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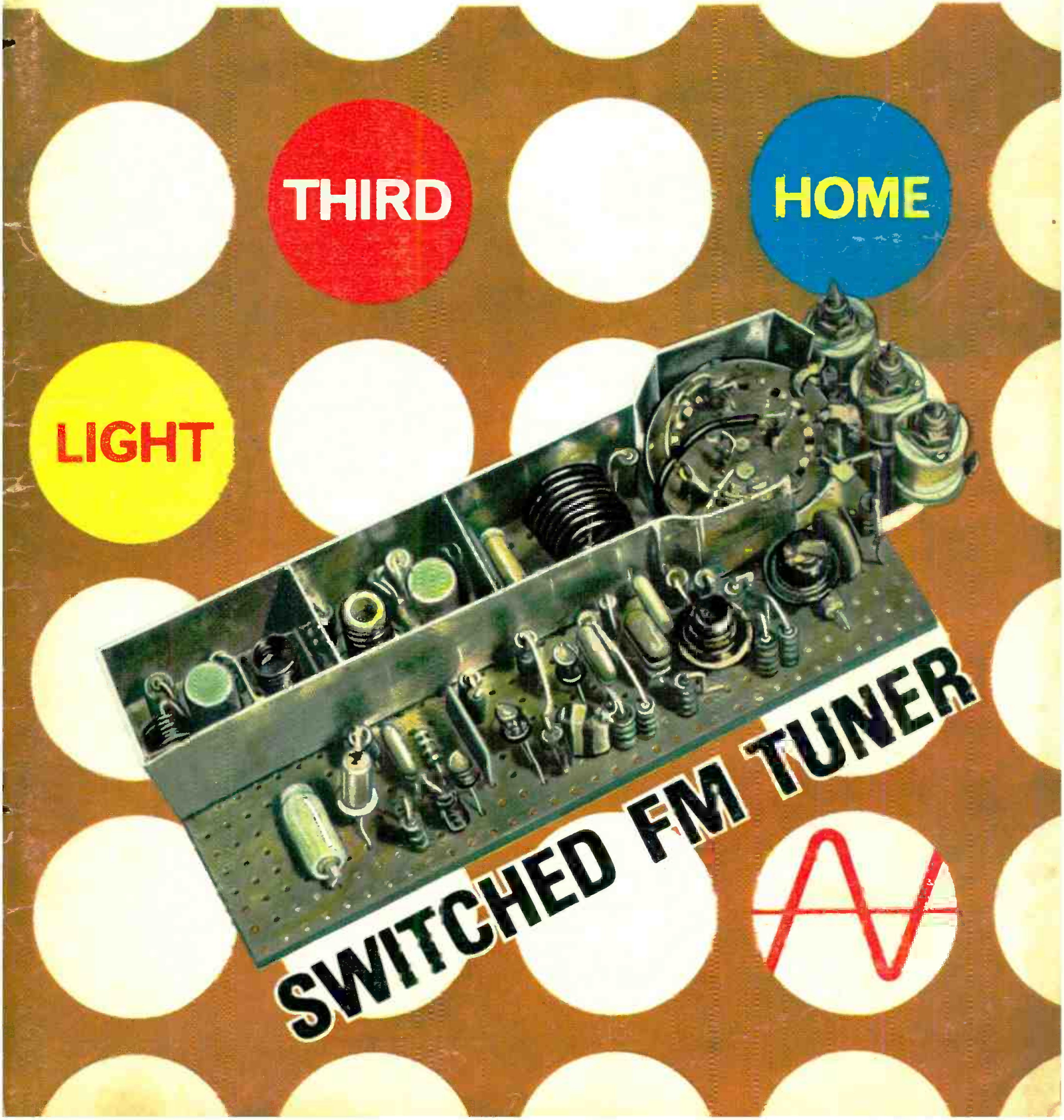
AUGUST 1967

2/6



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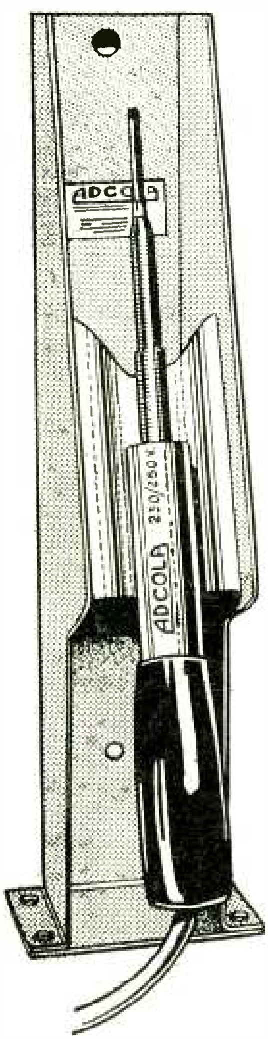

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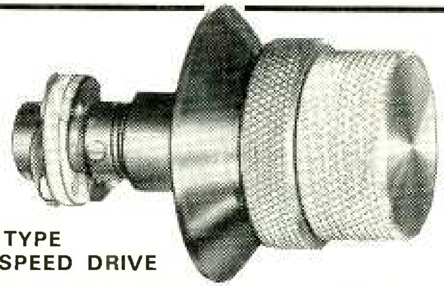

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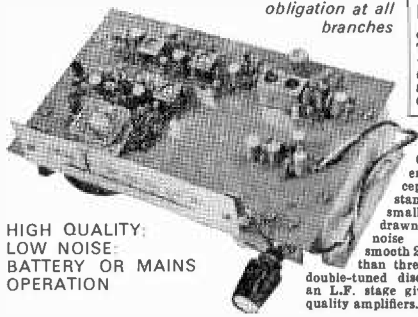

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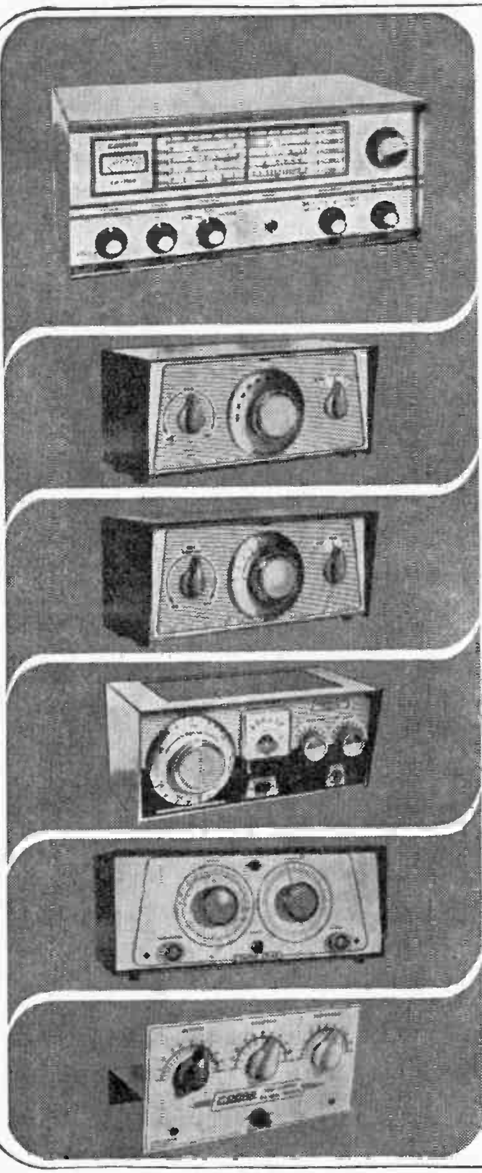

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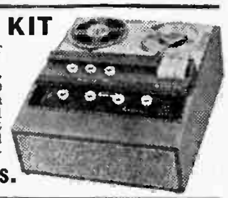
AUDIOTRINE HI-FI TAPE RECORDER KIT



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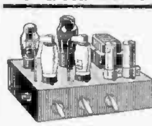
LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 1⅞in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most Tape Decks. Terms available. **10½ Gns.**

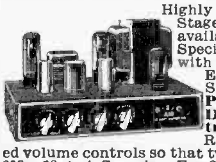
R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER



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

TAPE AMPLIFIERS 4-5 Watts output 200-250v Mains A.C. Suitable for use with Magnovox 363 Decks. Switched equalisation. **Originally 13 Gns.** **£6 19.11**

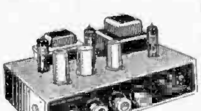
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers available. Hum level —70dB. Frequency response ±3dB 30-20,000 c/s. Specially designed sectionally wound ultra linear output transformer with 807 output valves. All first grade components. Valves EF86. EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that **any kind of Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts fully punched chassis, point to point wiring diagrams and instructions. **12 Gns.** Carr. 12/6
Supplied factory built with EL34 output valves. 12 months guarantee for **15 gns.** If required perforated cover with carrying handles can be supplied for **21/-.** Send s.a.e. for leaflet. **TERMS: Deposit 48/-** and 9 monthly payments of **33/7** (Total **£17.10.3**).

LOUDSPEAKER CORNER CONSOLE CABINETS Very attractive With polished walnut finish. Model M for 10" speaker Size 28 x 19 x 12 ins. **59/11** Model S for 12" speaker tweeter size 31½ x 22½ x 14 ins. **5 Gns**

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



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP Two input sockets with associated controls allow mixing of "mike" and gram. etc., etc. High sensitivity. 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. Frequency response ±3dB 30-20,000 c/s. Six negative feedback loops. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s, all types "mikes". Comparable with the very best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Reserve Power** provides 300v. 30mA. and 6.3v. 1.5a. for **Radio Tuner or Tape Pre-amp.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 4 and 15 ohm speakers. Kit complete to last nut. Chassis fully punched. Full instructions and point-to-point wiring diagrams (or factory built **£11.15.0**). Metal cover with 2 handles available for **21/-. TERMS ON ASSEMBLED UNITS: Deposit 36/6** and 9 monthly payments of **25/9** (Total **£13.8.3**). Send S.A.E. for illustrated leaflet of Cabinets, Speakers, Mikes, etc. **£8.15.0** Carr. 11/6

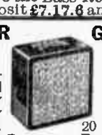
R.S.C. BASS-REGENT 50 WATT AMPLIFIER

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

★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response. ★ 4 Jack Inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes". ★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles. ★ Separate Bass and Treble Controls giving "lift" and "cut".
49½ Gns. Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at three times the cost.
Carr. 30/- Or deposit **£7.17.6** and 9 monthly payments of **£5.10.10.** (Total 55 gns.)

B20 MULTI-PURPOSE AMPLIFIER especially suitable for Bass Guitar

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



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

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

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. **4½ Gns.**

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50 c/s is available. Complete kit with diagram **47/9** or ready for use **59/11.**

SELENIUM RECTIFIERS F.W. (Bridged)

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

HEAVY DUTY SELENIUM RECTIFIERS **19/9**

12v. 15 amps, F.W. (Bridged). **Only**

POWER PACK KIT

Consisting of Mains transformer. Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6.3v. 2a Supplied with case in lieu of chassis **26/11.** Or assembled **39/11.** **22/11**

R.S.C. COLUMN SPEAKERS

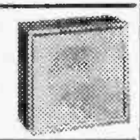
Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C58, 15-20 watts.** Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. Or Deposit **44/-** and 9 mthly pmts **31/5** (Total **£16.6.9**) **14 Gns.** Carr. 10/-
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **21 Gns.** Or Deposit **£3.11.0** and 9 monthly payments of **46/7** (Total **£24.10.3**).

30 WATT HI-FI AMPLIFIER

for Guitar, Vocal or Instrumental Group

A 4 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Latest valves. Strong Rexine covered cabinet with carrying handles. Attractive black/gold perspex facia. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Deposit £3 and 9 monthly payments of **37/5** (Total **£19.16.9**). **17 Gns.** Carr. 12/6

12in. HIGH QUALITY L'SPEAKERS



In teak veneered cabinets.
10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. Carr. 7/6 **£4.19.11**
20 Watt Model. 15 ohm. Size 18x18x10in. Gauss 12,000 lines. **£7.19.11**
Rexine covered £1 extra. Carr. 10/6
Terms available on both.

FANE HEAVY DUTY HI-FI SPEAKERS

122/10A Dual Cone. 12in. 20 watt. 15 ohms. Frequency range 40 to 18,000 c.p.s. Carr. 5/9 **£5.11.9**

LOUDSPEAKERS

Limited number at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available.
12in. HEAVY DUTY 30 watts 7 GNS. Carr. 12/6 Normally £12 approx.
15in. EXTRA HEAVY DUTY 40 watts 12 GNS. Carr. 17/6
Massive units. Gauss 17,000 lines. Usually app. **£17.**

R.S.C. GRAM AMPLIFIER KIT. 4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit, etc. supplied. Only **49/11.**

HIGH FIDELITY 12in. 10 WATT SPEAKERS 59/11
Flux Density 12,000 lines. Impedance 3 or 15 ohms.

