have now become an accepted part of amateur radio operating. Most of these were devised to reduce the number of morse code characters but some are still used verbally and in written characters. Their derivation is fairly obvious; contraction by omitting vowels (i.e., HRD=HEARD, RPT=REPORT), by phonetics (i.e., SED=SAID, GUD=GOOD), by using initials (i.e., SWL=SHORT WAVE LISTENER), by general contraction using first and last letters or by using an X as termination (i.e., VY=VERY, TX=TRANSMITTER). Here are some of the more common abbreviations in use.

ABT	About
AGN	Again
ANI	Any
ANT	Antenna
BC	Broadcast
BCI	Broadcast interference (by an amateur transmitter)
BCNU	Be seeing you
BK	Break
CK	Check
CKT	Circuit
CLG	Calling
CO	Crystal oscillator
CQ	General call
CONDX	Conditions
CUL	See you later
DE	From
DF	Direction-finding
DX	Distance (long distance reception)
ERE	Here
ES	And
FB	Fine business (excellent)
FD	Frequency doubler
FER	For
GA	Go ahead, good afternoon
GB	Goodbye
GE	Good evening
GLD	Glad
GUD	Good
HI	Laughter, high
HPE	Hope
HR	Hear/Here
HRD	Heard
HV	Have
LID	Bad Operator
MNI	Many
MO	Master oscillator
ND	Nothing doing
NW	Now
OB	Old boy
OM	Old man
OP	Operator
OT	Old timer
PA	Power amplifier
PSE	Please
R	All received correctly
RCVD	Received
RPT	Report
RX	Receiver
SA	Say
SED	Said
SIGS	Signals
SWL	Short wave listener
TKS	Thanks
TNX	Thanks
TVI	Television interference
TX	Transmitter
U	You
UR	Your, you are
VFO	Variable frequency oscillator
VY	Very
WX	Weather
WID	With

FREQUENCY AND TIME CHECKS

A number of stations operate in order to provide accurate time and frequency checks, mainly on 2500, 5000, 10,000, 15,000, 20,000 and 25,000 kc/s. Many of these stations operate continuously with audio tones and interruptions in morse and voice. WWV also gives radio propagation forecasts.

ATA, New Delhi, India, 10,000kc/s.
BPV, Peking, China, 5000, 10,000 and 15,000kc/s.
CHU, Ontario, Canada, 3330, 7335 and 14,670kc/s.
DCF77, Mainflingen, Germany, 77·5kc/s.
FFH, Paris, France, 2500kc/s.
HBN, Neuchatel, Switzerland, 5000kc/s.
IAM, Rome, Italy, 5000kc/s.
IBF, Turin, Italy, 5000kc/s.
JJY, Tokyo, Japan, 2500, 5000, 10,000 and 15,000kc/s.
LOL, Buenos Aires, Argentina, 5000, 10,000 and 15,000kc/s.
MSF, Rugby, England, 2500, 5000 and 10,000kc/s.
OMA, Prague, Czechoslovakia, 50 and 2500kc/s.
OLB5, Prague, 3170kc/s.
OLD2, Prague, 18,985kc/s.
RWM, Moscow, U.S.S.R., 5000, 10,000 and 15,000kc/s.
WWV, Washington, U.S.A., 2500, 5000, 10,000, 15,000, 20,000 and 25,000kc/s.
WWVH. Hawaii, 5000, 10,000 and 15,000kc/s.
ZLFS, Lower Hutt, New Zealand, 2500kc/s.
ZUO, Johannesburg, South Africa, 5000 and 10,000kc/s.

Apart from the above-mentioned stations, the following transmitters can be used as accurate frequency checks since the frequencies are maintained within a tolerance of better than ± 1 part in 10^6: GBR, Rugby, 16kc/s; Droitwich, 200kc/s; GRO, Skelton, 6180kc/s; GSB, Daventry, 9510kc/s; GSV, Daventry, 17,810kc/s. (GSV, GSB and Droitwich are broadcasting stations).

HOW TO BECOME A RADIO AMATEUR

Having acquired experience in listening on the amateur bands, many SWL's aspire to owning and operating their own amateur station. In the interests of all users of the air space, and to prevent absolute chaos, it is necessary to control the conditions under which amateur transmitting stations must operate.

In the U.K., applicants for an amateur licence must (a) be over 14 years of age, (b) be a British subject, (c) pass the Radio Amateur Examination, (d) pass the Post Office Morse Test. The R.A.E.

WKD	Worked	XTAL	Crystal	YL	Young lady
WL	Will	XYL	Wife (ex-YL)	73	Best regards
WUD	Would	YF	Wife	88	Love and kisses

AMATEUR CALL SIGN PREFIXES

The following list of call sign prefixes is arranged to indicate where a common prefix is shared by areas which can be counted as separate "countries" for scoring purposes. This list has been prepared by the Radio Society of Great Britain, our national radio society.

AC3	Sikkim	CT1	Portugal	FH8	Comoro Is.
AC4	Tibet	CT2	Azores	FK8	New Caledonia
AC5	Bhutan	CT3	Madeira Is.	FL8	French Somaliland
AP	W. Pakistan	CX	Uruguay	FM7	Martinique
AP	E. Pakistan	DJ, DL, DM	Germany	FO8	Clipperton Is.
BV	Formosa	DU	Phillipine Is.	FO8	French Oceania
BY	China	EA	Spain	FP8	St. Pierre and
C9	Manchuria	EA6	Balearic Is.		Miquelon
CE	Chile	EA8	Canary Is.	FR7	Reunion Is.
CE9, VP8	Antarctica	EA9	Ifni	FR7	Gloriseuses Is.
CEØ	Easter Is.	EA9	Rio do Oro	FR7	Juan de Nova
CEØ	Juan Fernandez	EAØ	Spanish Guinea	FS7	French St. Martin
CM, CO	Cuba	EI	Eire	FU8	New Hebrides
CN8	Morocco	EL	Liberia	FW8	Wallis and
CP	Bolivia	EP	Iran		Futuna Is.
CR4	Cape Verde Is.	ET2	Eritrea	FY7	French Guiana
CR5	Portuguese	ET3	Ethiopia		and Inini
	Guinea	F	France	G	England
CR5	Principe, Sao	FB8	Amsterdam and	GC	Jersey
	Thome		St. Paul Is.	GC	Guernsey and
CR6	Angola	FB8	Kerguelen Is.		Dependencies
CR7	Mozambique	FB8	Tromelin Is.	GD	Isle of Man
CR8	Portuguese Timor	FC	Corsica	GI	N. Ireland
CR9	Macao	FG7	Guadeloupe	GM	Scotland

requires a knowledge of fundamental receiving and transmitting theory and a knowledge of amateur licence regulations. The Morse Test is at 12 words per minute.

Sources of Information

How to Become a Radio Amateur: This is an invaluable pamphlet giving details of the R.A.E., licence conditions, etc. It can be obtained on request from: Radio Services Department (Radio Branch), General Post Office, Headquarters Buildings, St. Martins-le-Grand, London, E.C.I.

Pamphlet No. 55 (Radio Amateurs' Examination): This contains the syllabus upon which the examination is set and can be obtained, price 1/-, from The City and Guilds of London Institute (Publications), 76 Portland Place, London, W.1. Also obtainable from the same address, price 2/-, are copies of the question papers set during the last three years.

The Radio Amateurs' Examination Manual: This is designed for those studying for the R.A.E. and covers the whole syllabus. Price is 5/6 from Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. Other useful publications by the RSGB include *A Guide to Amateur Radio* (price 4/-) and *Morse Code for Radio Amateurs* (price 1/9).

PHONETIC ALPHABET

In order to convey a call sign or other information through interference, amateurs may resort to phonetic words. This may lead to confusion with newcomers since a popular phonetic alphabet uses geographical locations (such as A=America, H=Honolulu)! Although there is no compulsion, U.K. operators are encouraged to use the alphabet contained in the Radio Regulation, Geneva 1959, and adopted by NATO Services and other bodies, viz.:

A	Alfa	H	Hotel	O	Oscar	V	Victor
B	Bravo	I	India	P	Papa	W	Whisky
C	Charlie	J	Juliet	Q	Quebec	X	X-ray
D	Delta	K	Kilo	R	Romeo	Y	Yankee
E	Echo	L	Lima	S	Sierra	Z	Zulu
F	Foxtrot	M	Mike	T	Tango		
G	Golf	N	November	U	Uniform		

GW	Wales	KC6	E. Caroline Is.	M1	San Marino
HA	Hungary	KC6	W. Caroline Is.	MP4B	Bahrain Is.
HB	Switzerland	KG1	see OX	MP4Q	Qatar
HC	Ecuador	KG4	Guantanamo Bay	MP4T	Trucial Oman
HC8	Galapagos Is.	KG6	Mariana Is.	MP4M	Muscat and Oman
HE	Liechtenstein	KG6	Guam	OA	Peru
HH	Haiti	KG6	Marcus Is.	OD5	Lebanon
HI	Dominican Rep.	KG6I	see KAØ	OE	Austria
HK	Colombia	KH6	Hawaii	OH	Finland
HKØ	San Andres and	KH6	Kure Is.	OHØ	Aaland Is.
	Providencia	KJ6	Johnston Is.	OK	Czechoslovakia
HKØ	Malpelo Is.	KL7	Alaska	ON4, 5, 8	Belgium
HKØ	Bajo Neuvo	KM6	Midway Is.	OX, KG1	Greenland
HM	Korea	KP4	Puerto Rico	OY	Faeroe Is.
HP	Panama	KP6	Palmyra Group;	OZ	Denmark
HR	Honduras		Jarvis Is.	PAØ, PI1	Netherlands
HS	Thailand	KR6	Ryukyu Is.	PJ	Netherlands
HV	Vatican City	KS4	Swan Is.		W. Indies
HZ	Saudi Arabia	KS4B	Serrana Bank and	PJ2M	Netherlands
I1, IT1	Italy		Roncador Cay		St. Martin Is.
IS1	Sardinia	KS6	U.S. Samoa	PK	Indonesia
JA, KA	Japan	KV4	Virgin Is. (U.S.)	PX	Andorra
JT1	Mongolia	KW6	Wake Is.	PY	Brazil
JY	Jordan	KX6	Marshall Is.	PYØ	Trinidade and
K	see W	KZ5	Canal Zone		Vaz. Is.
KA	see JA	LA	Jan Mayen	PYØ	Fernando de
KAØ, KG6I	Bonin and	LA, LB	Norway		Noronia
	Volcano Is.	LA	Svalbard	PZ	Netherlands
KB6	Baker, Howland	LH	Bouvet Is.		Guiana
	and American	LU	Argentina	SL, SM	Sweden
	Phoenix Is.	LU-Z	see CE9	SP	Poland
KC4	see CE9	LX	Luxembourg	ST2	Sudan
KC4	Navassa Is.	LZ	Bulgaria	SU	Egypt

AMATEUR BANDS (U.K.)

Frequency Band (Mc/s)	Classes of Emission	Maximum d.c. Input Power
1·8–2·0	A1, A2, A3, A3A, F1, F2, F3	10 watts
3·5–3·8 7·0–7·10 14·0–14·35 21·0–21·45 28·0–29·7		150 watts
70·2–70·4		50 watts
144–145 145–146 420–450 1,215–1,325 2,300–2,450 3,400–3,475 5,650–5,850 10,000–10,500 21,000–22,000		150 watts
2,350–2,400 5,700–5,800 10,050–10,450 21,150–21,850	P1D, P2D, P2E, P3D, P3E	25W (mean), 2·5kW (peak)

Note: A—classes of emission are forms of amplitude modulation, F—frequency modulation and P—pulse modulation.