TRANSISTOR SALE Mullard OC71, OC72, OC81, **2/11.** OC44, OC45, **3/11,** OC75, **7/9,** AF117 **6/9.** Post 6d. for 3.

JASON VHF/FM TUNER
Complete kit with valves.
£6.19.11

INTEREST CHARGES REFUNDED
on H.P. and Credit Sale Accounts settled in 3 months.

MOVING COIL AMMETERS **8/9**

Sangamo thermo-couple type 0-3.5 a. Dia. 2½ in. Each

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED, Interleaved and Impregnated Primaries 200-250v. 50 c/s. Screened.

MIDGET CLAMPED TYPE 2½ × 2½ × 2¼in.

250v., 60mA, 6.3v. 2a	14/11
250-0-250v., 60mA, 6.3v. 2a	15/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a	19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	33/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	33/9
300-0-300v. 130mA, 6.3v. 4a c.t., 6.3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	33/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a.	42/9
425-0-425v. 200mA, 6.3v. 4a, c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6.3v. 4a, 6.3v. 4a, 5v. 3a	69/9
450-0-450v. 250mA, 6.3v. 4a, c.t., 5v. 3a	79/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a	19/9
250-0-250v. 100mA. 6.3v. 3.5a.	21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a.	22/9
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a.	32/9
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier	39/9
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a	32/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	39/11

FILAMENT or TRANSISTOR POWER PACK Types 6.3v. 1.5a **6/9,** 6.3v. 2a **7/9,** 6.3v. 3a **9/9,** 6.3v. 6a **19/9,** 12v. 1a **8/9,** 12v. 3a or 24v. 1.5a **19/9,** 0-9-18v. 1½a. **15/9.** 0-12-25-42v. 2a **27/9.**

CHARGER TRANSFORMERS 0-9-15v. 1½a, **13/11** 2½a, **16/11,** 3a, **18/11,** 5a, **21/11,** 6a, **25/11,** 8a, **31/11**

AUTO (Step UP/Step DOWN) TRANSFORMERS
0-110/120v.-200-230-250v. 50-80 watts, **14/9** 150 watts, **29/11,** 250 watts, **49/9,** 500 watts, **99/9**

OUTPUT TRANSFORMERS

Standard Pentode 5,000Ω or 7,000Ω to 3Ω	7/9
Push-Pull 8 watts EL84 to 3Ω or 15Ω	11/9
Push-pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15Ω	21/9
Push-pull EL84 to 3 or 15Ω 10-12 watts	19/9
Push-pull Ultra Linear for Mullard 510, etc.	35/9
Push-pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15Ω	29/9
Push-pull 20 watt high quality sectionally wound, EL34, 6L6, KT66, etc., to 3 or 15Ω fully shrouded	55/9

SMOOTHING CHOKES
150 mA, 7-10H, 250Ω **12/9.**
100 mA, 10H, 200Ω **9/11.**
80 mA, 10H, 350Ω **7/9.**
60mA, 10H, 400Ω **4/11.**

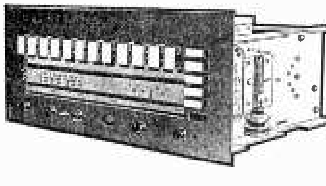
R·S·C HI-FI CENTRES LTD.

Lasky's Radio

SPECIAL INTEREST ITEMS!

EXCLUSIVE LASKY'S BARGAIN—

SOLID STATE MULTIPLEX STEREO AM/FM TUNER/ AMPLIFIER CHASSIS



Model T10E—made for U.K. use by famous North American manufacturer and originally installed in De Luxe Hi-Fi consoles costing several hundred pounds. The chassis is of outstanding appearance and quality and offers many unique features plus an extremely comprehensive specification.

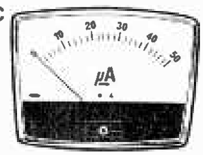
Features ● Separate transistorised AM and FM tuners ● 3 AM wavebands—LW, MW and Continental T.R. band ● full FM cover with 5 push button preselected stations (sep. tuning controls for AM and FM ranges) ● built in multiplex decoder with unique FMX feature which provides automatic switching from mono to stereo when stereo signal is received and vice versa ● unique split amplifier facility for simultaneous play of radio plus any other source ● channel reverse ● switched inputs for tape and auxiliaries (sep. sockets for tape in and out) ● switched extension speaker outlet ● thermal safety trip ● socket for stereo headphones.

Tech. spec.: Output 10 watts RMS per channel; output imp. 8Ω p.c.; sensitivity 50mV for 8W output at 1 Kc.; input imp. 100 KΩ p.c.; 12 unique tumbler type function controls, 8 push button wavechange and station selection controls, vol., bass, treble and balance controls, push button contour (loudness) control; illuminated tuning scale; AM ranges: MW 520-1640 Kc/s, LW 140-290 Kc/s, Continental TR 170-345 Kc/s; FM range 88-108 Mc/s with switched AFC. Operates on 200/250V A.C., 50 or 60 c/s. Size 17½ x 8 x 12in.

***LASKY'S PRICE* 59 Gns** Post & Packing 20/-

A range of Hi-Fi Console Cabinets by the same famous manufacturer are available at almost ½ list price and may be seen at our Hi-Fi Audio Centres.

NEW! LASKY'S CLEAR PLASTIC PANEL METERS



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

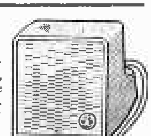
Type KR-52 3 x 2½in. (illustrated)

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

Type MK-38A 2in. square		**Type KR-65 3¾ x 3in.**	
1 mA DC	22/6	1 mA DC	36/-
5 mA DC	22/6	5 mA DC	35/-
300 V DC	22/6	300 V DC	35/-
55μA	27/6	500μA	42/6
1 mA S Meter	29/6	1 mA S Meter	39/6
Type MK-45A 1¾in. square		**Type MK-65A 3in. square**	
1 mA DC	25/-	1 mA DC	36/-
5 mA DC	25/-	5 mA DC	35/-
300 V DC	25/-	300 V DC	35/-
500μA	25/-	500μA	39/6
1 mA S Meter	35/-	1 mA S Meter	37/6

MICROPHONE BARGAIN

STC MODEL 414



A high quality omni directional moving coil microphone—suitable for use with sound reinforcement and P.A. systems, tape recorders, transistor amplifiers etc. Attractive grey moulded case for free standing or hand held use—size 2¾ x 2¾ x 2¼in. Complete with 6ft. of screened cable. New and unused in makers cartons—fully guaranteed.

Type A low imp. 200Ω Lasky's Price £1.19.6 Post
Type B High imp. 50KΩ Lasky's Price £2. 5.0 2/-

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE AT RECORD LOW PRICES

3in. Message tape, 150ft.	2	6	5¾in. Long play, 1200ft. Acetate	12	6
3in. Message tape, 225ft.	3	9	5¾in. Standard play, 850ft. PVC	11	6
3in. Message tape, 300ft.	7	6	5¾in. Long play, 1200ft. Mylar	15	0
3¼in. Triple play, 600ft. Mylar	10	0	5¾in. Triple play, 2400ft. Mylar	45	0
4in. Triple play, 900ft. Mylar	17	6	7in. Standard play, 1200ft. Acet.	12	6
5in. Double play, 1200ft. Mylar	15	0	7in. Standard play, 1200ft. Mylar	12	6
5in. Long play, 900ft. Acetate	10	0	7in. Long play, 1800ft. Mylar	19	6
5in. Standard play, 600ft. PVC	8	6	7in. Double play, 2400ft. Mylar	26	0
5in. Triple play, 1800ft. Mylar	35	0	7in. Long play, 1800ft. Acetate	15	0
5¾in. Double play, 1800ft. Mylar	22	6	7in. Triple play, 3600ft. Mylar	50	0

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

Musicassettes—over 100 titles in stock Philips, Mercury, Fontana, C.B.S., Pye, Reprise W.B. Send S.A.E. for full list.

CONSTRUCTORS BARGAINS

THE SKYROVER De Luxe

7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31–94M and also 4 separate switched bandspread ranges, 13M., 16M., 19M. and 25M., with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions. Superhet, 470 Kc/s. All Mullard Transistors and Diodes. Uses 4 U2 batteries. 5in. Ceramic Magnet P.M. Speaker. 500 mW Output. Telescopic and Ferrite Rod Aerial. Tone Circuit with separate Tone Control. Volume Control. Tuning Control and Waveband Selector. In wood cabinet, size 11¼x6¾x3in. covered with washable material, plastic trim and carrying handle. Car aerial socket fitted.

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

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

Four U2 batteries 3/4 extra.

LONG WAVEBAND COVER FOR THE SKYROVER

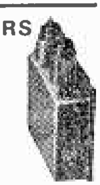
A simple additional circuit provides coverage of the 1100/1950M. band (including 1500M. Light programme). This is in addition to all existing Medium and Short wavebands. All necessary components with construction data.

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

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

Data 2/6 extra: refunded if you purchase the parcel. All components available separately.

SPECIAL PURCHASE—UHF/VHF TV TUNERS



Well known British makers surplus stocks. Now available for the first time to the Home Constructors. **Add 2/6 Post and Packing on each.**

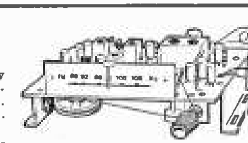
VALVE UHF MODEL (illustrated)

In metal case size 4 x 6 x 1½in. Fully tunable—complete with PC86 and PC88 valves. LASKY'S PRICE 29/6 Without valves 7/6

TRANSISTORISED VHF TUNER

Sub-miniature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors. In metal case size 3 x 1¾ x 2¼in.
LASKY'S PRICE 37/6

TRANSISTOR FM TUNER CHASSIS



Fully tunable—range 88 to 108 Mc/s. Completely wired on printed circuit. 10·3 Mc/s. IF. 6 transistors and 3 diodes. Slow motion tuning drive. Size 6¼ x 4 x 2½in. Operates from any 9v. D.C. source. Full data and circuit supplied.
LASKY'S PRICE £7.19.6 Post 5/- extra.

SINCLAIR SUPER MINIATURE KITS

Write for details of Package Deals

THE MICRO-6 miniature radio only 1⁴/₅ x 1³/₁₀ x 1½in.	£2 19 6
THE MICRO/FM (tuner/receiver)	£5 19 6
THE MICROMATIC World's smallest radio kit 1⁴/₅ x 1³/₁₀ x ½in.	£2 19 6
THE MICROMATIC Ready built tested and guaranteed	£3 19 6
THE Z-12 12 watt amp. and pre-amp fully built	£4 9 6
PZ-3 power pack for Z-12	£3 19 6
STEREO 25 Pre-amplifier control unit fully built	£9 19 6

NOW AVAILABLE! — JOYSTICK AERIALS

Revolutionary variable frequency antenna for transmission and reception. With a variable matching unit these antennae perform as a high 'Q' device at any selected Medium or Short waveband. Send for S.A.E. for descriptive leaflet.

AERIALS (7' 6" Long)		Matching units	
VFA Standard	£4 15 0	A.T.V. 3A	£3 12 6
VFA De Luxe	£5 19 6	A.T.V. 4	£4 4 0
		A.T.V. 4/RF	£6 6 0

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 1¾in. Circuit supplied.
LASKY'S PRICE 15/11 Post 2/-. ECC85 valve 9/- extra.

TRANSISTORS

ALL BRAND NEW AND GUARANTEED

GET 81, GET 85, GET 86 **2/6**; 873A, 874P **3/6**; OC45, OC71, OC81D **4/6**; OC44, OC70, OC76, OC81 **5/6**; (match pair 10/6); AF117, OC200 **6/6**; OC42, OC43, OC73, OC82D **7/6**; OC201, OC204 **15/-**; OC205, PC206 **19/6**; OC28 **24/6**; OC75 **8/-**.

TRANSFILTERS

by BRUSH CRYSTAL CO. Available from stock.

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.

9/6 each Post 6d.

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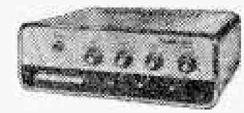
HI-FI AMPLIFIERS — TUNERS — RECORD PLAYERS

20+20 STEREO AMP. AA-22U

GARRARD PLAYER AT-60

10W POWER AMP. MA-12

9+9W STEREO AMP. S-99



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

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

GARRARD AUTO/RECORD PLAYER. Model **AT-60,** less cartridge **£14.12.10.** With Decca Deram pick-up **£19.7.4** incl. P.T.

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

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

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

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

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

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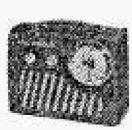
RADIOS

Oxford



UXR-1

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

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

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

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

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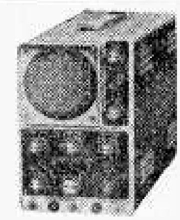


OS-2

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

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

VVM, 1M-13U

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model 1M-13U. Circuit and specification based on the well-known model V-7A but with many worth-while refinements. 6" Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling.
Kit **£18.18.0** Assembled **£26.18.0**

V-7A

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

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

RF-1U

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

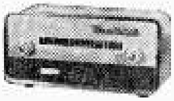
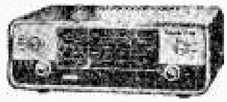
HFW-1

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

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

Prices and specifications subject to change without notice

VALVE TUNERS


TUNERS
←FM
AM/FM→


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

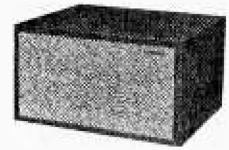
★**HI-FI AM/FM TUNER.** Model AFM-1. Covers AM 16 to 50 200-550 and 900-2000 metres FM 88-108 Mc/s. Pre-aligned Tuning Heart (AFM-T1—£4.13.6 incl. P.T.) and I.F. amplifier (AFM-A1—£22.11.6). Printed circuit board, 8 valves. Built-in power supply. **Total Kit £27.5.0**

★ Models available in two units for your convenience.

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

LATEST MODELS


STEREO AMPLIFIER, TS-23


BOOK SHELF SPEAKER

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

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TOTAL PRICE KIT **£13.16.0** incl. P.T.

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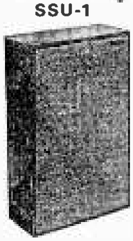
SPEAKER SYSTEMS


SSU-1


Berkeley

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

The **BERKELEY SLIM-LINE SPEAKER SYSTEM,** fully finished walnut veneered cabinet for faster construction. Special 12" bass unit and 4" mid/high frequency unit. Range 30-17,000 c/s. Size 26" x 17" only 7⅜" deep. Modern attractive styling. Excellent value. Kit **£19.10.0** Assembled **£24.0.0**

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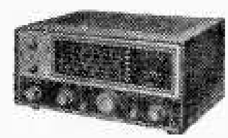
"AMATEUR" EQUIPMENT


DX-40U

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


RA-1

AMATEUR BANDS RECEIVER Model RA-1. To cover all the Amateur Bands from 160-10 metres. Many special features, including: half-lattice crystal filter; 8 valves; signal strength "S" meter; tuned R.F. Amp. stage.
Kit **£39.6.6** Assembled **£52.10.0**

160-10M TRANSMITTER. Model DX-100U. Careful design has achieved high performance and stability. Completely self-contained.
Kit **£81.10.0** Assembled **£106.15.0**


GD-IU

COMMUNICATIONS TYPE RECEIVER. Model RG-1. A high performance, low cost receiver for the discriminating listener. Frequency coverage: 600 kc/s–1·5 Mc/s and 1·7 Mc/s–32 Mc/s.
Kit **£39.16.0** Assembled **£53.0.0**

GRID DIP METER Model GD-IU. Covers 1-8 to 230 Mc/s in 5 bands. Can be used as absorption wave-meter. Aligns IF stages traps, filters etc., etc. Compact size . . . can be held in one hand. Kit **£11.9.6.** Assembled **£14.9.6.** Coil set for ext. freq. to 350 kc/s **17/6** extra.

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Model HA-14

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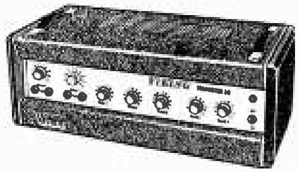
VIKING TRANSISTOR

40-50 WATT AMPLIFIER



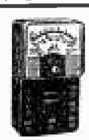
OPERATING INSTRUCTIONS GENERAL, An extremely reliable lightweight amplifier capable of giving 40-50 watts of undistorted sound, made possible by the use of the latest semi-conductors (transistors) and techniques which ensure space-age reliability under the most rugged conditions. It is designed as a general purpose amplifier particularly suitable for use with musical instruments that require exceptionally high treble response (not recommended for Bass Guitar). Tremolo facilities are available on Channel 1 only. INPUTS—CONTROLS—CHANNEL 1 (Tremolo): this contains two high gain input jack sockets controlled by **Volume Control 1** which is mounted directly above the two sockets marked tremolo. BASS 1: gives a controlled boost to the lower frequencies on Channel 1 only. TREBLE 1: gives a controlled boost to the high frequencies on Channel 1 only. TREMOLO: this operates on Channel 1 only and the variations of intensity and speed of the Tremolo beat is adjusted by the controls DEPTH and SPEED. A socket is provided in the rear of the amplifier so that the Tremolo may be switched on and off by the use of a footswitch plugged into the socket. If you wish the Tremolo to be used without the footswitch, this is possible as the footswitch is only used to short out the effect. INPUTS AND CONTROLS—CHANNEL 2 (Normal): this contains two high gain input jack sockets controlled by **Volume Control 2** which is mounted directly above the sockets marked **Normal.** TREBLE: gives a controlled boost to the treble frequencies on Channel 2 only. MAINS VOLTAGE: fully adjustable, 200-250 volts, A.C. 50 cycles. POWER OUTPUT: 40-50 watts sine wave British rating. Very little distortion. OUTPUT IMPEDANCE: 3 ohms. Price **21 gns.** plus £1 postage and packing.

WOLSEY U.H.F. AERIAL AMPLIFIER, two stage, gain 23 dB, noise factor 8 dB, power consumption 6 mA at 14 volts. Two AF186 transistors, complete with built-in power supply in metal case, list price 9 gns., our price **4½ gns.** plus 2/6 postage and packing.

MAINS TRANSFORMER, primary 200/250 volt, secondary 425/425 volt. 250 mA, 6·3 volt 4 amp, 5 volt 3 amp; fully shrouded. chassis mounting. Price **£2.5.0** plus 7/6 postage and packing. Auto transformer step-up-step-down, 240/110 volt 400 watt. Price **£1.5.0** plus 7/6 postage and packing.

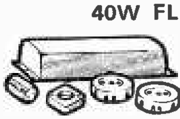
MAINS TRANSFORMER 200/250 volt, secondary 250/250 volt, 70 mA, 6·3 volt, 3 amp drop through. Price **12/6** plus 4/6 postage and packing. Elac 10 inch, 10,000 lines ceramic magnet, 3 or 15 ohms, 7 watt, **£1.9.6** plus 4/6 postage and packing.

POCKET MULTI-METER



Size 3¾ x 2½ x 1⅛in. Meter size 2½ x 1⅛in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1000. 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.

40W FLUORESCENT LIGHT KIT



Incorporating GEC Choke size 8½in. x 1⅝in. x 1⅝in 2 bi-pin holders, starter and starter-holder. P. & P. 5/6. 11/6

Similar to above: 80W. Fluorescent Light Kit incorporating GEC choke size 11⅝in. x 1⅝in. x 1⅝in. 2 bi-pin holders, starter and starter holder. P. & P. 6/6. 17/6

Twin 40W Choke instant start for 2 x 2ft. tubes 17/6. P. & P. 5/6.

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3-4 watt Amplifier built and tested. Chassis size 7 x 3½ x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6. £2.5.0 plus 5/6 p. & p.
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Price 39/6. inc. carrying strap. Circuit Diagram 2/6 free with parts. P. & P. 3/6.

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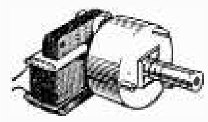


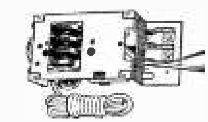
Type E MOTOR

Small A.C. mains motor 230/250 volts complete with gearbox, 6 r.p.m. Price **15/-** plus 4/- P. & P. Similar to above motor but without gearbox. Price **9/6** plus 3/- P. & P.

Silicon Rectifiers

250 v. P.I.V. 750 milliamps. Six for **7/6**, Post paid.

TRANSISTORISED 1½ WATT AMPLIFIER



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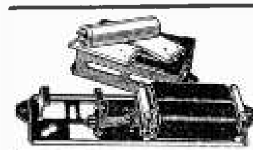

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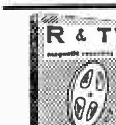
Incorporating "C" core type mains transformer, full wave metal rectification and smoothing condenser. Smooth output 250 v. 250mA and 6·3v. 4 amp. for Heaters. 25/-. P. & P. 9/6.



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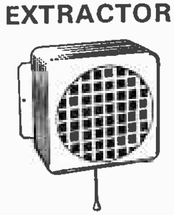
7"	L.P. 1800ft.	18/6	7"	T.P. 3600ft.	42/6
5¾"	D.P. 1800ft.	18/6	4"	T.P. 900ft.	15/-

P. & P. on each 1/6, 4 or more post free

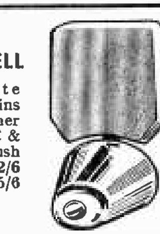
EXTRACTOR FAN



AC Mains 230/250 v. complete with pull switch. Size 6" x 6" x 4". Price 27/6 plus 5/- P. & P.

GEC DOORBELL

Complete with mains transformer 240 v. AC & bell push Price 12/6 plus 5/6 P. & P.

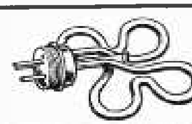


8-watt 4-valve PUSH-PULL AMPLIFIER & METAL RECTIFIER

Size: 9" x 6" x 1½". A.C. Mains, 200-250V 4 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 of 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, **£4.4.0.** P. & P. 11/-, 8" x 5" speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P.

GEC KETTLE ELEMENT

3,000W WITH AUTOMATIC EJECTION
200/240 v. Size of hole required 1⅛".
List Price 32/-. Our PRICE
15/-. P. & P. 1/6.



NEW TRANSISTORISED SIGNAL GENERATOR

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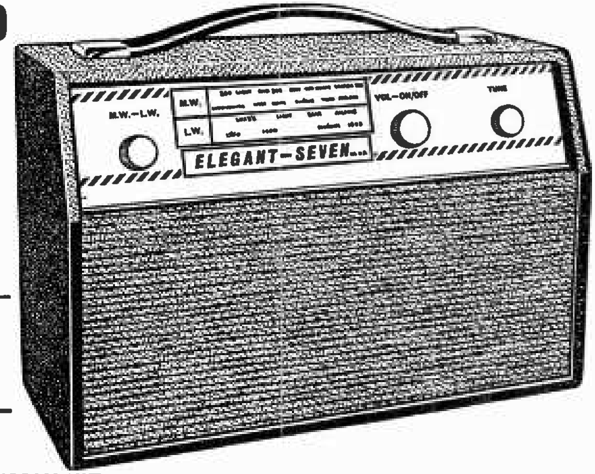

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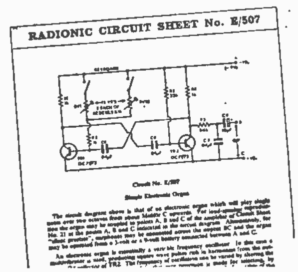
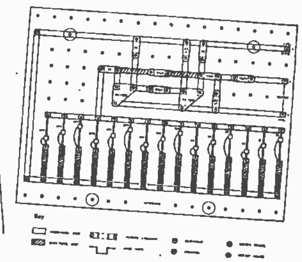


Theoretical Circuit



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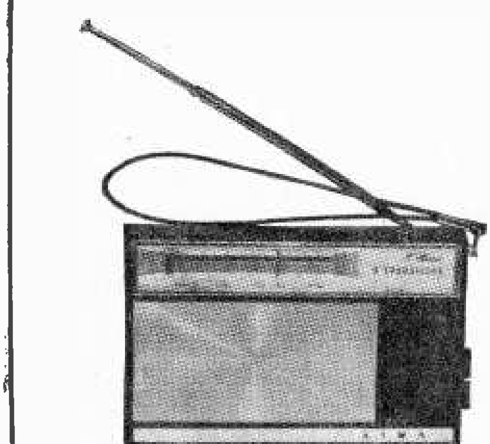

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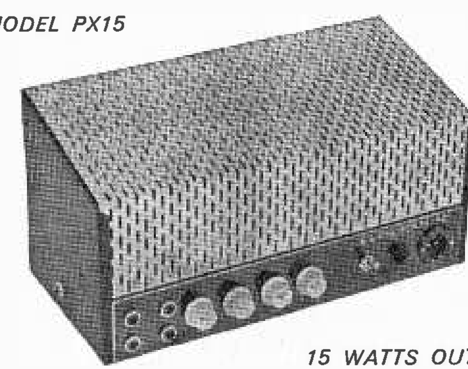

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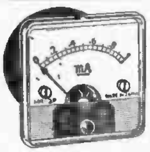

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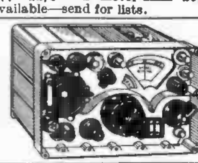