CUT HERE

SV	Greece
SV	Crete
SV	Dodecanese
TA	Turkey
TF	Iceland
TG	Guatamala
TI	Costa Rica
TI9	Cocos Is.
TJ	Cameroun
TL8	C. African Rep.
TN8	Congo Republic
TR8	Gabon Republic
TT8	Tchad Republic
TU2	Ivory Coast Rep.
TY	Dahomey Rep.
TZ	Mali Republic
UA1, 3, 4, 6, UNI	European S.F.S.R.
UA1	Franz Josef Land
UA2	Kaliningradsk
UA9, Ø, UW9	Asiatic S.F.S.R.
UB5, UT5, UY5	Ukraine
UC2	White Russian S.S.R.
UD6	Azerbaijan
UF6	Georgia
UG6	Armenia
UH8	Turkoman
UI8	Uzbek
UJ8	Tadzhik
UL7	Kazakh

UM8	Kirghiz
UO5	Moldavia
UP2	Lithuania
UQ2	Latvia
UR2	Estonia
VE, VO	Canada
VK	Australia
VK	Lord Howe Is.
VK	Willis Is.
VK9	Christmas Is.
VK9	Cocos Is.
VK9	Nauru Is.
VK9	Norfolk Is.
VK9	Papua Territory
VK9	New Guinea
VKØ	see CE9
VKØ	Heard Is.
VKØ	Macquarie Is.
VP1	British Honduras
VP2	Anguilla
VP2A	Antigua, Barbuda
VP2V	British Virgin Is.
VP2D	Dominica
VP2G	Grenada and Dependencies
VP2M	Montserrat
VP2K	St. Kitts, Nevis
VP2L	St. Lucia
VP2S	St. Vincent and Dependencies
VP3	British Guiana
VP4	Trinidad and Tobago

VP5	Turks and Caicos Is.
VP6	Barbados
VP7	Bahamas
VP8	see CE9
VP8	Falkland Is.
VP8	S. Georgia
VP8	S. Orkney Is.
VP8	S. Sandwich Is.
VP8	S. Shetland Is.
VP9	Bermuda Is.
VQ1	Zanzibar
VQ7	Aldabra Is.
VQ8	Cargados Carajos
VQ8	Chagos Is.
VQ8	Mauritius
VQ8	Rodriguez Is.
VQ9	Seychelles
VR1	British Phoenix Is.
VR1	Gilbert and Ellice and Ocean Is.
VR2	Fiji Is.
VR3	Fanning and Christmas Is.
VR4	Solomon Is.
VR5	Tonga Is.
VR6	Pitcairn Is.
VS5	Brunei
VS6	Hong Kong
VS9	Aden and Socotra
VS9	Maldive Is.
VS9	Sultanate of Oman
VS9K	Kamaran Is.

These ranges are selected by pressing a function button (mA, V or Ω) and also a range button. Each of the three range buttons will select a current range, a voltage range or a resistance range. Thus the left-hand range button will give ranges of 0—1mA; 0—1V or 0—1kΩ, depending on which function button is depressed. Thus three range buttons allow us to select 3 current ranges, 3 voltage ranges and 3 resistance ranges. The fourth current range (0—50μA) is obtained by pressing the mA function button and releasing all the range buttons. (This can be done by slowly pressing a button half-way in until it unlocks the other buttons, and then releasing it.)

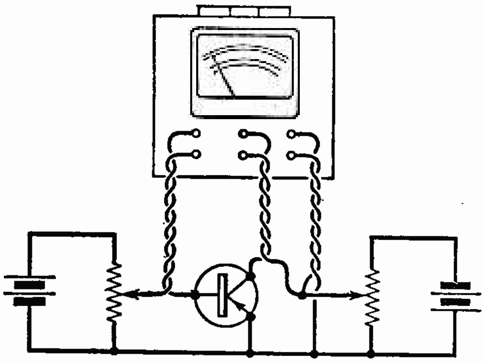


Fig. 2: Checking transistor performance.

V FUNCTION BUTTON

The fourth voltage range (0-500V) is obtained by pressing the V function button and releasing all the range buttons. It is suggested that the buttons be colour coded, using red for current, green for voltage and yellow for resistance. Thus buttons "input 1", "input 2" and "mA" will be coloured red; buttons "input 3" and "V" will be coloured green; and button "Ω" will be coloured yellow. The three range buttons are each divided into three equal areas which are coloured red, green and

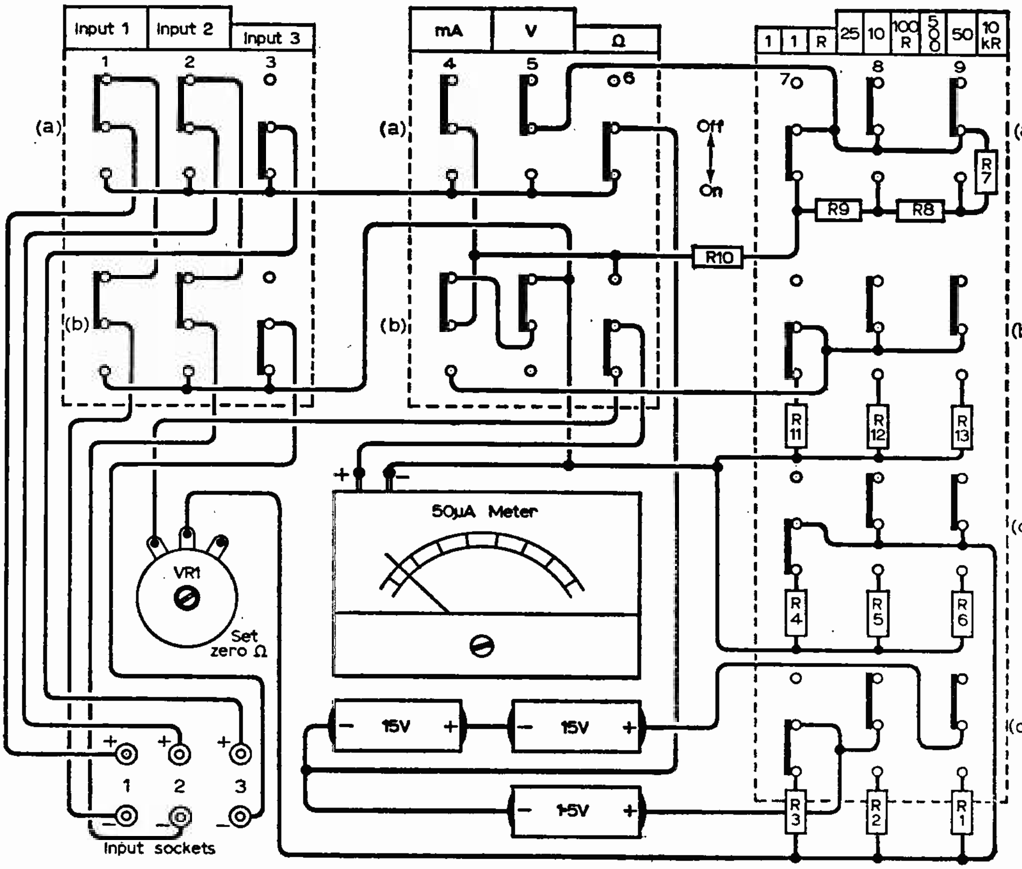


Fig. 3: Wiring and layout diagram.

yellow respectively. Thus for each button the appropriate current, voltage and resistance range can be written on the red, green and yellow panels. When all the function buttons are released the meter movement is short circuited, and the meter should be left like this when not in use.

Each button operates a 4-pole 2-way switch. The circuit diagram is given in Fig. 1 and the layout in Fig. 3. The case is made from plywood bonded with epoxy resin (Araldite etc). The resistances are nearly all non-standard valves. If you are on good terms with your dealer he may let you go through his stock of 10% resistances with his meter until you find ones near enough. This way means that your meter will be slightly innacurate on some ranges, but it should not be enough to worry about.

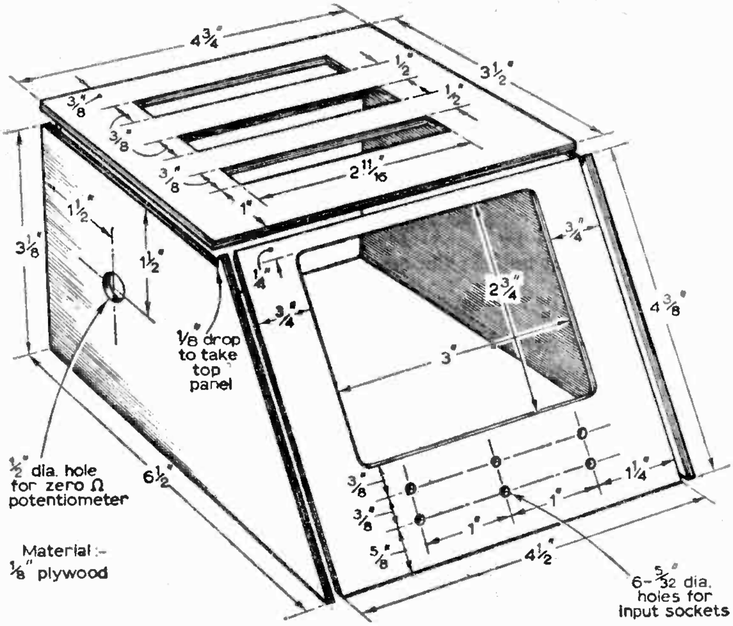


Fig. 4: Cabinet drilling and constructional details.

SPECIAL RESISTORS

The very low value resistances are best made from lengths of electric-fire element. Pull out a few feet of element to remove the kinks, measure this length accurately (in inches) and borrow an ohmmeter to measure its resistance. Divide the length by the resistance and you will get a number which represents the length which has a resistance of 1Ω. Multiply this by the resistance you want. This will give you the length of wire you will need (in inches). Remember to cut off a piece slightly longer than this to allow for the soldered ends. The 0·1Ω resistance may be best made out of copper wire. If you use fire element for this one, it will be about ¼in. long and may be a bit too small to handle easily. If you use Wellco spiral element, 230/250V 500W, a 6·5mm length has a resistance of 1Ω, and you will find the suggested lengths for each resistance in the components list. The wire should be insulated with a varnish.

CONSTRUCTION

Construction should be started around the banks of switches, leaving leads about 6in. long for connecting to the meter, the batteries, the potentiometer and the input sockets. The four screws at the back of the meter are removed and the cover can then be lifted off. The existing scale should be

COMPONENTS LIST

Resistors:

All selected from 10%, ¼ watt

Resistance	Value	Nearest standard value
R1	524kΩ	560kΩ
R2	4·944kΩ	4·7kΩ
R3	49·45Ω	47Ω
R5	384Ω	390Ω
R6	15·8kΩ	15kΩ
R7	9MΩ	8·2MΩ or 10MΩ
R8	800kΩ	820kΩ
R9	180kΩ	180kΩ
R10	19kΩ	18kΩ
R11	53Ω	56Ω

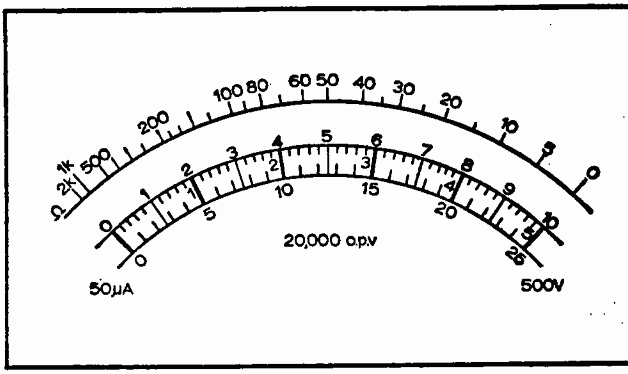
The following resistors are made from resistance wire:

Resistance	Value	Length of 230/250v 500 watt fire element (Wellco Ltd)
R4	3·16Ω	202mm
R12	2Ω	130mm
R13	0·1Ω	6·5mm

Other Components

VR1 1000Ω linear w.w. pre-set potentiometer
B1 Two 15V batteries in series (Ever Ready B154)
B2 One 1·5V baby cell battery (Ever Ready LPU 11)
Three 3-way pushbutton units, each operating a 4-pole, 2-way switch (Broadway Electronics Ltd., Tooting).
50μA meter, ex-government (Radio & TV Components (Acton) Ltd.).
Six sub-miniature sockets and plugs.
One piece of ⅛in. plywood, 12⅛in. x 11in.
Two pieces of leathercloth for covering 18in. x 5in.; 15in. x 4in.

Fig. 5: Scale calibration for the new dial (see text).



removed, and the scale shown in Fig. 5, copied on to thin card, mounted in its place. The pointer can be lengthened, if desired, by gluing a short length of very fine wire to the end of it. If this is done, it must be counterbalanced very carefully so that the position of the pointer does not change when the meter is horizontal and vertical.

The wooden case can be covered with leathercloth. ■

UNDERSTANDING F.M.

—continued from page 762

polarity only. The pulses "pile up" additively in C2, but not indefinitely because there is a drain into the following a.f. circuit through C4. Allowing for the smoothing effect of C2 C3 and the time constants of the network it will be realised that the pulses lose their separate identities but set up voltages that change with their rate of arrival. The smoothing network includes the adjustment required for de-emphasis. D2 eliminates pulses of opposite polarity.

To produce distinct pulses the carrier must be converted to a very low intermediate frequency between 100 and 500kc/s and the gain of the receiver is consequently low. Nevertheless, it provides a simple system of the highest quality and a successful valve version appeared in the April 1965 issue of this journal. It is well suited to transistor circuitry and a design is in development at the moment.

As the object of this article has been to explain the nature and behaviour of the f.m. carrier in order that the discriminators likely to be encountered can be understood, such matters as the relationship between frequency modulation and phase modulation, pre-emphasis and de-emphasis, limiter circuitry, and interference, have not been included because these can be pursued after the information in these pages has been understood. ■

ECONOMY FM TUNER
(October 1965 P.W.)