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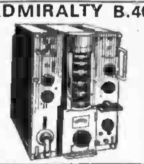

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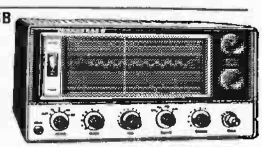

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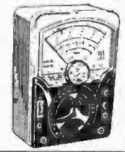

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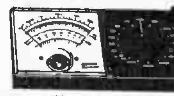

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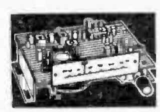

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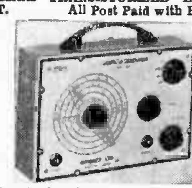

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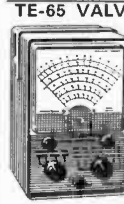

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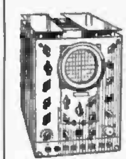

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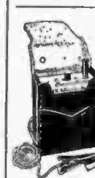

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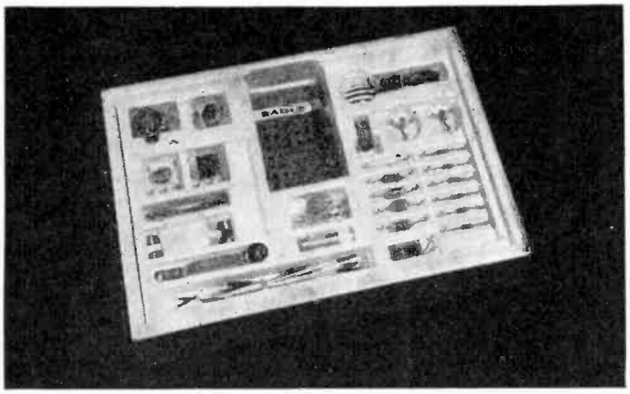

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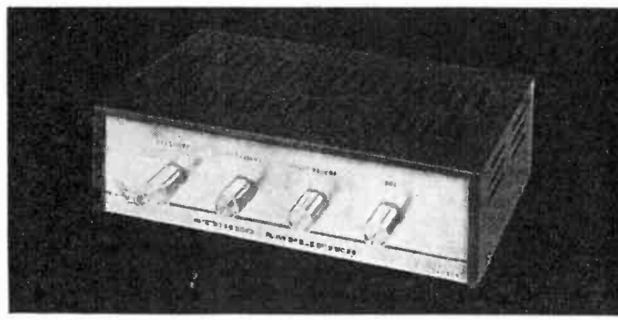

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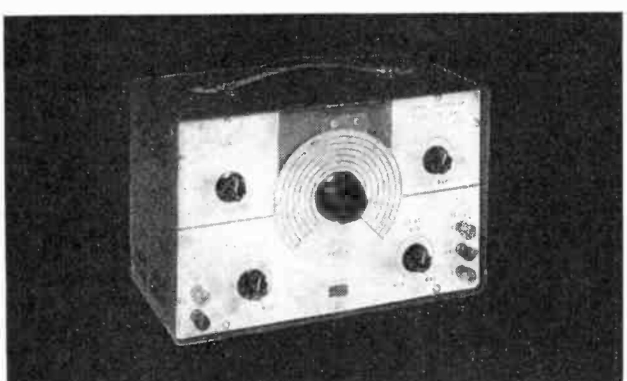
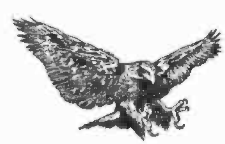


*TE.*188–*R.F. Signal Generator*



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PRACTICAL WIRELESS

VOL 43 No 4

issue 726

AUGUST 1967

TOPIC OF THE MONTH

The IC Revolution

AS reported elsewhere in this issue, the keynote of the recent RECMF Exhibition in London was the spectacular advances made in the field of micro-electronics. The Integrated Circuit has been a laboratory wonder for some time but the earlier applications in computers, missiles and aircraft equipment are now being supplemented by an infiltration into more homely spheres such as washing machines, TV sets and radio receivers.

Until recently the IC was an expensive development but this was not an over-riding factor with professional and Government equipment where the extra reliability and reduction in size was worth while. Now, however, due to advances in techniques, such as automated production and testing, the IC is becoming a practical proposition for more commercial applications. Soon it will be possible not only to break even but to show a saving in cost against using conventional components. And the IC will be edging more and more into domestic equipment.

What does this mean to the average amateur enthusiast? One thing that is certain is that he will not be setting up his own IC plant on the kitchen table! And, while it is obvious that the IC and the circuit module will infuence the shape of amateur activity there will be, for as long as one can predict, plenty of scope for construction using conventional components—in addition to the fascinating possibilities of hybrid designs using both IC unit and discreet component assemblies which we feel sure will provide countless opportunities for the individualistic amateur constructor and designer.

Later this year P.W. will be publishing a constructional article describing an f.m. tuner using a commercially available IC. And in two weeks time, the August *Practical Television* features a TV test oscillator for the home constructor using an available integrated circuit.

The amateur will adjust himself to the new thinking and take advantage of the ready-made building bricks so that in time the IC will open up new opportunities for the home constructor.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

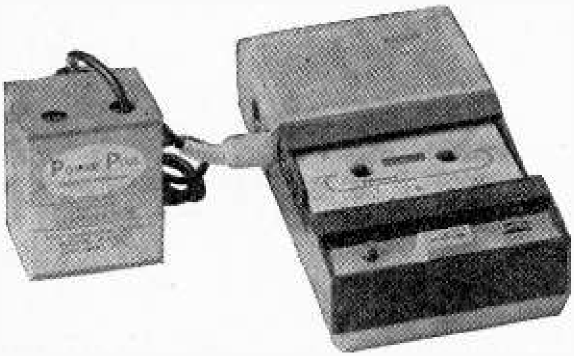
CONSTRUCTIONAL

FEATURES

SEPTEMBER ISSUE WILL BE PUBLISHED ON AUGUST 4th

NEWS AND COMMENT...

MAINS UNIT FOR BATTERY RECORDERS



From R.C.S. Products Ltd., comes the latest in their range of battery eliminators. It is specifically designed for use with the Philips range of portable tape recorders including the EL3301 and the latest model, EL3302 and has the 5-pin din plug so that it can be plugged directly into the machines.

Output is 7·5V. Price is £2 5s. and postage and packing, 2s. 6d. Trade and Export enquiries invited. R.C.S. Products Ltd., 11 Oliver Road, Walthamstow, London, E.17.

DERBY'S TENTH ANNUAL MOBILE RALLY

Derby and District Amateur Radio Society, the first Wireless Club to be formed in Great Britain, are to hold their Tenth Annual Mobile Rally at Rykneld School, Derby, on Sunday August 13th.

This Rally, say the organisers has always been known as a family event and this year's attractions will once again have all the family in mind with Treasure Hunts, Prize Draw, Junk Sale, Film Show, Radio Controlled Model Aircraft and many other attractions.

Admission and car parking space at the Rally is free and there is also ample indoor accommodation should the weather decide to keep to the British summer tradition.

The talk-in Stations this year will be G3ERD/A and G2DJ/A.

CAR PORTABLE

Recently announced by Ferguson is model 3152, a l.w., m.w., s.w., v.h.f. ten transistor receiver incorporating permeability tuning for use in a car. Separate bass and treble controls are provided and there is a 34in. telescopic aerial for the v.h.f./s.w. bands. There is a push-button dial illuminator and a 6 x 4in. high sensitivity speaker. Sockets for car aerial, tape recording and earphone listening are provided. Cabinet is upholstered in midnight blue Vinyl with chromium plated grilles front and rear. Price is 33 guineas plus 9s. 6d. PT surcharge.

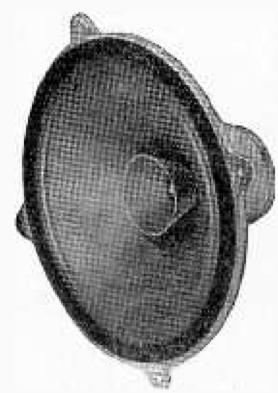
IEEE-SPONSORED CANADIAN CONFERENCE

The 1967 International Electronics Conference and Exposition to be held in Toronto September 25, 26 and 27 is attracting world-wide interest. The sponsors—the Canadian Region of the Institute of Electrical and Electronics Engineers—expect the attendance of electronics experts and other guests from around the world will exceed 10,000.

At this year's exposition over 180 Canadian, U.S. and overseas companies will present displays of their latest electrical and electronic products and devices as applied to industry, commerce, medicine, defence and space research. The Conference brings together scientists, engineers, technicians armed service personnel and business men to hear more than 110 carefully selected technical papers.

An interesting feature of the Technical Programme will be a showing of films dealing with electronic research and electronic products.

BUILT-IN TWEETERS



Baker Reproducers Ltd., Bensham Manor Road Passage, Thornton Heath, Surrey have published a new leaflet showing their range of loudspeakers. The basic range is the same, but a new model, the Major, incorporating built-in concentric tweeter cone has been introduced, and the de-luxe Mk. II and the Superb now also have built-in tweeter cones. Prices of all models remain the same. The picture shows the Major 12in. speaker, costing £8.

SWL's AHOY!

World Radio Club, a recently launched weekly quarter-hour programme in the BBC's World Service for SWL's and DX-ers carries news and comment on all aspects of broadcasting and receiving. Technical talk, advance information on listening conditions and DX News are features of the programme and questions and suggestions will be welcomed from Members of the Club. A Membership card will be sent on request to: World Radio Club BBC, Bush House, London, W.C.2. Times of transmission and frequencies are as follows:—

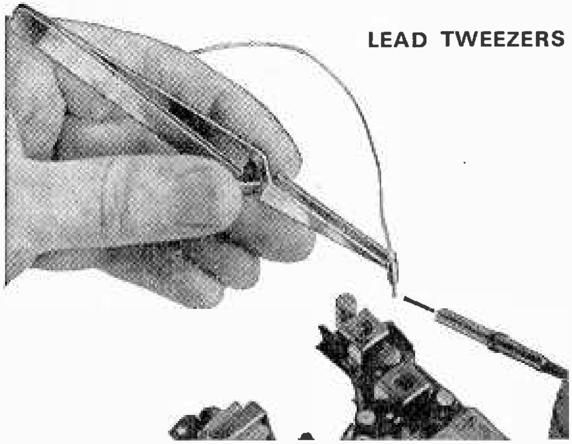
Saturdays 0745 G.M.T., Africa, Mediterranean, 498 and 324 m.w., 41, 19, 16, 13 metres. Australia and New Zealand, 41, 31, 25, 19 metres.

Sundays 0245 G.M.T., Western Hemisphere and Pacific, 49, 41, 31, 25, 19 metres.

Tuesdays 2100 G.M.T., Africa, Middle East and Mediterranean, 211 m.w., 31, 25, 19, 13 metres. Australia and New Zealand, 31, 25, 19 metres. South America 16 metres. West Indies and Central America 13 metres.

Thursdays 1245 G.M.T., Africa, Middle East and Mediterranean, 211 m.w. 19, 16, 13, 11 metres. South and South East Asia and Far East, 25, 19, 16, 13, 11 metres. West Indies and Central America, 16, 13 metres.

NEWS AND COMMENT...



LEAD TWEEZERS

Antex, whose range of soldering irons are known throughout the world have recently introduced a range of anti-wicking tweezers, for use during soldering operations to prevent fine stranded wires from acting as a wick and drawing up excess solder by capillary action. The tweezers also provide protection to the insulation and to some extent act as a heat shunt.

Three different sizes of tweezers are available, ranging in price from 5s. 6d. to 17s. 6d. The model 99 is illustrated.

NEW QTH FOR YARMOUTH CLUB

The Chairman of Gt. Yarmouth and District Radio Club has informed us that the Club now has a new QTH at 98 South Market Road, Great Yarmouth, and meetings are held every Friday at 7.30 p.m.

DANGEROUS SOLDERING IRONS

The Home Office stated recently that people could be electrocuted by certain electric soldering irons imported from Japan. They have the trade names of Hilka and QQQ which are printed in red on a metal plate let into one side of the plastic butt. The nameplate also includes the inscription "40W 220-240V", and it may also bear the number 1513. The Home Office stated that on some of these irons there is a protective metal spring surrounding the mains flex where it enters the handle, and this could be pushed into the iron further than the makers had intended thus making contact with a live terminal.

The statement added, "The Home Office strongly recommends that members of the public should not use these irons unless they have been examined by a competent person and if necessary modified to make them safe.

"The attention of the importers concerned has been drawn to the defect and they have undertaken to ensure that in future, the coil spring will be replaced by a non-conducting flex protector."

Trade associations representing importers, wholesalers and retailers have undertaken to warn their members of the defect.

Japanese authorities have informed the Home Office that steps will be taken to ensure that electric soldering irons supplied to the UK in future are satisfactory in all respects and do not present any hazard.

LOCAL RADIO TURNED DOWN

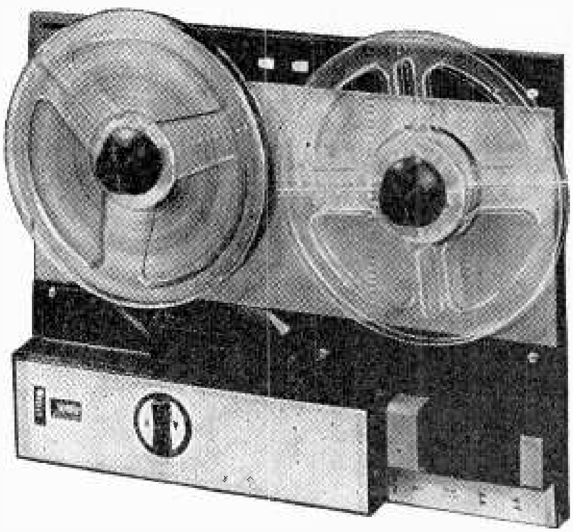
The Greater London Council will not support the proposal for an experimental local broadcasting station for London. This decision was made after the General Purposes Committee decided that the running costs, estimated at £50,000 a year would be too much of a burden on the rate-payers. It is also reported that Manchester has reversed its decision to support a local radio station for the same reason.

CAN YOU HELP THE POLICE?

A "Sailor" radio receiver, type 66T, serial number 72473 and a Hector depth sounder, serial number 23063 were among items stolen from the motor vessel "Kyanos" at Emsworth Yacht Basin between 7.00 p.m. on Monday, May 29 and 9.45 a.m. on Wednesday, May 31. Other items stolen were a Log, made by Brooks and Gatehouse, serial number 16832, a Compass, P.L. grid type, ex-R.A.F., a chrome-plated Clock made by Brown and a chrome-plated Barometer made by Brown. The total value of all these stolen goods is £450.

If you have seen or been offered any of these items, contact your nearest Police Station or the Superintendent, Chichester Police Station, West Sussex Constabulary. Tel. 84433.

VERTICAL TAPE DECK



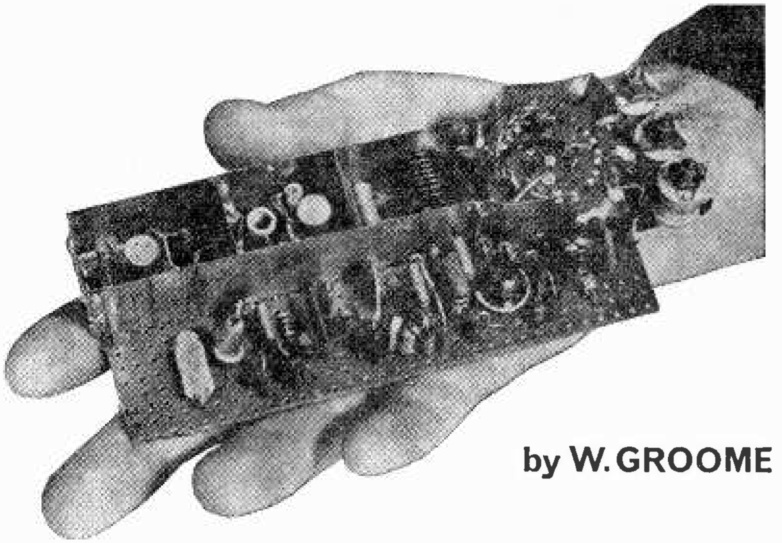
Van Der Molen are now marketing the vertical tape deck mechanism used in their VR4 and VR7 tape recorders as a separate unit.

This now makes available for the first time in the medium price range a quality tape deck that can be mounted vertically.

Specification:—7in. spools—fast wind and rewind—rev. counter—wow and flutter 0·15% at $7\frac{1}{2}$in. per second, 0·25% at $3\frac{3}{4}$in. per second, 0·35% at $1\frac{7}{8}$in. per second—6 watt overwind on motor. Normally supplied with $\frac{1}{4}$ track record replay head and ferrite erase head. Price £15 15s. 0d.

Van Der Molen Limited, 42 Mawney Road, Romford, Essex.

switched fm tuner



by W. GROOME

INTEREST in the pulse-discriminator type of v.h.f. tuner—as the only radio source of fidelity standard and as a project well within the home constructor's resources—was clearly indicated in the letters received from home and overseas readers after the appearance of my article in the April 1965 issue of this journal. The design now offered is in response to requests for a transistor version.

The change to transistors enables us to employ new circuits already developed for other purposes in the spheres of pulse manipulation and linear amplification—circuits which have no exact valve counterparts—and a long experimental period has enabled me to incorporate some which particularly aided the overall design plan. Although miniaturisation was not a priority the photograph shows a compact layout on Veroboard and the fact that this follows the theoretical diagram quite closely will be found both helpful and instructive. The extra space required for the standard-sized components of switched tuning are considered fair trade for accuracy in the hands of the careless user and for the absence of inter-station noise. This type of tuner has no tuned i.f. or discriminator circuits to align, hence the major problem of the v.h.f. constructor without test gear is overcome.

Tests at fifteen miles range, where a crude split-flex dipole on the ground-floor carpet gave a well-limited signal, suggest that modest indoor dipoles will be sufficient in many areas, but in the interests of fidelity one should aim for an input considerably above the bare limiting level. This broadens the bandwidth and lifts interference spikes into the clipped areas of the i.f. carrier. Reception with a few inches of aerial is of little benefit in an area subject to multi-path interference for which, with any tuner, the only remedy is a directional array. In common with all tuners the sensitivity for stereo will be lower than on mono. A suitable decoder will be described in a later article.

In Fig. 1 a common-base r.f. amplifier Tr1 serves as a buffer between aerial and oscillator. L1 and L2 are air-cored and self-supporting. Alloy-diffused transistors OC171 (not interchangeable with OC170 in this tuner) can be bought quite cheaply. The r.f. signal is transferred to the base of a self-oscillating

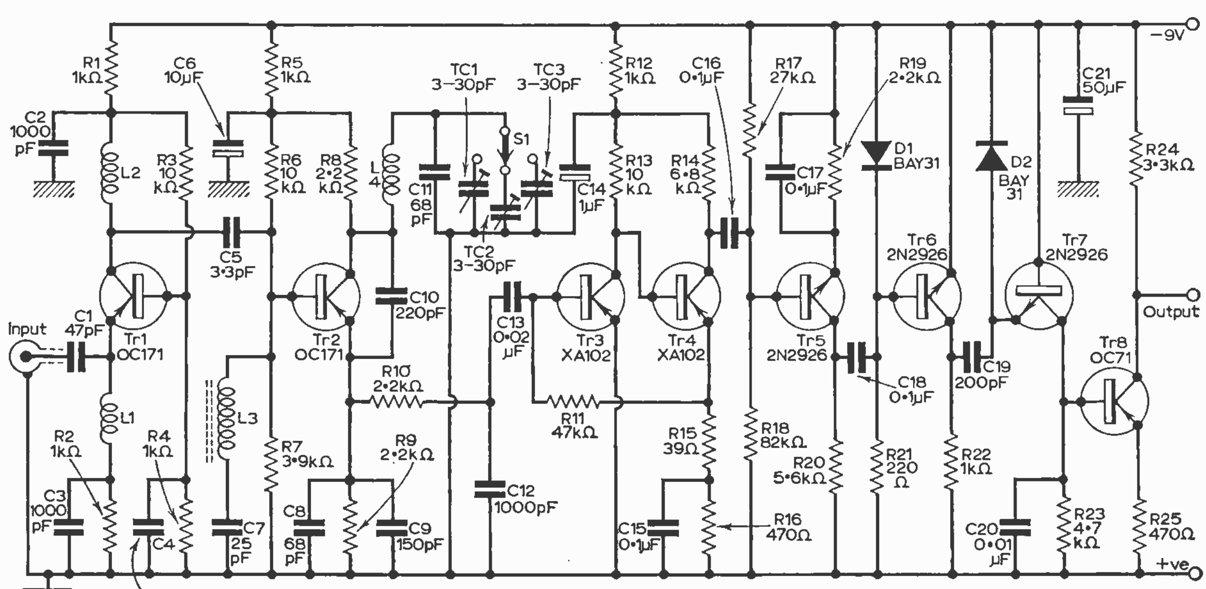


Fig. 1: Circuit of complete tuner.

mixer Tr2 via C5, L3 and C7, of which L3 is dust-cored to facilitate adjustment. To avoid "pulling" by the signal the oscillator runs at 30-35Mc/s and the third harmonic is used for mixing. Radiation is prevented by the r.f. buffer and the recommended screening. In TV channel 4, where the second harmonic might have caused some trouble, no trace of interference was apparent when the tuner, the TV and their aerials were operated in the same ground-floor room.

The superior frequency stability of the Clapp oscillator is largely due to the use of a series-resonant tank circuit. While the collector-to-emitter feedback network, which includes transistor capacitance and strays, forms an unavoidable and variable portion of the tuning capacitance in the more familiar Colpitts circuit, it is unable to appear directly in parallel with that of the series-tuned Clapp oscillator, hence the benefit of good LC design is fully realised in the latter. The design is due to L. C. Hopkins (*Wireless World,* September 1965) and experimental substitution of physically smaller coils of the same inductance proved the superiority of his relatively large component for the highest frequency stability. The effect of rather close screening is slightly adverse and an alternative is discussed later. Thermal variations and collector current fluctuations are off-set by a negative temperature coefficient capacitor C9 and d.c. feedback resistor R5 to refer collector current changes to the base where they tend to cancel. The oscillator is frequency-stable, without crystal control or a.f.c. The tuning capacitance comprises C11 (fixed) and one of the trio TC1, TC2 or TC3, as selected by S1. These "beehive" pre-sets must be of 3—30 pF and not the 2—8 pF type currently on the surplus market.

Filtering of the i.f. output is simplified by the wide difference between the i.f. kilocycle frequencies we wish to retain and the megacycle frequencies we intend to reject, and is achieved by R10 C12 and also by the choice of cheap r.f. alloy-junction transistors for the i.f. stages Tr3 Tr4, for these provide ample gain at i.f. while imposing losses in the megacycle ranges. Transistors XA102 can also be bought quite cheaply. The d.c. feedback pair Tr3 Tr4 is well known in applications ranging from audio to video frequencies for its thermal stability and economy of components.

The use of n-p-n transistors in a circuit having a positive earth line gives the next three stages a more complex appearance in the diagram than is really the case, but these stages merit description for reasons other than this. The object of the pulse discriminator is to derive an a.f. voltage rising and falling exactly in accordance with the rise and fall of f.m. carrier frequency. This frequency-to-voltage conversion means, in other words, setting up voltages proportional to the rate of arrival of carrier (or i.f.) cycles. To be acccurately additive the cycles must have a fixed unit value regardless of frequency, a uniformity that can be provided only by converting the i.f. sine waves into pulses. Most valve circuits, including my own, used a pentode limiter and resistance-capacitor (r.c.) differentiator to produce uniform but rather small "spikes," and a diode "pump" to pile these up in a r.c. network to lose their separte identities in contributing to the a.f. output.

While the output from a valve limiter was sufficient to operate the pump linearly the smaller amplitudes of transistor circuits may not. In the fields of pulse circuitry where the pump is required to provide a linear "staircase" for accurate counting, triggering or frequency measurement this defect led to the development of a diode-transistor pump which is not only linear but has a large output. Among the several articles on this pump and its applications the most instructive is probably D. E. O'N Waddington's (*Wireless World,* July 1966). His three-stage discriminator comprising a driver (Tr5 in Fig. 1), limiter (D1 Tr6) and pump (D2 Tr7) has been adopted here with only minor change simply because there seems to be none better. It works quite well with p-n-p XA102's (with appropriate reversal of polarities) but as the resin-potted 2N2926 transistors are quite inexpensive, the substitution is hardly worth while except for the keen experimenter.

By reverting to p-n-p for the output stage (Tr8) we can use direct coupling. While the OC71 or equivalent is suitable for monaural reception this, and C19 R22 which integrate the pulses and provide de-emphasis, will have to be replaced when the tuner is modified for stereo. Space on the veroboard is left for these modifications, which will be described when the decoder circuit is published.