Fig. 1 shows the screen grid (pin 8) of V2 connected to the junction of R2/C2. This should have been shown connected to the junction of R1/C1 only.

MINIATURE OSCILLOSCOPE
(November 1965 P.W.)

Henry's Radio Limited, 303 Edgware Road, London, W.2. have informed us that they are able to supply new, from stock, the ACR10 (VCR139A) c.r.t. We understand that this will replace the VCR139 without any changes to the circuitry. The price is 25s. 0d. plus 2s. 6d. post and packing.

BUILT-IN TUNER FOR TAPE RECORDERS
(September 1965 P.W.)

The H402 coil kits are now being supplied with two different codings. The colour coding of the cores given in the article is correct where the transformers have part numbers viz: E360—S301—S203 etc., and where the ferrite rod aerial has only three leads.

Where the ferrite rod aerial has four leads, the GREEN and BLACK leads should be joined together and taken to chassis (+ve). Also where the transformers do not have part numbers, the colour coding of the cores are as follows: Oscillator—Black. 1st i.f.t.—Yellow. 2nd i.f.t.—Red. 3rd i.f.t.—Grey.

A circuit diagram supplied by the coil kit manufacturers, is included with each set of coils, and reference to this before construction will clarify the connections.

PRACTICAL WIRELESS AND PRACTICAL TELEVISION FILM SHOW

The Film Show, which is held annually, is to be held as before, at Caxton Hall, Caxton Street, Westminster, London, S.W.1. The date of the Show, which is arranged in collaboration with Mullard Limited, is Friday, 4th February, 1966, at 7.30 p.m. sharp. The films to be shown are "Electromagnetic Waves, Part II" and "Thin Film Microcircuits" and the illustrated talk will be on "Transistor Topics". Refreshments will be provided. The talk will be given by Mr. I. Nicholson of Mullard Limited, and in the chair will be Mr. W. N. Stevens, Editor of "Practical Wireless" and "Practical Television". Applications for free tickets should be made to FILM SHOW, "Practical Wireless", Tower House, Southampton Street, W.C.2 and *not* to Caxton Hall. A stamped addressed envelope must be enclosed.

Dealings with the G.P.O.

I ENCLOSE part of recent correspondence between myself and the G.P.O. Radio Services Branch.

From the University of Sheffield Amateur Radio Society:

Q1 . . . Can Sound 'B' licensees operate on any amateur frequency provided that they use a Sound 'A' callsign, the holder of which is present?

A1 . . . The holder of an amateur (Sound) licence 'B' is permitted to operate an 'A' station under the direct supervision of the licensee on all amateur frequencies. Operation, however, is restricted to telephony only.

Q2 . . . Can Sound 'B' licensees operate a club (Sound 'A') station as authorised operators, unsupervised, on frequencies higher than 420Mc/s?

I appreciate that the use of Morse is not allowed when a Sound 'B' licensee is transmitting.

A2 . . . The holder of an Amateur (Sound) licence 'B' cannot be authorised to act as an additional operator of an 'A' club station.

I feel that these answers could be of sufficient significance for comment in PRACTICAL WIRELESS.

J. P. Billingham.

Ardsley,
Barnsley.

Tape Terminology

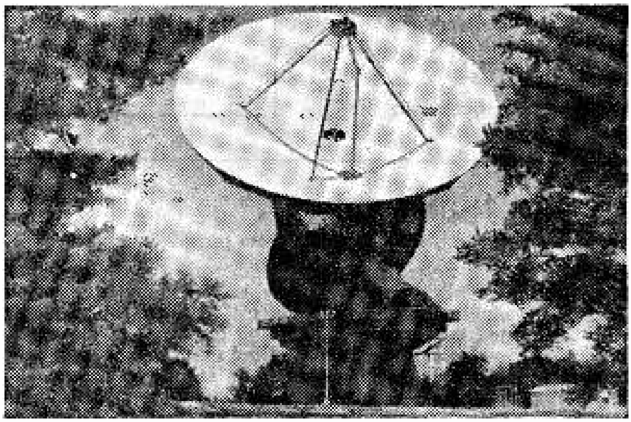
THE remark in Mr. Read's letter (November 1965 issue) has been somewhat anticipated. On the 20th of October, George Newnes published a short work, "Questions and Answers on Radio and Television", putting technical matters into language that, I hope, will be both instructive to the layman and helpful to the accomplished. Also published on that date was my more ambitious work on the subject that appeals to Mr. Read, "Tape Recording Service Manual". Although this is a volume costing three guineas and containing technical data on a great many tape recorder mechanisms and circuits, it also contains a section dealing with the principles of tape recording and general servicing procedures in which Mr. Read may be interested.

H. W. Hellyer.

Bargoed,
Glamorgan.

NEWS AND..

THE WORLD'S MOST PRECISE "RADIO EYE"



A new 140 ft. diameter radio telescope is now operational in Green Bank, (West Virginia) USA. It is being used by astronomers to detect sources of noise in outer space. Unique feature of the telescope is a Westinghouse metal bearing which pivots 2,600 tons on a film of oil only the thickness of a hair.

Built at a cost of $13 million the station, known as National Radio Observatory, is designed to be the world's most precise instrument for pinpointing waves from outer space.

THE COLDEST PLACE ON EARTH

In a recent issue of the Mullard Outlook, details were given of the Mullard Cryomagnetic Laboratory located at Oxford, England. This forms part of the internationally known Clarendon Laboratory which has become famous for its contributions to research in the field of magnetic fields at very low temperatures.

Mullard scientists in their new laboratory with its source of very high power magnetic fields have recently been testing many new types of semi-conductor material. This may, in time, lead to revolutionary methods of generating, transforming and distributing electric power. In the course of studying aspects of solid state physics, the scientists have been able to achieve temperatures as low as a millionth of a degree above absolute zero—almost as cold as the conditions found in outer space.

The Mullard Cryomagnetic Laboratory is believed to be the only one in the world to have reached so far down the temperature scale and thus earned for itself the title of "The Coldest Place on Earth".

LASER TELEPHONE LINE IN MOSCOW

The first laser telephone communication system linking two districts in Moscow is being put into operation. Special transmitting equipment converts telephone signals into impulses which are superimposed on a laser ray. The receiving equipment directs the ray to a large parabolic mirror which reflects it into a system of filter and photo transformers where it becomes a telephone signal again.

..COMMENT

INTERNATIONAL RADIO COMMUNICATIONS EXHIBITION

Now fairly established as a regular event in the radio calendar, this year's exhibition at the Seymour Hall fully lived up to the reputation of its predecessors.

The home-constructed units bore witness to the very high standard attained these days by Amateurs, and with some exhibits it was difficult to define the borderline between these units and some of the commercial items. Of particular note was the solid state mobile equipment built by G3LOK and the superb s.s.b. transceiver constructed by G3SBA.

The British Amateur TV Club displayed an impressive array of gear with a triple-turret TV camera with built-in monitor screen televising the exhibition from the balcony.

In the professional field, K.W. Electronics displayed their KW2000A s.s.b. transceiver while across the hall Brian J. Ayres & Co. were showing a range of National equipment. Highlight here was the much talked of solid state receiver, the HRO-500 costing about £705. Needless to say, this is not a t.r.f.!

The manufacturers award this year was presented to Tom Withers of T.W. Electronics for their solid state v.f.o. for 144 Mc/s. Messrs Imhofs offered an impressive display of cabinets of all shapes and sizes, and Electroniques offered their very excellent coils and receiver front-ends for the serious amateur. J. Beam aerials showed a number of their time proven v.h.f. and u.h.f. arrays, plus the able assistance of Vic. Hartopp to answer the numerous queries.

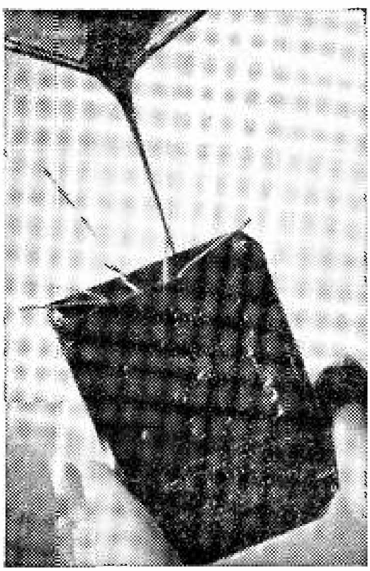
The accent this year was clearly two things—the increase in solid state circuitry, and s.s.b. Next year might even see greater marriages between these two.

MARCONI SOLID SWITCHES

The photograph shows the final stage in the production of one of the new range of Marconi high-speed solid-state switches.

Hard black Araldite, an extremely tough epoxy-resin, is being poured into the body of the switch to provide complete encapsulation. This technique provides the maximum possible protection for solid-state electronic circuits. After curing at 60°C, the switch becomes an entirely solid unit which is capable of operating under extreme environmental conditions.

These new switches are fully transistorised and can be used as direct replacements for electro-mechanical relays. They are virtually indestructible and will operate almost indefinitely.



Thumbnail History of Radio

I WOULD like to thank the many old-timers who have helped me in my researches for the above-mentioned article. Most of this information has been passed on to me by the old operators on 80m whose ranks are sadly diminishing all the time. I feel that it is especially important to collect all this information before it is lost.

R. F. Farley, G3SSJ.

Mytchett,
Nr. Aldershot,
Hampshire.

The Meaning of Amateur

Do your correspondents think that amateur footballers should knit their own jerseys and socks, or that amateur cyclists should construct their own cycles?

So why should amateur radio enthusiasts be any different? Why should they not have the benefit of commercially-made equipment as much as amateurs in any other field?

R. G. Hasler.

Birmingham, 28.

I DO not think we should take too seriously the letter on this subject from Mr. Heathfield in the December issue—he generalises too much on only a few observations. Will he now do us the favour of visiting those of his friends whose hobby is photography and then tell us how much of their apparatus (cameras, lenses, light meters, rangefinders, print-driers, etc.) they have made for themselves, and if he considers it a bad thing that they should buy commercial gear.

Has it escaped his notice that a commercial-looking piece of equipment may in fact have been built from a kit of parts such as those offered by K. W. Electronics, or Heathkit?

Our hobby is perhaps unique in that so much of the apparatus used in it can be built at home to save heavy outlays if one is so inclined; that so much is published to enable this to be done, and that so many people (despite what Mr. Heathfield would like us to believe) still do "roll their own" and enjoy doing it.

W. E. Thompson, G3MQT.

St. Leonards-on-Sea,
Sussex.

TAPE
TAPE
TAPE TERMINOLOGY
TAPE
PART SIX

by H. W. Hellyer

THREE-HEAD SYSTEM

Using separate Erase, Record and Play Heads.

TONE CONTROL

Used during playback to "tailor" the response of the tape recorder to suit listening conditions. Can consist of a simple top-cut network or a more complicated bass and treble constant-control, using feedback networks and balanced controls.

TRACK

The magnetised path of the recording after it has passed the recording head. Trackwidth depends on the gap length. Fig. 19 shows actual and proposed track dimensions on standard quarter-inch (average) tape. Figures given are in inches, and some tolerance is allowed for most measurements, depending on head manufacture. The diagram is not to scale.

(a) Half-track operation, BS. 1568.
(b) International half-track standard.
(c) Original Continental quarter-track standard, now discontinued.
(d) Proposed "compatible" standard.
(e) American MRIA quarter-track standard.

Note that various standards have been proposed, and the latest attempt is to ensure compatability, i.e. the replaying of two-track recordings through a four track machine for stereo reproduction, without losses and also to be able to replay quarter-track recordings on a half-track machine, which is at present not satisfactory. Spaces between tracks and at edges are called "safety lanes".

TWIN TRACK

Correctly referring to a stacked head with two gaps, one above the other, for simultaneous recording and playback of two tracks. (As opposed to two-track, where a single gapped head is used for recording and replay of two tracks by tape inversion at the end of the reel.) Similarly, quarter-track recording is made on a four-track machine having two gaps, and employing the tape inversion principle. Track numbering is normally 1 and 4 for the outer tracks and 2 and 3 for the inner tracks, giving a numbering 1 to 4 from top to bottom. But some manufacturers favour different numbering systems.

TRANSDUCER

A device which is actuated by waves from one transmission system and supplies related waves to other media. Practically, a microphone or loudspeaker which converts sound waves to electrical impulses, or vice versa.

TWEETER

Small loudspeaker specially designed to handle the higher audio frequencies. Normally connected via a filter which cuts off tones below about 2,000c/s.

ULTRASONIC FREQUENCY

A frequency lying above the audio frequency range; usually employed to indicate the frequency range of the bias oscillator. This is not strictly accurate, bias frequency is usually in the radio frequency part of the spectrum.