The tuner is built on a piece of Veroboard

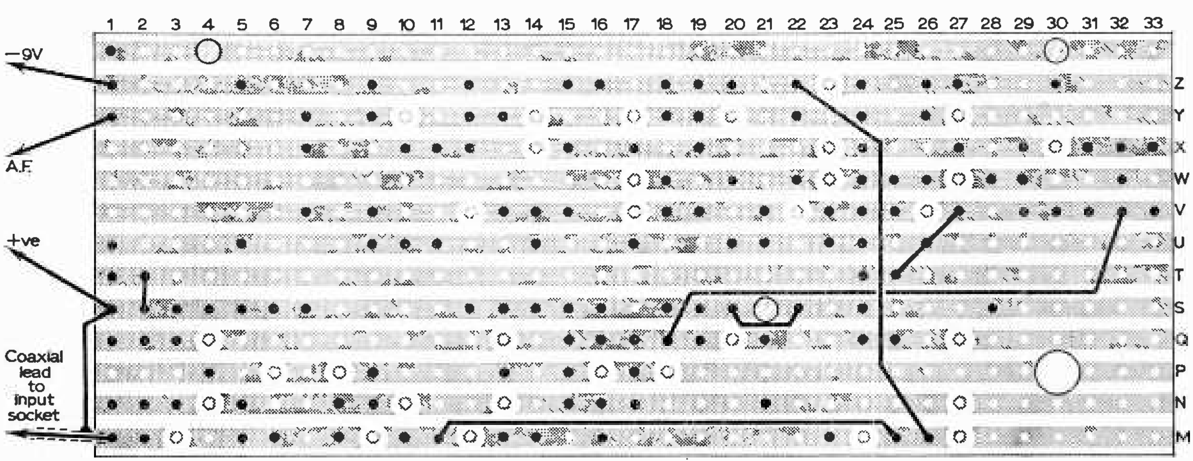


Fig. 2: Veroboard conductor divisions, panel drilling and underside wire connections.

measuring 5 x 2 in. (Fig. 2) with 13 conductors of which one has no circuit function, and can be drilled for fixing screws. A further screw-hole can be made at S21 provided the adjacent holes S20, S22 are linked by a bare tinned wire soldered to the conductor to maintain continuity. When attaching to other metallic equipment remember that this screw will be at earth potential. The conductor reference letters have been chosen to avoid confusion with component references. It will be helpful to attach lettered and numbered gummed paper strips to the plain side for easy reference during assembly.

In the assembly tables the first column gives the conductor and hole reference (letter and number) to the hole on which an "up-ended" component stands perpendicular to the panel and the second column indicates similarly the hole to which the other wire end is attached. The third column indicates the component in agreement with the circuit diagram, the layout drawings and component list. Thus the first line in table 1 means "solder capacitor C1 to conductor M hole 2, standing on that hole, then solder the other wire end at conductor N hole 2". As the tuner is compact the pictorial diagrams have been expanded considerably to enable the positions of all components to be clearly indicated. These, with the assembly tables, should enable you to build the tuner without difficulty or error.

The small size of the tinplate screens (Fig. 9) permits a light method of attachment as work proceeds. As already stated the lid degrades the efficiency of the oscillator coil a little and shifts the tuning range, although not seriously in the prototype. If the eventual installation permits the space you could increase the height of the screens in order to raise the lid away from the coil. Alternatively, the use of an earthed housing for the tuner will enable the lid to be dispensed with. It is not necessary for stability, but is included in the design to prevent the radiation that can occur with all oscillators. The tinplate partitions indicated only by broken line in Fig. 9 measure 13/16 x 1 in. and are simply soldered to the longer screens. One separates the oscillator from the r.f. stage; the other is set in the midst of the oscillator stage to further reduce the stray field of the coil in the r.f. direction.

The tuning capacitors TC1, TC2 and TC3 are mounted on the small tinplate platform illustrated in Fig. 6 by shortening their spikes at the fixed ends and soldering these directly to the tinned metal. The assembly is then held in position on the panel by the switch. Three of the coils are shown in Fig 3. It is convenient to wind L1 and L2 on the 0·3in. diameter former intended for L3 and then, with ends suitably bared, bent and trimmed, remove for fitting directly to the panel. L3 is wound on a short 0·3in. polystyrene former and uses a v.h.f. core, coded purple. This should have a small base or tag-ring from which all except two tags should be removed. This coil is held quite firmly enough by the circuit wiring as shown in Fig. 3. The oscillator coil L4 (Fig. 3) is wound on a temporary 0·5in. diameter former. Its thick wire ends must be filed down to a size that will pass through the Veroboard holes.

SECOND AND FINAL PART

of this article will appear next month. A components list is given on opposite page.

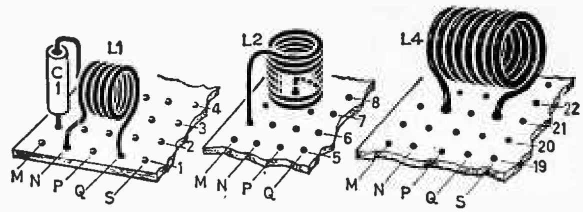


Fig. 3: Self-supporting coils, showing connection to panel.

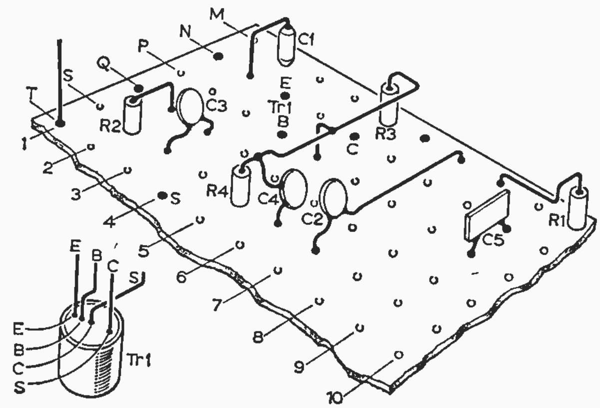


Fig. 4: Expanded view of r.f. stage. Coils and transistor omitted for clarity. OC171 inserted with leads joggled.

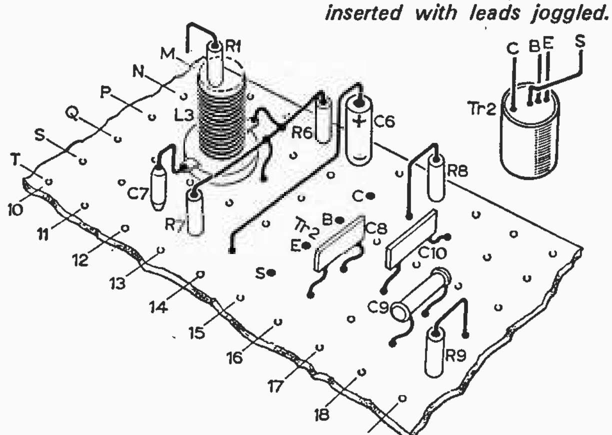


Fig. 5: First part of oscillator-mixer: OC171 inserted.

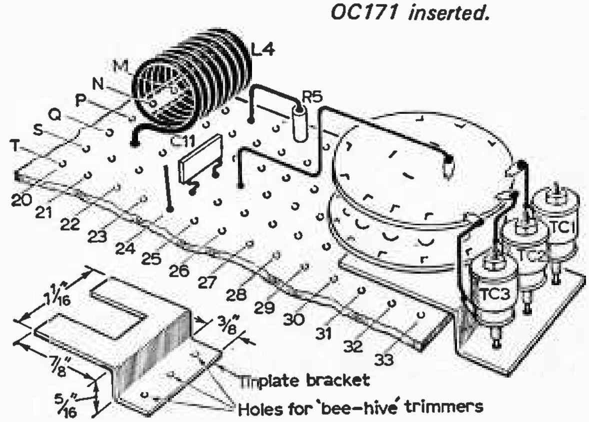


Fig. 6: Completion of oscillator-mixer plus details of the tinplate platform.

★ components list

Resistors:

R1	1kΩ	R14	6·8kΩ
R2	1kΩ	R15	39Ω
R3	10kΩ	R16	470Ω
R4	1kΩ	R17	27kΩ
R5	1kΩ	R18	82kΩ
R6	10kΩ	R19	2·2kΩ
R7	3·9kΩ	R20	5·6kΩ
R8	2·2kΩ	R21	220Ω
R9	2·2kΩ	R22	1kΩ
R10	2·2kΩ	R23	4·7kΩ
R11	47kΩ	R24	3·3kΩ
R12	1kΩ	R25	470Ω
R13	10kΩ		

All 10% ½ watt miniature

Capacitors:

C1	47pF ceramic
C2	1000pF disc ceramic
C3	1000pF disc ceramic
C4	1000pF disc ceramic
C5	3·3pF ceramic
C6	10μF 15V electrolytic
C7	25pF ceramic
C8	68pF silver mica
C9	150pF ceramic
C10	220pF silver mica
C11	68pF silver mica
C12	1000pF disc ceramic
C13	0·02μF disc ceramic
C14	1μF 15V electrolytic
C15	0·1μF polyester
C16	0·1μF polyester
C17	0·1μF polyester
C18	0·1μF polyester
C19	200pF silver mica or ceramic
C20	0·01μF polyester
C21	50μF 15V electrolytic

Variable Capacitors:

TC1, 2, 3 3–30pF Philips "Beehive" trimmers.

Semiconductors:

Tr1	OC171	Tr5	2N2926
Tr2	OC171	Tr6	2N2926
Tr3	XA102	Tr7	2N2926
Tr4	XA102	Tr8	OC71 or equivalent
D1	BAY31, BAY38, BAY41		
D2	BAY31, BAY38, BAY41		

Inductors:

L1 5 turns 24 s.w.g. enam. copper wire, close-wound, 0·3in. inside diameter, self-supporting air-cored coil.

L2 7½ turns close-wound, as L1

L3 12 turns 24 s.w.g. enam. copper wire, close wound on 0·3in. polystyrene former, with tag ring (purple dust core—v.h.f.)

L4 8 turns 18 s.w.g. enam. copper wire, close wound, 0·5in. inside diameter, self supporting air-cored coil.

Miscellaneous:

S1 1 pole, 3 way—otherwise 3 pole, 3 way with all unused tags wired to positive line on panel.

Veroboard 5 x 2in. (5 x 2½in. cut down)

RECMF

BRITISH 1967 RADIO AND ELECTRONIC COMPONENT SHOW

IN a statement to the Press, Mr. A. F. Bulgin, O.B.E., M.I.R.E. (Chairman of the RECMF Exhibition Committee and founder-member of the Radio and Electronic Component Manufacturers Federation) claimed "Our industry is in very good shape. If all British industry were on a par, this country would be on top of the world".

Facts? Component output is up by over 7%—at around £200M—while exports (£64.6M) have increased by 17% in the past year. First indications are that 1967 will be even better. Many British companies are supplying to overseas governments components which cannot be matched in their quality-price brackets and are able to comply with ever-tightening specifications. Improved productivity and production techniques are leading to some outstanding cost-cuts by manufacturers.

And the Exhibition? This all-British show, with a record number of over 300 exhibitors, was a decided footslog and it was no surprise to learn that it occupied an area of more than 100,000 square feet—the biggest ever staged. Attendance figures were up by 10% to a total of 59,247 visitors from all over the world. Orders, or initiated deals, added up to at least £25M.

The keynote was undoubtedly the spectacular advances made in the field of microminiaturisation. The integrated circuit is here with a bang. This market seemed, at one time, to be threatened with domination by American companies, being backed by heavy government subsidies through the space development projects. However, British industry has fought back and to such an extent that it is claimed that British microelectronics are at least equal to anything produced abroad and many of them at lower cost. One company announced that due to new production techniques, they have been able to halve the price of some of their IC's!

Such a silicon chip can carry every component for a radio chassis except for inductances and the audio amplifier. In fact Mullard showed a new range of linear IC's including a complete stereo f.m. receiver made up entirely from modules. A microcircuit incorporating a metal-oxide-semiconductor transistor in the input stage was shown and others included an a.m.-f.m. device which performs the function of i.f. amplifier, mixer/oscillator and demodulator; a 1W audio output amplifier; a tape recorder amplifier.

Believed to be the first-ever linear IC capable of performing the functions of mixer/oscillator, i.f. amplifier, demodulator and audio amplifier for driving a complementary output stage is the Mullard 530M, which can be used in l.w., m.w. and s.w. receivers. The IC is basically a 10·7Mc/s i.f. amplifier with demodulator but it has a second amplifier which may be used as mixer/oscillator. An a.g.c. circuit is included. The i.f. amplifier gain is 60dB. The 530M can also be used in f.m. receivers as a high-gain i.f. amplifier with good limiting characteristics. The a.f. section can again be used for driving an output pair. The unit is in a 14-lead dual-in-line encapsulation.

The audio amplifier module 320TAA incorporates an MOS transistor in the first stage and has a frequency response substantially flat from 50—15,000c/s. This IC could be used as, for example, a record player amplifier where it can be used to drive a high-voltage output transistor to form a simple a.f. amplifier of 2W output.

Many other companies, of course, were displaying microcircuits but we have given prominence to the Mullard products since their applications are more within the field of interest of *P.W.* readers, viz: domestic equipment.

Transistor technology continues apace, and silicon planar types were well to the forefront, many of them in epoxy encapsulation. Mullard, for instance, showed new types suitable for TV, radio and audio applications including additional "lock fit" types and a series of 5A audio power transistors.

Mazda had a new range of silicon planar devices, epoxy encapsulated, including types suitable for a.m.-f.m. radio receivers. The new Mazda SA19 stereo tape recorder circuit, using these transistors, was demonstrated.

AEI Semiconductors featured a display of working demonstrations highlighting solid-state component applications, together with a static display of all types of semiconductors and microcircuits.

Among the wide range of STC components was a new TO-18 device, the 2N918 with a minimum gain of 15dB at 200Mc/s and a maximum noise factor of 6dB at 60Mc/s, suitable for v.h.f.-u.h.f. receiver front ends. Two other new ones were the 2N3962 and 2N3954 which are intended primarily for a.f. input stages and have exceptionally good noise performances.

In this short space we cannot deal in detail with the various products which took our eye. The intrinsic value of everything on show was in the multi-million pound bracket and some of the components, hardly out of the prototype stage, are estimated to have cost over £1M to develop and tool-up. Here, then, is a round-up of some items we noticed.

NEW CELL

A new rechargeable cell by Cadmium Nickel Batteries Ltd. will simplify the operation of cordless appliances. The new Voltabloc cell has a minute hole in the nylon cap normally sealed by a neoprene grommet. When gas pressure rises, due to overcharging or overdischarging, the grommet is compressed and the gas is released. When pressure drops, the hole is resealed. The company claims that this is the first cell to provide resealing.

MINI SPEAKER

Shown for the first time by Elac was the E6-S, a 10-watt speaker with a frequency response of 55–16,000 c/s and measuring 11 x 8 x 6in. The drive unit is a dual cone 6-inch unit of the long-throw type with the diaphragm linearly suspended on moulded rubber. This is claimed not only to provide freedom of movement but to entirely eliminate mechanical and edge-distortion effects.

MINI MINI OSC

The micro-oscillator shown by Marconi is claimed to be the smallest self-contained oscillator in the world. The complete circuit, with its crystal, is contained in a TO-5 can approximately the size of an OC45-type transistor. Another miniature oscillator on the Marconi stand used a tiny microcircuit, the transistor of which heats the can and maintains effective temperature stabilisation. It operates in the range —55deg. C. to +90deg. with a short-time stability of one part in 100,000,000.

PC ECONOMY

Pressac Ltd. are now producing conventionally etched printed circuit boards and a new form of die-stamped alternatives—a development which enables p.c.s to be produced economically in any quantity from one upwards. Pressac also displayed a solderless connection system using a pneumatic crimping press.

MEMORY MATERIAL

Witch-doctory up to date! That's what Raychem Ltd. achieve with their radiation-chemistry techniques to build-in an elastic memory in plastics materials. Plastics tubing is subjected to high-energy electron beam radiation and is then expanded. When the tubing is heated, it returns exactly to its original size. In a practical application, a T-shaped junction is supplied expanded to permit easy insertion of the cables and wires along the arms of the T; application of heat shrinks the junction to its original size and firmly grips the cables.

LONG-LIFE POT

A roller-contact potentiometer was shown by STC. This long-life precision component, instead of the normal sliding contact, uses a silver alloy wheel which rolls over the winding, reducing wear to a minimum. On-load tests show that the potentiometer can accept at least 80 million end-to-end sweeps without failure or appreciable wear of the resistant element.

SQUARING THE CIRCLE

Wire Products & Machine Design Ltd. exhibited square wire made from Monel, a difficult metal to work but of high corrosion resistance. Square wire facilitates non-soldered jointing and the essential feature is that it must have sharp corners which dig into and grip the softer wire wrapped around it.

SOUND CUSHION

One of the Lustraphone exhibits was their "Sound Cushion"—a small pillow fitted with a battery-operated transistor amplifier which enables hard-of-hearing people to listen in comfort to radio and TV programmes without turning up the volume to an inconvenient level.

The same company also showed a new sub-miniature ultra-light ribbon microphone. The basic unit weighs only ¾oz and is three-eighths of a cubic inch in volume. It is the first unit of its kind using ceramic magnets.

MULTIPOLE PLUGS

Rendar Instruments Ltd. showed jack plugs and sockets carrying up to twelve circuits without danger of inadvertently opening or closing the wrong circuit during insertion No electrical contact is made as the plug is pushed in but a clockwise twist brings all circuits into operation and at the same time locks the plug-in position.

SEASPRAY-PROOF

A loudspeaker shown by Rola Celestion Ltd. can be saturated with seaspray or can work in a corrosive chemical atmosphere. It is fitted into a watertight cast housing with a moulded glass fibre diaphragm, forming a complete atmosphere seal. It is bolted into a moulded flare and the reflector is mounted in glass fibre.

REED RELAY

The Reedac reed relay (control power at 6—24V d.c. only 125mW) has semiconductor reliability, say manufacturers Astralux Dynamics Ltd., with a life of at least 500 million operations. This works out at about 16 years of continuous day and night operation once every second. It can switch up to 15A at 250V a.c.

101 ELEMENTS

One of the BICC exhibits was a colour TV camera cable coupler concentrating as many as 101 contracts into a casing about 2-in. diameter. Saves space on cameras and vehicles, makes for easier handling and improves mobility.

NON-FAIL LIGHT

A new emergency indoor lighting unit shown by Cadmium Nickel Batteries Ltd. normally uses low-voltage illumination from the mains but in the event of mains failure switches over to rechargeable cells which are kept topped up through the mains circuit. The unit gives 1½ hours' emergency illumination and the batteries are fully recharged in 30 hours when the mains is restored.

COMPONENT FREEZE

A new aerosol containing a freezing element which will lower the temperature of components to —50deg. C. was shown by Electrolube. In faulty circuits, the freezer is applied to suspected components one at a time; when the fault clears or changes, the faulty component or solder joint will be identified. The idea can also be used in the mechanical assembly of small parts—heat-sensitive components (such as transistors) can be frozen before soldering or the cold jets used to cool the leads. Electrolube claim that the freezer can be used as a local anaesthetic on the skin!

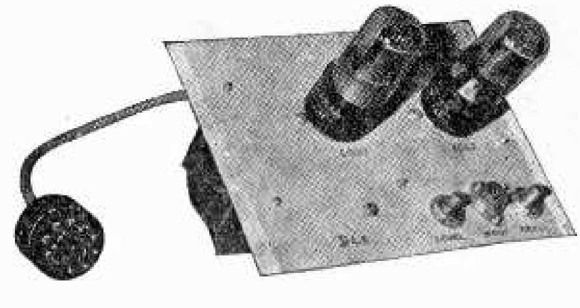
INCH CUBE

The Belclere Company displayed a range of miniature mains transformers which are smaller than one cubic inch—most of them being sold to America.

A.C. RELAYS

A new miniature plug-in a.c. relay range the first to be made in the UK, was exhibited by Oliver Pell Controls Ltd Six make-and-break contacts, or four changeover contacts, are available at 1A rating, or two changeovers to carry up to 5A.

Record player AMPLIFIER



P. Matthews

THE first two stages are of a normal pattern, and incorporate a high-mu double triode type 6SL7GT, a valve which will be found in most spares-boxes. Care has been taken to eliminate noise in the volume control by the insertion of R1 and C3. Normally, the slider of VR1 would have gone direct to the grid of V1A and the top end to C1. However, when this arrangement was tested over a period of time, it was found that the small grid current flowing in V1A tended to cause noise in the control, and so R1 was arranged to carry the current, and C3 to isolate VR1 from it. C2 and VR2 form a "top-cut" or "brilliance" control suitable for removing noise on older records. When this is set for maximum resistance, the amplifier has a nearly flat response over the audio frequency range, and the equalisation for the record and the cartridge would be applied between the player and the input terminals.

The output stage, built around V2, is a rather unorthodox self-reversing push-pull Class A type, based on the Schmitt inverter circuit. Basically, the principle is that V2A and B "see-saw" about the common cathode resistor R10, so that the signal potentials on the grid and anode of V2A are equal and opposite to those of V2B. In practice, this can never be exactly achieved as R9 would have to be so large that it would dissipate excessive power, but the unbalance is quite small here. It would be impracticable to use this circuit for more powerful valves, such as 6V6 types, as the common cathode resistor would then be dissipating nearly 10W, with the result that another 100V of h.t. would be needed.

Of course, an inductor could be used instead of a resistance, but this would pose other problems, such as unbalance at extreme ends of the a.f. range causing distortion, and also the size and cost of such a component. (I am experimenting with this system.) In this amplifier, where a resistance is used, only 20 extra volts are required and about ½W is dissipated. There is no need to bypass R9, the cathode bias resistor, since in Class A operation equal and opposite signal currents flow through it and no negative feedback (loss of gain) results. This form of self-inverting output stage is satisfactory only for Class A (constant current) operation because changes in anode current occurring with Classes AB and B would shift the operating point and tend to cause distortion.

The output transformer used in the prototype was an Elstone type MR/T which is a small "universal" 3Ω model with a number of optional ratios. Provided that the ratio is between about 45 and 70:1 there is not much variation in performance, and this to be expected with low-power Class A triodes. The optimum ratio is approximately 55:1. Heavy negative feedback, which considerably improves the frequency response and reduces hum and distortion is taken from the transformer secondary via R4 to the cathode of V1A. The value of R4 can be raised or lowered indefinitely to increase or decrease the sensitivity respectively. The frequency response improves with a small value of R4, but not much improvement occurs below about 10kΩ. If a capacitor between about 0·1 and 2μF is put in series or parallel with R4, there will be considerable bass boost, and this can be varied by the connection of a 10 or 25kΩ variable across it. If the capacitor is placed between either

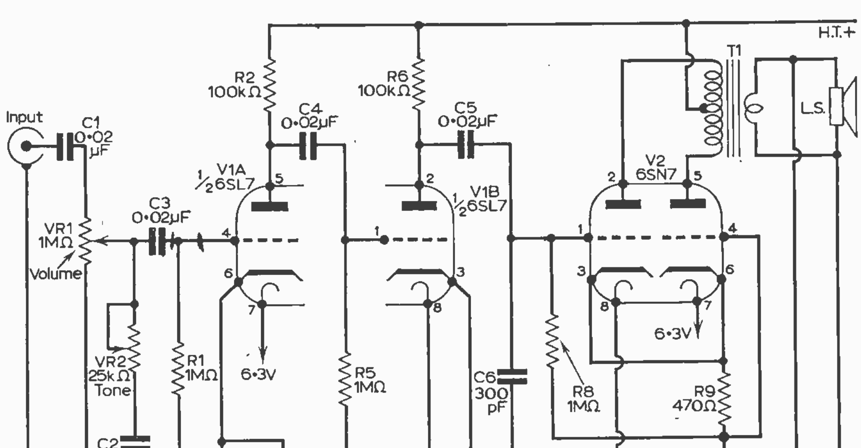


Fig. 1: Circuit diagram of the amplifier section.

end of R4 and chassis, treble boost will result, and can be varied as above. In both these cases, changing the value of the capacitor alters the frequency at which the boost starts and a low value causes the boost at extreme ends of the a.f. range.

Construction

It is impracticable to give exact chassis drilling details because there are so many alternative components which can be used in the construction. However, a suitable wiring and layout diagram for the amplifier is provided (Fig. 3) to assist the less-experienced constructor. The heater, h.t. and n.f.b. wiring has been omitted for clarity. It is preferable for the chassis to be made of aluminium, especially if a mains transformer is to be mounted on it. Another idea would be to mount the valves and associated components (not including transformers, controls and sockets) on a "floating" rectangular panel of paxolin or perspex, and screw this into a corresponding rectangular hole cut in the chassis. This method can, incidentally, be very useful with printed circuits.

No matter which form of construction is employed it is advisable to build the amplifier in sections such that the performance of each section may be tested and any faults cleared before the next section is built.