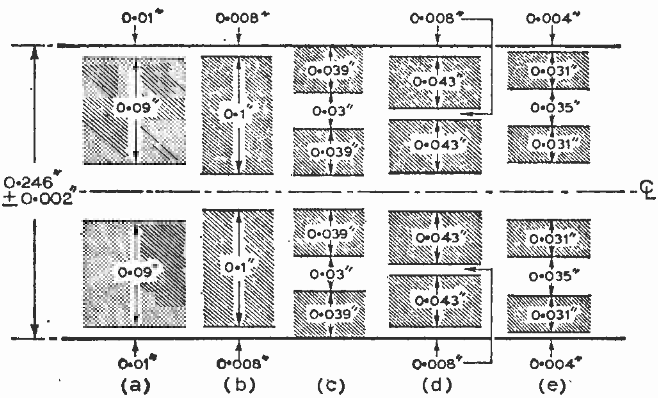


Fig. 19: Track dimensions on standard ¼" tape.

VARIABLE BIAS

Method of altering bias gradually to obtain good tone balance, usually during superimposition when the action of cutting out erase power can affect bias conditions, and when reduced bias is needed for the later signal to prevent overriding the original.

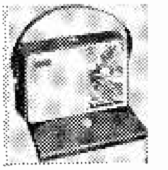
VARIABLE SPEED WIND

In some machines (professional types mainly) the speed of winding can be potentiometer controlled for special applications.

EXCLUSIVE TO PRACTICAL WIRELESS READERS

MORE TERRIFIC OFFERS FROM CONCORD!

TRANSISTOR POCKET RADIOS

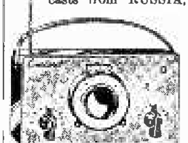


BULK PURCHASE ENABLES US TO MAKE THIS FANTASTIC OFFER—AND WITH MONEY BACK GUARANTEE ! ! !

The "SAN REMO" . . . so tuned that it brings the voices of star entertainers and vocalists dramatically to life—in your home, office, etc. Only 4¾ x 2¾ x 1¼in. Fits easily into your pocket or handbag. Works for months off 1/2 battery. Should last a lifetime, anyone can assemble it in an hour or two with our easy plan. Miniature speaker, carrying case—everything only 28/6. 2/6 P. & P. (Parts can be bought separately.) Limited period—so rush your order before it's too late. DEMONSTRATIONS DAILY.

ONLY 28/6

NO MORE TO PAY



IT HAD TO COME EVENTUALLY! THE "SKYSCRAPER" PERSONAL COMMUNICATIONS RECEIVER. Highly sensitive. World-wide short-waves reception including news in English and countless other broadcasts from RUSSIA, AMERICA, etc., etc. Take it anywhere—it's featherweight! 6in. x 3½in. x 1¼in. Band-spread Tuning, Vernier Dial, Miniature Valve Circuits, Plug-in Coils, Own Rod Aerial, etc. 50% of production to be exported. Anyone can assemble it within 2 hours—only a few connections to make—experience unnecessary. Parts incl. Case. Personal phone. Easy-to-follow plan—49/6 plus 2/6 Post, etc.

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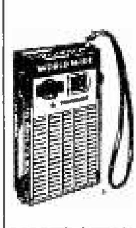
10 TRANSISTOR PERFORMANCE HI-FI RADIO



ONLY 55/-

POST 3/6

LIQUIDATION PURCHASE 500 ONLY Made to sell at 5½ gns. — Save £3.0.6. Latest camera style radio. Big-Set tone from tone-chamber moving coil speaker. new device plucks in Station after Station including Luxembourg, Caroline, etc. Fantastic coverage — 187-577 metres! Expensive looking finish, simulated leather, black and chromium. Size 4½" x 2½" x 1½". 7 semi-conductors. 55/-+2/6 batt.+3/6 P. & P. Refund if not delighted.

TRANSISTOR RADIO KITS

SOLD IN DEPARTMENT STORES AT £5.8.0.

OUR PRICE **37/6** P. & P. 3/6 Extra

Well-known brand Transistor Radio Kits—YOU SAVE £3.10.6. Covering all medium/long wave with parts including Mullard Semi Conductors. 48 page instruction manual. Entertaining and educational. No soldering, just plug in, making many different Radios in a few mins.

DON'T WALK-JUST TALK ! !

INTERCOM OUTFIT & BABY ALARM

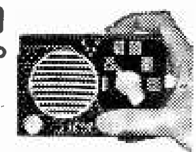
LIMITED QUANTITY SAVE £3.13.1

ONLY 49/11

Robustly made, brand new current models. You get 2 separate, fully transistorised intercommunicating sets — each can speak or listen to the other — complete with 60 ft. connecting wire. Fixed in a flash. Ends baby-crying worries. Ideal for Workshop to House, Sickroom, hundreds of uses! Hangs on wall or stands up. Our absurd price 49/11, battery 2/6, extra Post, etc. 3/7. Money refunded if not 6 gns. value!

NEW RADIO VOLKSRADIO

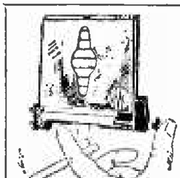
ANYONE CAN BUILD IN 2-3 HOURS!



19/6

EVEN THE OLDER CHILDREN BUILD THEM! . . . no soldering—only 16 connections! then hear it reach out bringing in station after station, loud and clear. Palm-of-hand size 4¼ x 2¼ x 1¼in. Many Testimonials: M.H. of Bradford, writes: ". . . *I have just completed one of your sets successfully. it is the first time I have ever tackled anything like a radio, and I must state here and now, I am amazed how easy it is to a layman like me. Your instructions and plan have obviously been very carefully thought out so that even the most dim can follow them . . .* " Direct from Manufacturers to You. Send 19/6 plus 2/6 post, etc.

PARTS AVAILABLE SEPARATELY

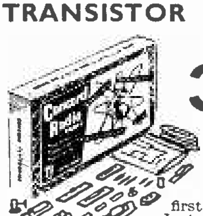


CAR CIGARETTE LIGHTER DISPENSER

High Class Stores sell at 3 gns. — save £2.4.6 Top quality chromium. Car cigarette Lighter —Dispenser. Fixed in a jiffy — Pressing Button delivers ready-lit Cigarette into your hand! Takes 10 cigarettes—King size or any size! As fitted to luxury cars. Safe, fool-proof. 4½ x 4 x ½in. Lifetime tested. ready to use. Refund if not worth 3 gns. 750 only. 18/6 plus 1/6 P. & P. (state 6 or 12v.).

ONLY 18/6

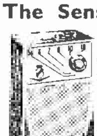
MAKE 5 DIFFERENT TRANSISTOR RADIOS FOR 35/-



NO EXPERIENCE NECESSARY. No Soldering. Only 8 connections for first radio to work. Just look, you get A.B.C. Plans, Cabinet, Loudspeaker (alone 17/6). Earphone, 4 Semi-conductors. Coils, Condensers, Resistors, Tuner, Switch, Screws, etc. YES — EVERYTHING! Loud clear English and Foreign reception. As supplied to Educational Authorities. H.M. Forces, etc. TESTIMONIALS GALORE. Mr R. O'D of Londonderry, writes:— "*. . . I received your components and I must say that I am very satisfied with them! I have it already set up! . .* " COMPLETE HOME/RADIO COURSE. Originally £6 SEND ONLY 35/- plus 3/6 post, etc.

FABULOUS ST. TROPEZ MK. 6

The Sensational Pocket Radio



This fantastic offer will amaze you—the beautifully compact ST. TROPEZ, measuring 4½ x 3 x 1¼in. receives perfectly in bedroom, office or gardens—over all medium waves including Luxembourg. Under 1d. per hour running cost. ANYONE can assemble it in one or two hours using our simple A.B.C. plan. 25/- (P. & P. 2/6 extra). Case extra. Parts can be bought separately.

Read what just a few of our satisfied customers say

R.C. of Harringay writes *Received with thanks Skyroma . . . Very pleased. Working well.*

B.M. of Harrogate writes . . . *I would like to thank you . . . It was a real bargain.*

L.S. of London W.8 writes . . . *given it a good try out and I am very pleased with the results.*

S.B. of Somerset writes . . . *delighted with this radio . . . glad if you could send one more.*

T.F. of Stevenage writes . . . *I would just like to say how pleased my son is with this radio.*

AMAZING CIGARETTE RADIO

ONLY 18/6

Yes, a perfectly ordinary packet of cigarettes! — but watch your friends' astonishment on hearing it fetch in station after station, loud and clear! Still holds 10 Cigarettes—yet cleverly conceals highly sensitive, fully transistorised circuit (including tiny battery). Even a young boy can assemble it in under 2 hours. No soldering. No experience necessary. Only 16 connections to make. Ideal for taking to work with you. From our bulging testimonial file, Mr. D. B. of Huddersfield, writes: "*. . . I have fitted the parts in and it is working wonderfully . . .*" ALL PARTS including Semi-Conductors, A.B.C. Plans, etc. ONLY 18/6 plus 2/6 post etc.

PARTS AVAILABLE SEPARATELY

CONCORD ELECTRONICS LTD. (DEPT. P.W.28) 9 WESTERN ROAD, HOVE, SUSSEX

TRANSISTOR ELECTROLYTICS

COMPARE THESE PRICES!

32μF	1·5 volt	25μF	6 volt	4μF	15 volt
·25μF	3 volt	30μF	6 volt	5μF	15 volt
2μF	3 volt	50μF	6 volt	6μF	15 volt
3μF	3 volt	100μF	6 volt	8μF	15 volt
8μF	3 volt	2μF	9 volt	16μF	15 volt
10μF	3 volt	10μF	9 volt	32μF	15 volt
12μF	3 volt	20μF	9 volt	50μF	15 volt
20μF	3 volt	2μF	12 volt	64μF	15 volt
30μF	3 volt	3μF	12 volt	2·5μF	25 volt
40μF	3 volt	4μF	12 volt	16μF	25 volt
·25μF	6 volt	10μF	12 volt	32μF	25 volt
2μF	6 volt	20μF	12 volt	2μF	30 volt
3·2μF	6 volt	25μF	12 volt	16μF	30 volt
4μF	6 volt	30μF	12 volt	25μF	30 volt
8μF	6 volt	1μF	15 volt	1μF	50 volt
10μF	6 volt	2μF	15 volt	5μF	70 volt

All the above at 1/2 each.

320μF	2·5 volt	250μF	15 volt	150μF	25 volt
200μF	3 volt	500μF	15 volt	100μF	30 volt
250μF	6 volt	100μF	18 volt	200μF	30 volt
400μF	6 volt	64μF	25 volt	50μF	150 volt

All the above at 1/6 each.

1,000μF	6 volt	750μF	15 volt	1,000μF	25 volt
1,000μF	12 volt	1,000μF	15 volt	500μF	50 volt
4,000μF	12 volt	500μF	25 volt	1,000μF	50 volt

All the above at 2/- each.

200/100μF, 257V or 200/200μf, 275V ... ... 6/6 each

CONDENSERS
Silver Mica, 3·3pF to 6,800pF. Including High Voltage Disc Ceramics (normally 3/- each) ... ... 10/- per 100
Paper Condensers: ·0001μF, ·001μF, ·002μF, ·005μF, ·02μF and ·04μF, all at 7/6 per 100. £3 per 1,000; ·1μF, ·25μF, ·5μF, 10/- per 100.

RESISTORS
1/10th, 1/6th, 1/4th, watt ... ... 10/- per 100
Mixed wattages ½ watt to 3 watt. Close Tolerance. Assorted Values. Polythene wrapped on cards of 10. Give-away price, 50/- per 1,000, plus 5/- post and packing.

TRANSISTORS (At a price you can afford)
OC71 equivalent, 1/- each, 25 for £1, 100 for £3.
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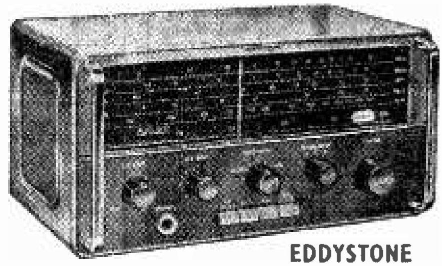

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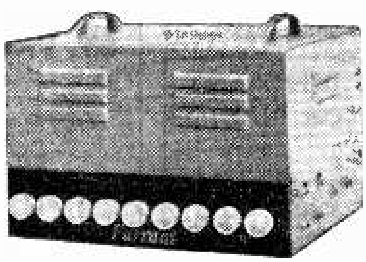

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Fig. 20 depicts (a) original circuit of wind-on and re-wind motors of typical three-motor machine, with loading resistor used to balance torque during Record or Playback. (b) Modified circuit using variable resistor to form bridge. (c) Motor torque varies as resistance (and hence applied voltage) is varied. Suitable for single-phase induction motors with no electrical connection between stator and rotor. Speed of motor is less than synchronous speed, the difference being the "slip" which increases as rotor speed decreases. The circuit allows relative torque variation. At point of intersection of curves, which depend on motor characteristics, motors are balanced and at standstill.

VARIABLE RELUCTANCE MICROPHONE

Older types of moving iron microphone come into this category, and are rarely used for present purposes. (See Microphones.)

VELOCITY MICROPHONE

A microphone in which the electric output substantially corresponds to the instantaneous particle velocity in the impressed sound wave. An example is the ribbon microphone, in which pressure gradient principle is employed, the difference in pressure between the two faces of the ribbon causing movement and electrical output. (See Microphones.)

VIDEO TAPE RECORDING

Method of recording television pictures on magnetic tape for subsequent replay. Problems involved are caused by the need for large bandwidth—at least 2 Mc/s—which calls for high speed of tape past heads. This can be achieved either by fast tape speed or by rotating a sequence of switched heads as the tape is moved. Fig. 21 shows basic rotating head system used for video tape recording. Two-inch Mylar tape is used at 15 in/sec. Headwheel spins at 15,000 r.p.m., giving relative head-to-tape speed of 1570 in/sec. Vision track is modulated on to an f.m. carrier from 42·2 to 6·8Mc/s before recording and demodulated after replay. There are four heads, and four channels, with each head having a 120 degree arc of tape contact—30 degrees of overlap. Each head is switched electrically during contact, and "killed" during out of contact period to reduce stray responses. Synchronising is supplied from servo control of motor and sync pulses are recorded on tape. Switching gate is controlled by photocell from motor into switching module.

The multiple head system scans the tape vertically with the tape at relatively slow speed. A tape speed of 7½ in/sec. will produce a track speed of 200 in/sec. or greater with rotating heads. As the tracks are nearly vertical, and in rotation, the tape must be wider than standard, and mechanical problems of speed regulation, head wear and synchronisation are encountered. Two such machines recently marketed have tape speeds of 12·6 and 19 cm/sec. and tape width of 50·8mm and 25·4mm respectively.

The alternative technique, of a stationary head

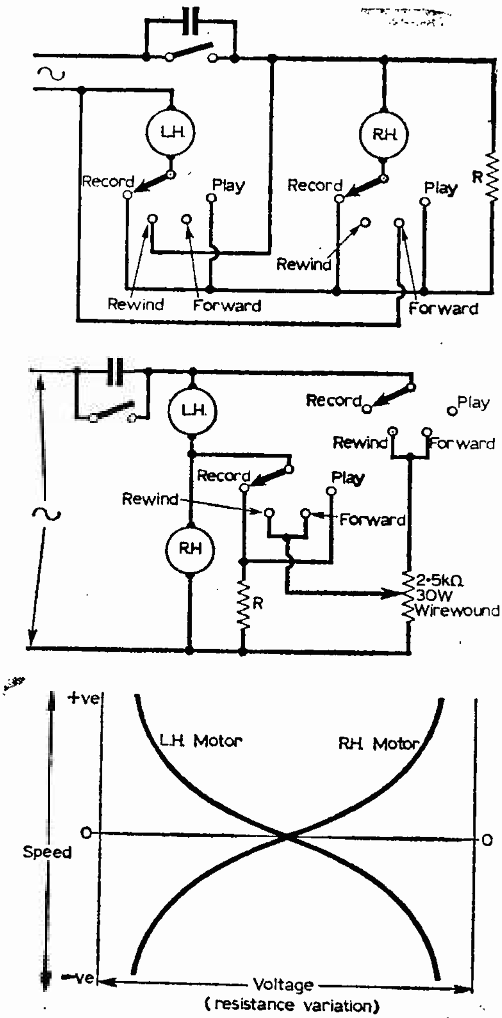

Fig. 20: Circuits of wind-on and rewind motors and motor torque graph.

and fast-moving tape, uses speeds of up to 150 in/sec., and a standard ¼in. tape, on which one track of video and another of f.m. sound are recorded. Typical head gap sizes are less than micron. (One example is the American Fairchild V-5000, using a tape speed of 120 in/sec., a standard ¼in. tape, and movable heads to scan four tracks. A single track is used with multiplexed video and audio signals. The record head has a relatively wide gap but the playback head gap is only 0·000039in. wide. Instrumentation tape is used, of 9,000ft. length on a 10½in. standard NAB spool.)

Later developments include thermoplastic video recording, first developed for radar equipment. A tape is prepared with a positively charged thermoplastic layer, which has a low melting point. The basic negatively charged tape has a higher melting point. Thermoplastics soften when heated and return to normal condition on cooling.

The principle involves heating the whole tape to the melting point of the charged thermoplastic layer by passing it through a vacuum and applying a dielectric heater. Ripples are formed on the tape in proportion to the moving electron beam of the cathode ray tube through which it passes, the beam being modulated by the video information. The dielectric process causes the thermoplastic layer to "freeze" temporarily in its ripple formation as it passes through and this modulated tape is replayed by passing light through a condenser lens, the transparent tape and an apertured plate, using the Schlieren optical system. A very wide bandwidth (up to 50Mc/s) is possible. The drawback is the elaborate vacuum pumping equipment, but development of a special tube with a mosaic of fine wires in place of the normal phosphor screen is still taking place. The wires are embedded in the glass and pass right through, forming a virtual extension of the electron beam, and eliminating the complication of vacuum sealing of the tape at the point of modulation.

Recently announced was a video-disc method of recording with parallel principles, but using a method of repeated "stills" instead of a moving picture, stored on disc. The great advantage of such a system, if it can be developed beyond the slow-scan 25 frames per second limitation, is the simplicity of the playback conversion equipment.

VOLUME

Correctly, an acoustic, rather than electrical term. Measurement refers to the pressure of the sound wave in terms of dynes/square centimetre. The louder the sound, the greater the pressure, but *loudness*, as a term, depends also on the frequency and waveform. Convenient form of volume expression is in decibels, this scale being nearer to the aural range than any linear form.

VOLUME COMPRESSION

System of sound recording where the level of the signal passing through an amplifier is arranged to control the gain in such a way that high sound levels are amplified less than low sound levels.

VOLUME UNIT (VU) METER

Type of modulation level indicator which measures electrical signal voltages and records relative levels of sound. This type of meter responds to average values but does not indicate peaks. Professional recording authorities favour peak programme meters for correct setting of modulation levels. American machines favour VU meters, the British and many Continental machines have various forms of peak reading meters or indicators (such as the magic eye) or modified forms of these, with rise times flattened slightly by charge circuits to give a compromise system.

A typical VU meter would be a rectifier-fed, moving-coil meter with a low total series resistance so that the non-linear forward characteristic of the rectifier makes it almost a square-law instrument, measuring energy or power rather than voltage or current. The scale is marked in volume units, each being approximate to one decibel with the instrument measuring a pure steady tone. But peaky waveforms will produce only the "averaged" response, sometimes referred to as the r.m.s. reading (not quite accurately, except with pure sine waveforms).

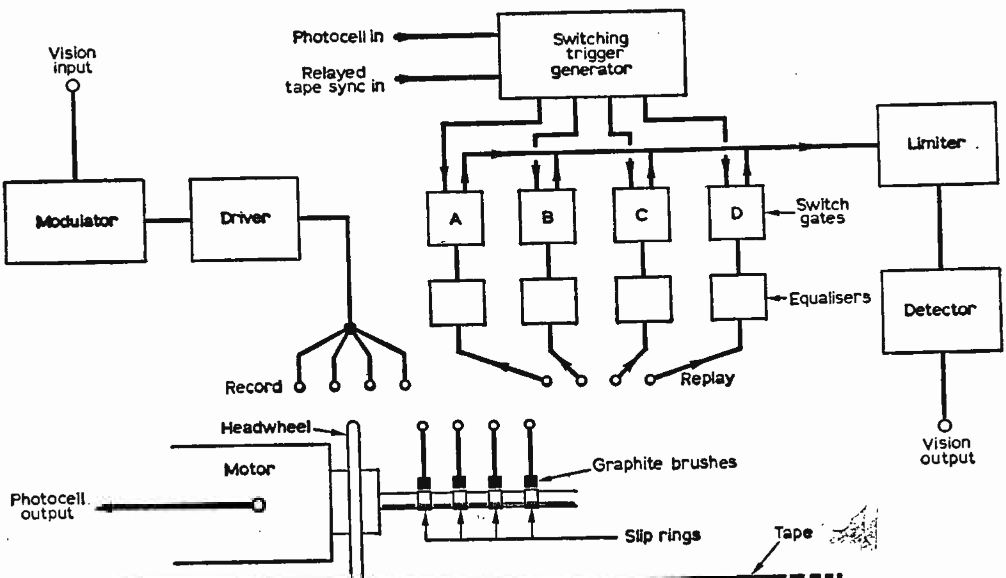

Fig. 21: Basic rotating head system for video recording.

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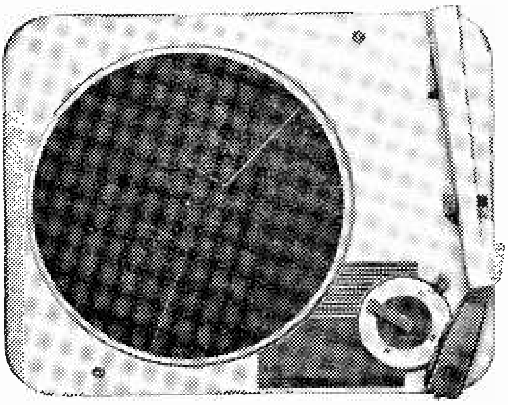

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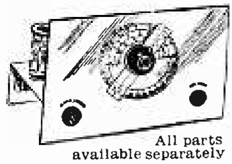

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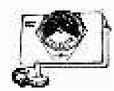

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WATT

The unit of electrical power. Defined as the energy expended per second by an unvarying electric current of one ampere across a potential difference of one volt. For audio purposes, both the peak power and the average power must be considered. Electro-acoustic efficiency is less than purely electrical measurement may indicate. Electro-acoustic efficiency ratio may be as much as 30:1 with commercial equipment. A speaker efficiency is only some 3 to 5% under normal domestic conditions, so that an amplifier with an average audio output of 10 watts is adequate for domestic purposes, even if transient peak powers are as much as 40 watts. Most domestic tape recorders with inbuilt speakers are only intended to give about 2-5 watts audio output, which is quite sufficient for normal purposes.

WAVELENGTH

In tape recording, directly related to the speed and frequency of the medium: i.e. the frequency of signal and the speed at which the tape passes the head gap, which determines the physical wavelength of the recorded "magnet" on the tape. Wavelengths become shorter as the frequency of the applied signal increases, but longer as the speed of tape transport increases. This is important during playback, where the higher speed permits use of a wider gap for a given frequency due to the extended wavelength, or, conversely, allows a higher frequency response for the same gap when the tape is recorded and replayed at a higher speed.

WOW

Distortion caused by periodic variation of tape speed. Although there is no standard, variations of up to twenty times a second in pitch of the sound are generally considered as "wow" while variations in the band 20-200c/s are called "flutter". Wow is more evident with sustained notes and music with "dying tones" such as piano and organ music. It is usually caused by eccentricity in moving parts. Regularity of the wow may be a clue to its origin. Flutter has the effect of making the tone harsh, and is often more difficult to determine. Its results sometimes sound like an overloaded amplifier due to frequency modulation of the recorded signal. Wow and flutter figures are stated as an R.M.S. measurement, typical specification being "less than 0·2% total r.m.s.". More than 0·5% is poor.

In Table 1 reel sizes in inches, tape length in feet, playing times in minutes and seconds for principal types of tape in general use. There are variations of tape length, and playing time between manufacturers. Figures given are common to the largest number of companies. Playing time is for a single track at $3\frac{3}{4}$ in./sec For alternative speeds divide and multiply by factors of 2. For complete tape playing time on more than one track multiply by number of recorded tracks (except for stereo).

End of Series

ELECTRONIC PITCH-PIPES

by

R. Bebbington
Grad. I.E.R.E.

ANYONE who has had anything to do with training or conducting choirs will appreciate the value of a set of pitch-pipes. Pianos are not always situated conveniently adjacent to the choir and to pitch the notes of the initial chord for unaccompanied singing can be something of a problem. The author knows from bitter experience that the notes you play on the piano and the notes you sing to the choir on your return—after knocking over a few music stands and negotiating several rows of seats—are not always the same. Usually the tenors will be quick to point this out to you, that is if the effort of reaching a top A that should only have been a top F has not permanently strained their vocal chords. The electronic pitch-pipes to be described have been used successfully for male voice singing and have been particularly useful for open-air activities.

Circuit Theory

The transistorised version of the well-known Hartley oscillator is employed as a high degree of stability can be obtained. Even with battery ageing there is no discernible variation in pitch, which means that the device may also be used as a pitch or frequency standard for other purposes.

The output of the oscillator is fed straight into a high-impedance miniature loudspeaker which serves as the collector load. Sufficient volume is obtained to allow the unit to be operated inconspicuously in a coat pocket and still be heard. Should extra volume be required an output stage can easily be added and a resistor substituted for the oscillator collector load. In its simplest form the unit can be really compact, the prototype measuring 4in. x 3in. x 1¼in. The frequency determining components are the tapped coil, the capacitors across it and, in the simplified version, the series variable resistor.

For accurate pitch control a capacitor for each note is preferable and this requires a single-pole, 12-way switch to cover every semitone in a complete octave or musical scale. It is extremely

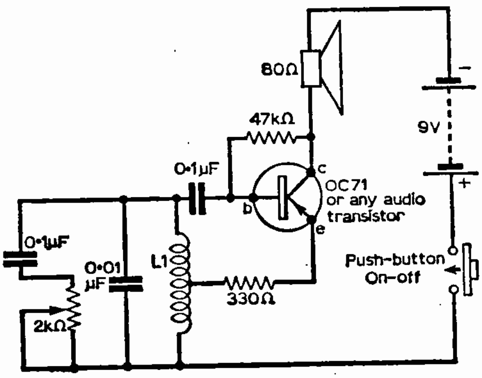

Fig. 2: Tones selected by potentiometer (see Fig. 4).

unlikely that exact values of capacitors will be found to tune each note in the scale and padding by smaller values will have to be done. If you are incapable of doing this, even with the aid of a piano, borrow the ear of a musical friend. If extreme accuracy is not so important the variable resistor is an easier and cheaper method of frequency control and can be quickly calibrated.

With the components listed in Fig. 2 the 2kΩ variable control has a frequency range of one octave from E flat to E flat.

Choice of coil will obviously influence the precise location of the frequency range, but this is immaterial as long as a complete octave is covered, since this is bound to embrace all the notes in any musical scale. However, as the coil is the only item that is not standard some details are perhaps called for at this stage. Many tapped coils have been tried and the circuit oscillated freely with most of them. These included inter-valve transformers, television blocking oscillator transformers, the tapped primary of a standard output transformer,

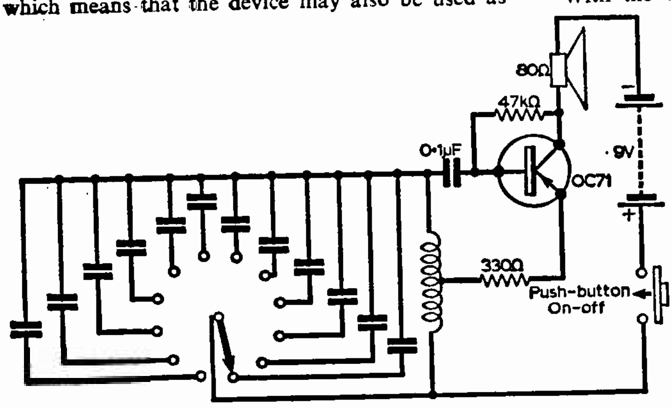

Fig. 1: Tones selected by switched capacitors.

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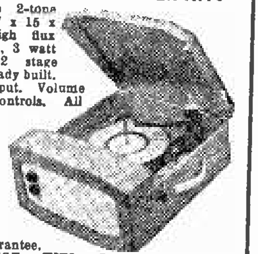

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16/450v	3/-	8+8/450v	3/6	32+32/450v	6/-
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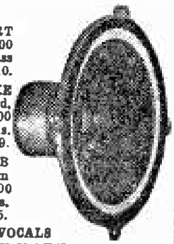

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10 watt } WIRE-WOUND RESISTORS { 1/9
15 watt } 10 ohms—6,800 ohms { 2/-
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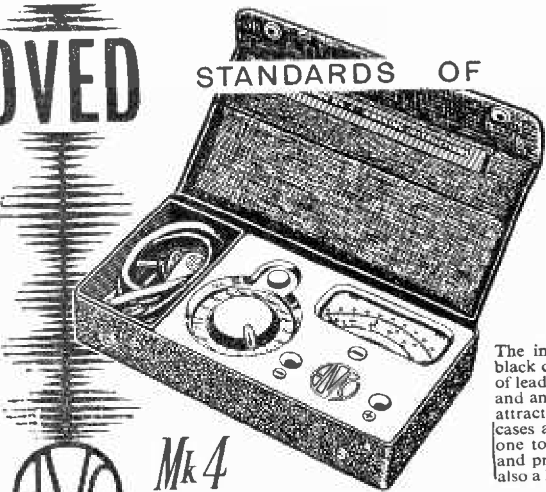

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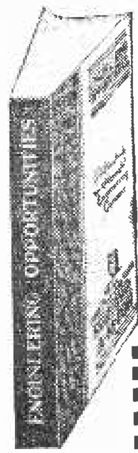

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etc. The latter was used successfully without laminations and a tapping was soldered on after exposing the primary layers by bending back one of the end cheeks. The exact position of the tap was not found to be critical.

Practical Layout

No hard and fast rules are given as regards size of unit as this will be dictated by the components available to the constructor. If a 2½in. loudspeaker is used an extremely portable unit may be built around it, particularly if resistance tuning is employed. Readers who are used to working from a theoretical diagram will no doubt have their own ideas about the practical layout and this should not present any problems. However, for the less experienced constructor and those who prefer to work from a wiring diagram a suitable layout is given.

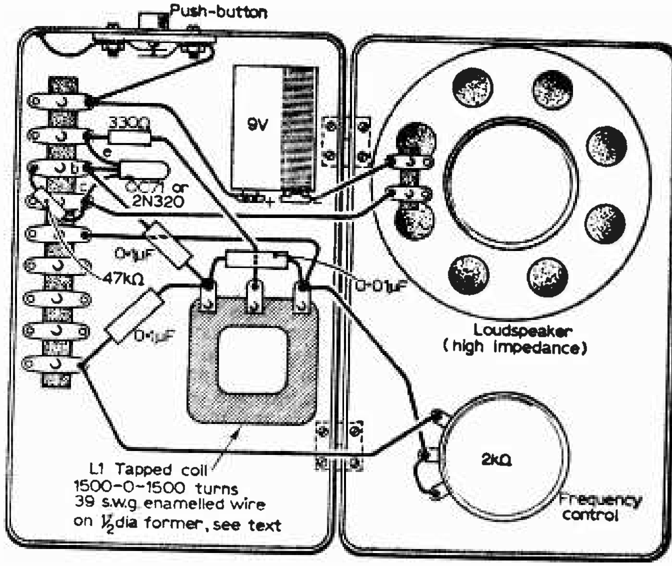


Fig. 3: Wiring diagram and layout of Fig. 2.

A small tin box was used to house the experimental model, the loudspeaker and tuning control being attached to the lid. Construction was simplified as the tagstrip and the "earthy" side of components could be soldered directly to the case. One slight drawback was that initial tuning and calibrating had to be carried out with the lid closed as the proximity of the metal lowered the pitch about a semitone by increasing the inductance of the coil. With a plastic case the problem of hand capacity might arise.

A 9V battery such as the Vidor VT3 was chosen because these are physically small but there is no reason why external batteries should not be used. Where space is no criterion a larger speaker may be utilised and this may have the more usual low-impedance speech coil if it is connected through a transistor output matching transformer.

Advantage was taken of the case being metallic to solder one of the push-switch contacts to it, the other contact being soldered to one of the adjacent points on the tagstrip. A half-inch length of thick copper wire soldered to the "earthy" contact and fitted with a small length of sleeving serves admirably as a push button. A hole should be suitably drilled, as indicated in the diagram, for this to protrude slightly through the side of the case.

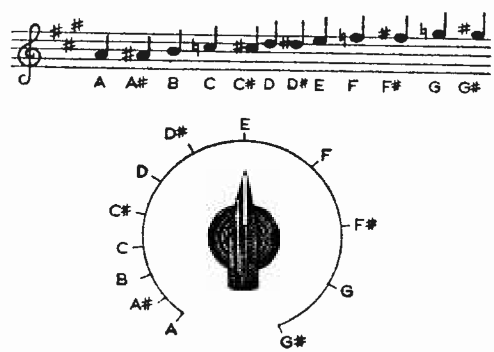


Fig. 4: Dial for the 2kΩ potentiometer in Fig. 2.

Calibration

Once the capacitors have been selected in the switched version a permanent scale can be accurately scribed as the 12 semitones will be equidistant on the positions of the switch. If the simpler resistor method of tuning is used, then there will be cramping towards the lower notes which could result in some slight pitch inaccuracies due to difficulties in reading the scale. Generally these would be too small to be serious.

Should the frequencies covered be too high in the musical range these may be lowered by increasing the fixed capacitor across the coil or, alternatively, inserting an iron core in the coil. ■

(Chromatics) A# C D# F G

Diatonic Notes	A	B	C#	D	E	F#	G#	A
Capacitor (μF)	0·2	0·17	0·14	0·12	0·1	0·08	0·06	0·05

Approximate values of the switched capacitors for the scale of A Major (3 sharps). The values for the chromatic semi-tones lie approximately half-way between adjacent notes.

A COMMENTARY BY HENRY

PRACTICALLY WIRELESS

No. 17 Illogical Conclusions

THAT hilarious pantomime "The March of Progress" has earned a few deft sideswipes from Henry's bladder. Any jester worth his cap and bells could hardly miss a target so wide.

In the field of telecommunications it would seem that Progress —with a capital—is marching onward with the relentless determination of a hungry rhinoceros. Every trade magazine we pick up heralds new approaches, developments, devices and even ideas. Editors delight in crystal gazing or, unforgivably, reminding us how accurate their predictions of a half-century ago have turned out to be.

Boffins—not to be outdone—brush up their syntax and publish the intimate details of their experiments. Scribes like me absorb the gist and breathe out hot air about "The Sets of Tomorrow" or less precisely, "New Concepts". The innocent bystander may be forgiven for thinking us all a dynamic class of citizens, leading the backward plodders of Industry and Commerce into some brave new world beyond the horizon.

One has only to read the dismal history of Colour TV to see what is meant. In the November issue of *Practical Television* the Editor recounted his remarkable dream—which ended with a delegate to one of those interminable Colour Television Standards Conferences crying: "But do we really *need* colour TV?"

Mr. Sidney Bernstein and Lord Thomson, chairmen of Granada and Scottish Television respectively, have come out against premature launching. This does not mean that either of these extremely astute gentlemen is a reactionary diehard. Their kick is not against progress, so much as against the effect mistiming of decisions may have upon their profits.

. . the relentless determination of a hungry rhinoceros.

And to be sure, decisions are not likely to be timed at all if the last breakdown of talks, following hard on a hasty "final" SECAM demonstration, is indicative.

The ironic fact that Henry is trying to wrinkle out and lay before you, dear Reader, is that technical magazines were running series of articles on Colour TV Principles, or Servicing Colour Receivers as much as ten years ago.

These were based on American experience, to be sure. Yet it is worth remembering that it is only as lately as 1964 that the larger companies in the States were able to make Colour TV pay. Last year, for the first time, colour TV sales overtook black-and-white receivers. What price Progress?

Getting away from radio's foundling, let's ask each other: "What sort of wireless signal are you getting?" Short of stringing the surrounding rooftops with piano-wire pigeon traps and digging below plastic water-main level for the earth return, can you pick up interference-free programmes?

I thought not. Then, am I being naive in suggesting that a logical conclusion is some form of communal aerial system? To indulge in another Progress Prediction, the future should bring all communication services, radio, TV, what-have-you to the house via a single pipeline. Water, Gas, Electricity. Telecoms, each with its inaccessible stop-cock and horrible quarterly bill.

Rather like the Editor's dream, you may say. And after

Digging for the earth return.

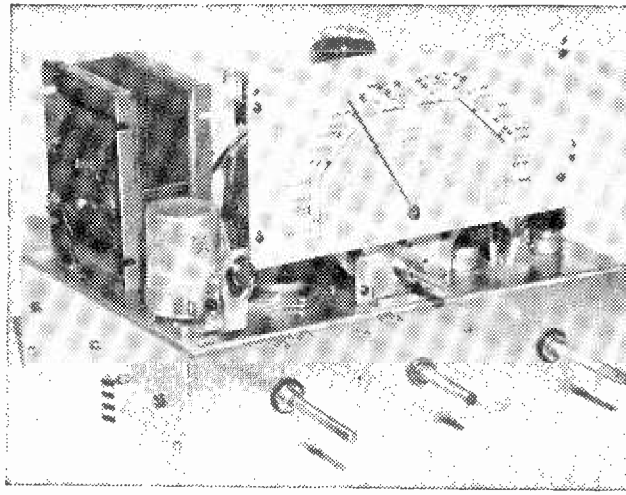
reading of the furore at Cwmbran New Town last autumn, I'd be inclined to agree. There, the Corporation decided to be in the van of progress by wiring their beautifully planned houses for all services and putting a one-and-sixpenny charge on the rates. But the concession was given to a relay company and the local traders came out strongly in protest to the local press. One can hardly blame them when the pipeline people are also their greatest rivals in the set retail business. There's not much living left in selling radiograms and tape recorders. Even if (see last month) Dame Progress hands us videotape on a plate.

The joke is that BBC2 had just then opened in the area and both radio dealers and pipeline technicians were chasing madly up and down the Welsh Mountains in search of the u.h.f. signals. Considering the ban on rooftop aerials that is imposed in the New Town, developments should be of some interest to followers of the pantomime called Progress.

When colour TV does come along, we wonder what the residents who voted against the levy on the rates will say. Possibly: "I don't care about the bloke down the road, Jack, My 'Coronation Street' comes through OK".

That should please Mr. Bernstein, at least.

An Economy Two-Band Receiver



by J. B. WILLMOTT

IN a recent article in this magazine, describing the numerous uses to which the EF50 type valve, now so widely obtainable from advertisers in this magazine at give away prices (frequently as little as 1s. 6d. each), the author made reference to a receiver designed and constructed over 10 years ago. This has given completely trouble free service, and accordingly a further prototype has now been constructed, using components currently obtainable. The receiver described here follows closely along the lines of the original design: it is capable of giving really good quality reproduction of local Medium and Long Waveband BBC programmes in good reception areas.

Obviously no "straight" (or superhet) receiver can give the same freedom from background noise or interference by Continental stations after dark as an f.m. receiver; but in areas of good BBC reception, extremely good results are assured, at a fraction of the cost of purchasing or assembling an f.m. receiver. In areas where the Light Programme is strongly received on Medium Waves, such for example as London, the Long Wave tuning coils and the attendant complication of wavechange switching, can be omitted entirely.

A double-wound mains transformer is specified and thus the chassis of the completed receiver is completely isolated from the mains supply and therefore safe to handle. A direct earth connection is recommended and it is surprising how much improvement in performance and lowering of background noise results from this often neglected connection.

Layout is not unduly critical apart from the

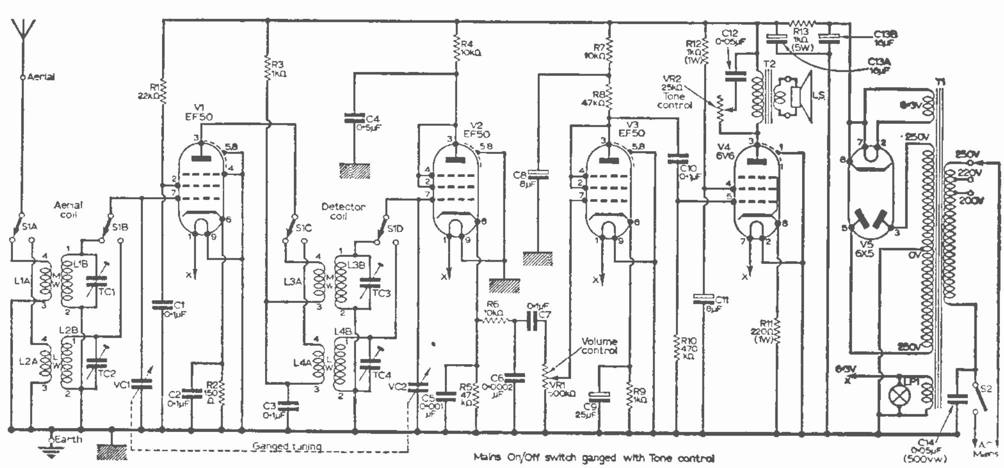


Fig. 1: Complete theoretical circuit diagram.

essential need to separate the r.f. and detector tuning circuits (achieved by mounting the respective tuning coils above and below chassis respectively) but it is suggested that the layout shown in Figs. 2 and 3 would be difficult to improve upon as it results in a neat and symmetrical disposition of components as well as ensuring shortness of wiring. A full list of all components required is given and there should be no difficulty in obtaining any of them from component stockists.

Briefly the circuit comprises an r.f. amplifier stage (V1), followed by an infinite impedance detector (V2), noted for its low distortion. Then follows an a.f. amplifier stage (V3), feeding into the power output stage (V4) power being supplied from the mains through a double-wound mains transformer with full-wave rectification provided by V5.

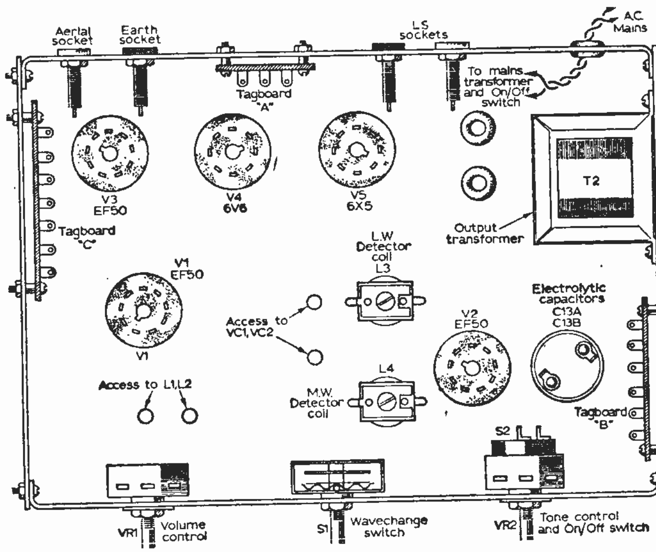


Fig. 2: Suggested underchassis layout.

Preparation of Chassis and Component Mounting

A ready-made four-sided aluminium chassis, dimensions 10in. x 7in. x $2\frac{1}{2}$in., which is a "standard" size, is specified and the details of drilling to be carried out are clearly shown in Fig. 3. The sizes of the various holes can be found by reference to the chart at the top of the diagram. The large valveholder cutouts are not all of the same size, a point which must be borne in mind, those for V1, V2 and V3 being $1\frac{1}{2}$in. diameter, V4 and V5 are $1\frac{1}{8}$in. diameter and the hole to accommodate C13 should be $1\frac{1}{4}$in. diameter. Established constructors will no doubt have the necessary range of screw-up-type hole cutters for the purpose but with patience these holes can be made by drilling a series of small holes around the circumference of each large hole, pushing out the centre blank and cleaning up with a file. This is admittedly somewhat tedious and investment in a set of hole cutters is strongly advised if any quantity of constructional work is envisaged in the future.

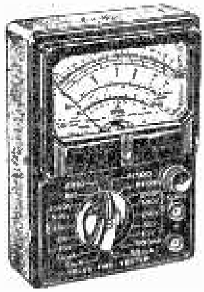
It will be noted that three of the holes marked "D" on the upper chassis surface and a further hole on the rear chassis should be fitted with rubber insulating grommets. It is through these holes that leads carrying mains supply or mains transformer connections will pass. The exact position of fixing holes for valveholders and the mains transformer are best marked out on the chassis surface, using the actual components as a template. Make certain that the valveholders are positioned so that the locating spigots take up the direction indicated by the spigots in Fig. 2. The fixing holes for the two-gang tuning capacitor and the "J.B. Full Vision Dial Assembly" are clearly shown. Obviously if any other make of tuning capacitor or dial assembly is used the position of these fixing holes will need to be amended. The two holes "D" near the centre of the area occupied by the gang capacitor provide for connecting wires to the lower tags on the fixed plates of this component passing through the chassis to the wavechange switch.

Mounting of components can begin as soon as all drilling is completed and it is recommended that all valveholders be fitted first, using 6BA nuts and bolts. A solder tag should be secured under the chassis to the fixing bolt nearest pins 1 and 9 on V1 to V3 inclusive and nearest to pins 1 and 8 on V4. A further solder tag should be secured above chassis on the fixing bolt of V1 valveholder nearest the holes "E" midway between L1 and L2 positions and also to the fixing bolt of valveholder V5 nearest to the mains transformer.

Attention should now be turned to fixing the full vision tuning dial assembly. This dial provides three-waveband indication but the short wave band is, of course, ignored in this design. The two-gang tuning capacitor is mounted on long 4BA bolts, using additional nuts (or brass spacers) to support it at the correct height above chassis for the spindle to accurately register with the driving boss on the drive assembly. Check to ensure that the drive operates smoothly and without strain before finally tightening the mounting bolts of the gang. It is advisable to solder a 6in. length of connecting wire to each of the two-gang lower tags before mounting the component, these wires being fed through the appropriate holes "D". Ultimately they will be cut to length and covered by insulating sleeving when wiring-up is carried out.

Next mount the mains transformer, seeing that the primary winding tags are nearest the side of the chassis. This will ensure that mains supply leads coming up through the single hole "D" are conveniently placed for connection to the primary winding, whilst secondary winding connections

TEST METERS



20,000 O.P.V. MODEL TP 58. Reads voltage up to 1,000 D.C. at 20,000 ohms per volt and A.C. at 10,000 O.P.V.; D.C. Current to 500mA; Resistance to 10 Megs.; Capacitance to 0.1µF; Decibels from —20 to +36. Size 3½in. × 5¼in. × 1½in., £5.19.6.

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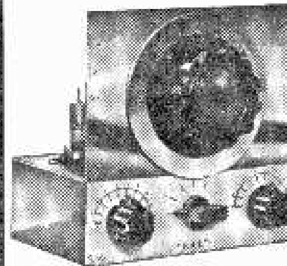

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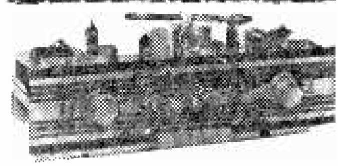

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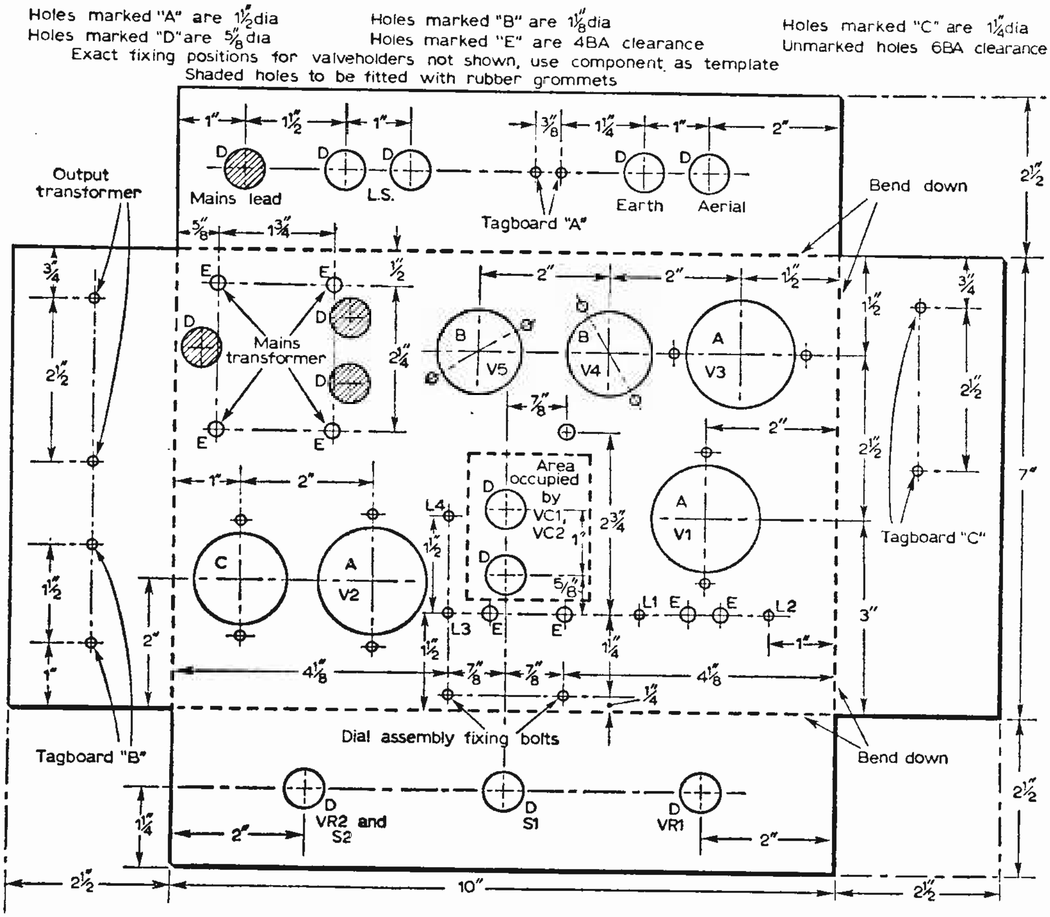

Fig. 3: Chassis drilling details.

utilise the two "D" holes to the right of this component. Now mount the electrolytic smoothing capacitor C13, using the clip specified in the components list, with its tags projecting through the hole "C". Before wiring is commenced check that all components are in their correct position and firmly bolted down.

Testing and Alignment

Before inserting valves and connecting to the mains supply the following check tests with an ohmmeter are highly desirable: First connect the meter across the receiver mains supply leads and check that when the on/off switch is turned to "on" the resistance of the primary winding of T2, some 20 to 50Ω, is indicated. Now connect the negative meter lead to chassis and the positive to pin 8 of V5, a momentary "kick" of the needle (indicating charging up the reservoir and smoothing capacitors), followed by a fall to almost open-circuit reading, should result. A reading of 50kΩ or less indicates an unwanted path between h.t. positive and chassis and must be investigated before proceeding further.

Retaining the meter negative lead on the chassis, place the positive test prod on the cathode pins of V1 to V4 in turn and in each case a resistance indication corresponding to the value of the relative cathode resistor (see Fig. 1). Now remove the negative clip from the chassis, place the positive meter prod on the cathode (pin 8) of V5 and connect the meter negative in turn to the anode and screened grid pins of V4, the "anode" of V3 and V2 (comprising pins 2, 3 and 4 linked together in each case) and the anode pin of V1. In each instance continuity should be established and a resistance reading reflecting the value of the various dropping and decoupling resistors in circuit at the points tested.

If all the foregoing tests are carried out with satisfactory results the receiver can be connected to the mains with confidence. Remove test meter connections, ensure that on/off switch is in the "off" position. Insert all valves, connect loud

COMPONENTS LIST

Resistors:

R1	22kΩ	R8	47kΩ
R2	150Ω	R9	1kΩ
R3	1kΩ	R10	470kΩ
R4	10kΩ	R11	220Ω 1 watt carbon
R5	47kΩ	R12	1kΩ 1 watt carbon
R6	10kΩ	R13	1kΩ 5 watt w/w
R7	10kΩ		

All resistors $\frac{1}{2}$W 10% except where otherwise stated.

Capacitors:

C1	0·1μF 350V paper
C2	0·1μF 350V paper
C3	0·1μF 350V paper
C4	0·5μF 350V paper
C5	1000pF mica
C6	200pF mica
C7	0·1μF 350V paper
C8	8μF 350V electrolytic
C9	25μF 25V electrolytic
C10	0·1μF 350V paper
C11	8μF 350V electrolytic
C12	0·05μF 350V paper
C13a/b	16+16μF 450V electrolytic
TC1	50pF trimmer
TC2	50pF trimmer
TC3	50pF trimmer
TC4	50pF trimmer
VC1, VC2	500pF J.B. 2 gang

Potentiometers:

VR1	500kΩ carbon
VR2	25kΩ carbon with switch

Valves:

V1	EF50	V4	6V6
V2	EF50	V5	6X5
V3	EF50		

Miscellaneous:

L1	Wearite PA2
L2	Wearite PA1
L3	Wearite PHF2
L4	Wearite PHF1
T1	Mains Transformer "Douglas", 250-0-250V 80mA, 6·3V 3·5A, 6·3V 1A.
T2	Output transformer 5000Ω:3Ω

Speaker 3Ω 8-10in. dia.
Chassis 10 x 7 x $2\frac{1}{2}$in.
J.B. "Full Vision" dial and drive assembly.
S1 4 pole 2 way. 3 B9G valve holders. 2 I.O. valve holders. Red "Pilot" indicator bulb holder. 6·3V 0·3A bulb.

speaker and aerial (also earth if used) to appropriate sockets. Insert mains plug and switch on. After a few seconds the heater glow in V5 and V4 will be visible, then advance the volume control to maximum, when a slight breathing sound should be audible from the loudspeaker. Gently touch a screwdriver blade on the centre tag of VR1 and a loud mains hum should emanate from the loudspeaker, indicating that the a.f. stages are functioning. Removing and replacing the aerial lead should produce a loud "click" from the speaker indicating that the r.f. section is also functioning. Rotating the tuning capacitor should locate the local BBC transmitter. Clockwise position of the wavechange switch gives medium wave band coverage, anticlockwise gives long wave band.

As soon as a signal of some sort is heard adjust the trimmers on the appropriate aerial and h.f. coils (long or medium wave band, according to setting of SW1). With SW1 definitely in the m.w. position endeavour to tune in a station at the low wavelength end of the dial such as the BBC Light Programme on 247m or Radio Luxembourg on 208m, then adjust the trimmers (on L2 and L4) for maximum volume consistent with reasonably accurate station indication by the dial pointer. Slight adjustment of the pointer itself is permissible to obtain exact indication of station tuned to. Now swing the tuning capacitor towards the high wavelength end of the dial and the local regional and Third programmes should be received at the correct point on the dial as the J.B. "Full Vision" is designed to match accurately to Wearite "P" type coils. Switch to long wave and, as the only station likely to be required will be the BBC Light

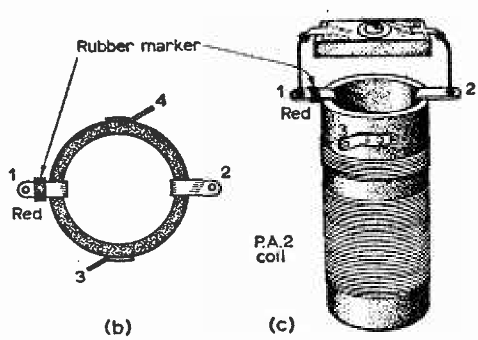

Fig. 4: PA2 coil connections

on 1,500m set the pointer to this mark and adjust the trimmers on L1 and L3 for best results.

The receiver should be found to have more than adequate volume, even when used with a short "picture rail" aerial, within 30-50 miles of BBC regional transmitters and a most pleasing standard of reproduction. Thanks to the employment of infinite impedance detection it will be particularly noticeable that transient sounds such as cymbals and other percussion instruments come through with especially realistic clarity, superior to all but the most expensive superhet or f.m. receivers. One final word: When inserting or removing EF50 valves a firm, straight pull (or push) is desirable. Any effort such as rocking from side to side to assist insertion or removal is liable to crack the glass seals around the valve base pins. ■

CLUB SPOT

No. 3 BASILDON & DISTRICT AMATEUR RADIO SOCIETY

THE Basildon and District Amateur Radio Society was formed in 1962 by a number of licensed amateurs and short wave listeners living in the new town of Basildon and the surrounding country area. The Club now has over fifty members of whom twenty are licensed with a number of them SWL's studying for the Radio Amateurs' Examination or for the Post Office Morse tests. Club members cover a wide range of ages and professions, teenagers still at school and members in their sixties; firemen and chartered accountants.

Most of the licensed amateurs operate on the frequencies 160, 80 and 40 metres, but there is strong interest in 70 and 144Mc/s and 70 centimetres. G3EDM and G3ORT are keen mobile operators. G3PZZ and G3OIT are active on the DX bands. G3PGN and G3OQT can often be heard at weekends operating on 70Mc/s, while G3ASH and G3IJB are active on 144Mc/s.

The Club is affiliated to the Radio Society of Great Britain and each year enters for National Field Day. In 1963 and 1964 the Club won the Bristol Trophy, awarded for the highest score achieved by a single station entry.

The Club holds meetings twice a month: the first at the Bullseye Hotel, Town Centre, Basildon, when wives and girl friends are cordially welcomed, and the second meeting, usually held in the thrd week of the month, is devoted to talks, junksales, lectures and film shows. This latter meeting is held in the Mayflower Restaurant, adjacent to the Van Gogh, Paycocke Road, Basildon. Members are advised of forthcoming activities in a monthly newsletter.

Last year the Club visited the G.P.O. receiving station at Brentwood and later the transmitting station at Ongar, where great interest was shown in the equipment used by the Post Office. Envious eyes were cast on the masts supporting the transmitting and receiving aerials, but all cars were searched before leaving these stations by the chairman, Geoff Mills (G3EDM)!

In recent months visits have been arranged to the Marine Control Centre of Lathol Ltd., which controls the movement of all oil tankers entering or leaving the Thames: to the G.P.O. Telephone Exchange at Grays/Thurrock, and to the Communications Division of the Municipal Airport of Southend-on-Sea. For the winter months the Committee has planned a demonstration of portable and mobile equipment, a lecture on aerials, a film show, junk sales as well as an illustrated lecture on lasers.

With acknowledgements to the *Southend Standard*

Members of the Club taking part in the R.S.G.B. N.F.D. this year.

The Society endeavours to look after the interests of those concerned with amateur radio, whether members or not, and is at present co-operating with the Company concerned regarding possible interference, from or to, the wired television system being installed in Basildon New Town.

The Club aims to bring the activities of the amateur world to the attention of residents in the district through the local press as well as the National magazines. It welcomes new members, whether licensed or not, and a letter to the Secretaries, B.D.A.R.S., Milestone Cottage, London Road, Wickford, Essex (Telephone: Wickford 2462) will bring full details of membership. The subscription for those over 18 years of age is only 12s. 6d. per year—so come and join a really go-ahead Club. ■

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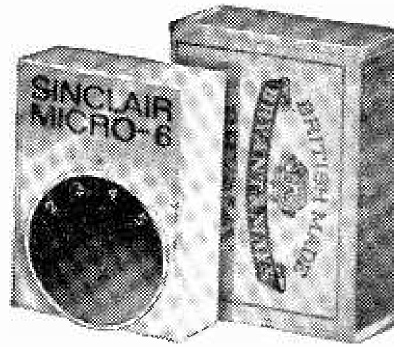

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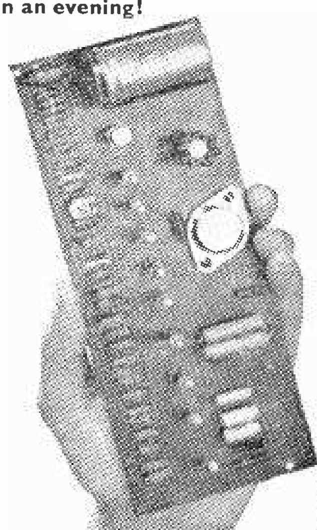

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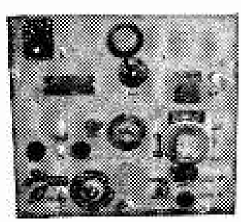

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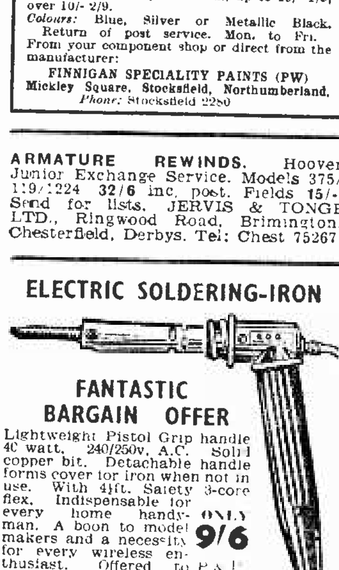

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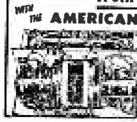

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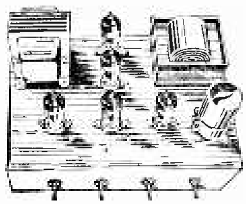

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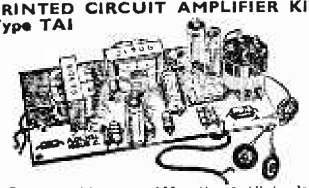

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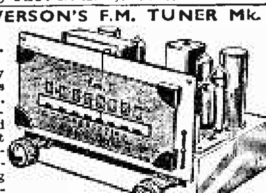

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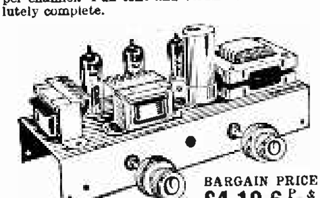

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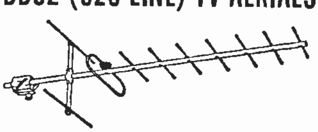

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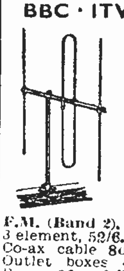

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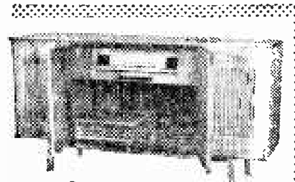

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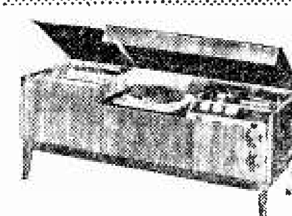

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PRACTICAL WIRELESS, JANUARY, 1966

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