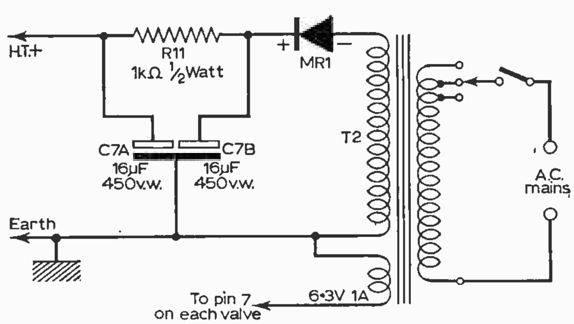
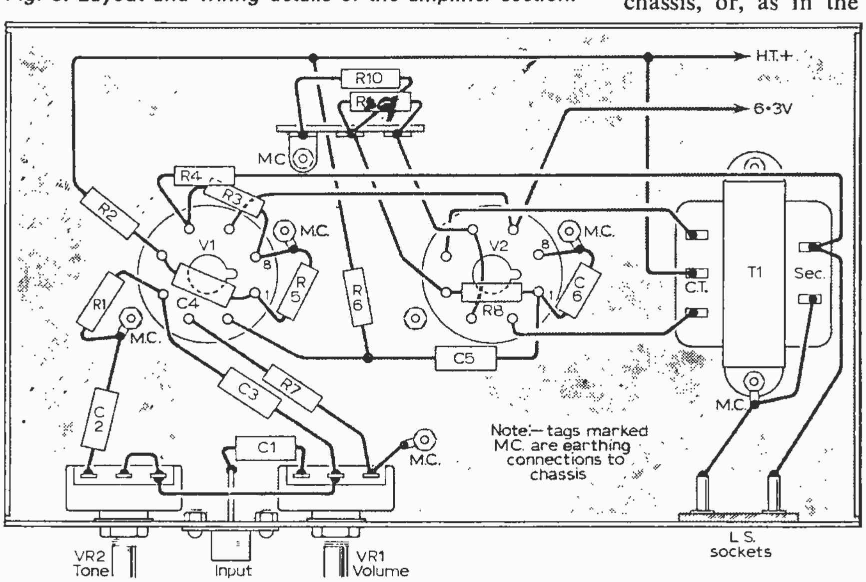


Fig. 2: Power supply suitable for use with the amplifier.

Fig. 3: Layout and wiring details of the amplifier section.



★ components list

Resistors:		Capacitors:	
R1	1MΩ	C1	0·02μF
R2	100kΩ	C2	0·02μF
R3	1kΩ 10%	C3	0·02μF
R4	10kΩ 10%	C4	0·02μF 400V.
R5	1MΩ	C5	0·02μF 400V.
R6	100kΩ	C6	250—500pF
R7	3·3kΩ	C7A, C7B	16+16μF 450V. electrolytic
R8	1MΩ		
R9	470Ω		
R10	1kΩ 10%	**Valves:**	
R11	1kΩ ½W	V1	6SL7
All 20% ¼W unless otherwise specified.		V2	6SN7

Miscellaneous:

Mains transformer—see text, output transformer—see text, two metal rectifiers—BY100 or similar, chassis to suit, two international octal valve holders, 1MΩ potentiometer, 25kΩ potentiometer, solder, wire, etc.

Suitable sections, in order of construction, are:

1. The power unit excluding h.t.; all valve heaters. (Test by checking that the heaters light.)
2. H.T.; V2 circuitry up to C5. (Test by touching the end of C5 whereupon a buzz should be heard in the loudspeaker.)
3. The circuitry of V1B up to C2 but not R2. (Test as before but with C2.)
4. The remainder. Test with musical input. If distortion is present with a low input, check, and replace if necessary, C5, C4, R7 and R3, in that order. If buzz, howling, "motor-boating" or whistling occur, it might be the record but would more probably be due to incorrect phasing of the n.f.b. loop, and the connections to the output transformer secondary should be transposed.

The power unit

The power unit can be built either on the same chassis, or, as in the prototype, a separate chassis, where it can be used with other equipment. Figure 2 depicts a possible circuit using half-wave rectification. It will be seen that there is no need to use a smoothing choke for such a small current as a resistor will suffice and take up less room.

There should be no difficulty in obtaining a 0—250V half-wave mains transformer, but half of a 250 or 275V, 60 or more mA. full-wave mains transformer will do just as well if the centre-tap is earthed and h.t. taken from *one* (not both) of the secondary connections. So much for the circuit and construction. The rest is up to you. ■

practically wireless commentary by HENRY

No. 36

Out of business

IT is always at the weekend. Always when old Mr Tinkle has locked the cycle, wireless and iron-goods shop and trundled off in his old van when the family radio gives up the ghost.

Our transistor portable is one of those peak performance, economy circuited, fully stabilised, complementary push-pull, direct-coupled miracles so designed that a considerable drop in battery voltage is possible before distortion sets in or conduction vanishes. Consequently, there is little warning when the battery is ailing; none of that throaty cross-over distortion that the old set used to descend to. One moment the Miracle is going, the next it is dead. And it always happens at the weekend.

Oh yes, we have a second set, just as it says in the advertisements. The snag is that the second set, and for that matter, the third and the fourth, are in an advanced state of dismemberment.

In any case, it is doubtful whether old Mr Tinkle would have a battery of our kind in stock. The makers of Miracles, in their infinite wisdom, decided upon a split supply, with a total of some sixteen volts and an unusual connector.

Bombard them with bits!

Getting spare parts for the Miracle is rather like asking for a rise when the Squeeze is on. The newer stores don't want to know us. The more enterprising salesman says: "You haven't a hope, Sir. Now, I can show you our latest models . . ."

They don't make them like that any more. They didn't make them like that even then, Henry thinks. At least they didn't bother to make any spare parts. Perhaps the implication is that the Miracle would never go wrong, in which case it would be truly miraculous. Perhaps it is simply that vast stocks of rusting oscillator coils and switch slide toggle clamps (I'm not joking) are disintegrating in some bonded warehouse on a wild and windy quayside, where Customs and Excise men prowl, eagle-eyed beneath the shadowy peaks of their portcullised caps, tossing their knobs of chalk from hand to hand . . .

Some of the shops where we enquire about spare parts are genuinely helpful. The young salesman has never heard of the Miracle. Nor has his mate. Between them they decide it was maybe Brattin and Smythe that marketed these receivers. Or was it Bulligers? They leaf through the catalogues, unsuccessfully, and turn to their senior colleague, who has just completed a sale and has the remnants of a smile to prove it.

He remembers, oh, indeed he does! Very small discounts Bullin and Smerge gave. Anyway, they are long since out of business. Perhaps the service department knows of a source. He buzzes for a white-coated gentleman who emerges from some deep abstraction with a visible jerk . . .

"Miracle," he snorts, "Not worth repairing. Couldn't guarantee the job. Bitch of a thing to take to bits."

Eagle-eyed Customs men.

He accepts a cigarette, tucks it behind his ear and admits that it is just possible he might know of a distant colleague who has some bits and pieces. But he, personally, himself, would not bother to replace that part. He would be tempted to modify the switch, using a Radiospares standard item and the toggle from a Philips gramophone mechanism.

Meanwhile, back at the homestead, an anxious search for alternatives goes on. By the time Henry returns, footsore and dispirited, the family awaits him, jubilant.

The cause of their jubilation rests on the kitchen table. An early Miracle, hardly marked, picked up for a song in the surplus store. "The man said it was going till recently. Can't be much wrong."

An old campaigner, Henry does not have to unbox the newcomer to know that whatever it is that has gone wrong will be the same as went wrong with the original. We now have two defunct Miracles.

We begin to see why Battin and Smooge went bankrupt. Perhaps Battin eloped with Smooge's wife and left the orders for the toggles in his waste basket. Or maybe Smooge caught them first and bombarded them with the parts from that particular stores bin, breaking all the slides and Battin's nose into the bargain.

RADIO ALARM

PATRICK HIGHAM

THERE are numerous types of alarm clock on the market. They vary in size, quality and price, but all produce the same effect. At a predetermined time, set manually by the user, they sound an alarm signal of one sort or another. Some buzz, some hoot, while others emit tones of varying pitch. This article describes how to modify a particular model of standard alarm clock so that it will switch on a transistor radio at any desired time. This has a decided advantage in that the volume control can be adjusted to give the desired level of sound. Thus, to suit individual whims, it is possible to be awakened by soft music or very loud music, depending upon the depth of sleep of the person concerned.

In planning the project, the following features were considered important. First, the radio should not draw current until the clock switched it on. Secondly, the clock should be capable of turning the set on at any time during the day. Thirdly, the system must be capable of switching the set off after a certain time has elapsed unless the set is deliberately switched on. Again this is essential in the interests of battery economy. The system must be simple, reasoning that the more items there are, the more likely it would be that something could go wrong. The prototype has given trouble-free service for over six months to date and has proven satisfactory in every way.

The particular clock used was made by Westclox and cost approximately twenty-two shillings. Theoretically any alarm clock could be modified, there being nothing extraordinary about the author's clock. If another make or model is used, it is important to ensure that there is sufficient room in the case to accommodate the necessary components.

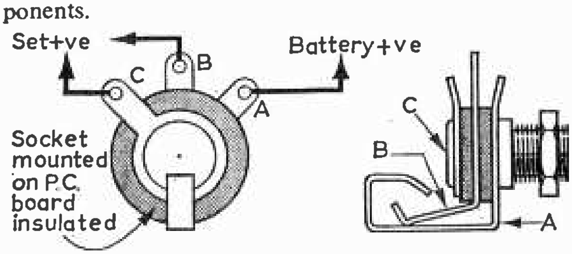


Fig. 1: Jack-socket connection data for the receiver—A goes to the battery positive line, while B and C either go across the receiver's on/off switch (parallel connection) or in series with one of the "live" leads to the on/off switch.

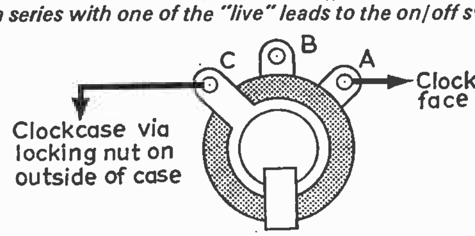


Fig. 2: Jack-socket connection data for the alarm.

MODS TO THE SET

Since the alarm clock acts directly as a switch it is necessary to run two wires from it to the set. Perhaps the neatest and simplest way of achieving this is to mount a small jack socket on the chassis or, even better, the case. The exact position for this socket is unimportant. *Note. It is not safe to use this device on mains supplies, or battery supplies greater than 50 volts.*

It is possible to connect the switch (alarm contacts) either in series or parallel with the main switch on the set, this is left to individual preference. However with the clock contacts wired in parallel with the set on/off switch, the set switch is rendered inoperative when the clock contacts are closed. The author chose to connect his alarm clock contacts in series with the set switch.

The method of connecting the alarm clock to the set is as follows. A small (3·5mm.) jack socket is fitted to the set. This is of the normally closed type. With nothing plugged in, terminals a and b short together thus allowing continuity via the set on/off switch. With a jack plug inserted, the spring contacts open and continuity is provided via the jack plug leads which go to the alarm contacts via another jack plug and socket mounted on the clock case.

MODS TO THE CLOCK

The alarm clock is considered to consist of two parts. The clock face, which has the clock works mounted on it, and the rear metal case consisting of a metal shell. The case is used as an electrical conductor and the jack socket is mounted directly

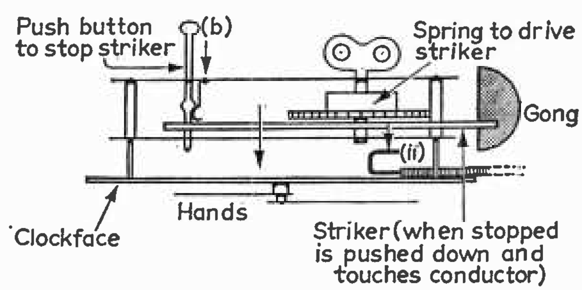


Fig. 3: Essential parts of the alarm clock movement.

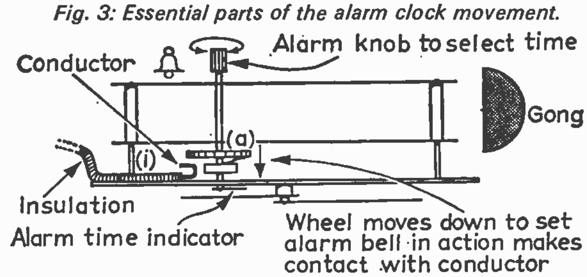


Fig. 4: Striker mechanism in the alarm clock.

to it without any insulation. The diagrams indicate how the author's alarm clock worked, and how the various parts of the clock mechanism were used to provide switching contacts. Not all makes of alarm clock work in this manner—this would be too much to hope for! However, it is hoped that these diagrams will serve as a guide for those who wish to modify different clocks. The conductors (i) and (ii) in Figs 3 and 4, were made from single-strand, stout, insulated wire. This wire is held to the rear of the clock face with Sellotape which is ideal provided that it is pressed well down to exclude air underneath. The two conductors are then joined together and connected to the jack socket on the clock case. This connection must be kept well clear of all moving parts of the clock mechanism, this also applies to the jack socket.

SEQUENCE OF EVENTS

With the clock connected to the radio set via the jack plugs and sockets the following sequence of events takes place. Assuming that the alarm has been set for 7 o'clock. When the hands reach 7, the small wheel (a) in Fig. 4, drops down and makes contact with the conductor (i). This turns on the radio and also sets the striker beating the gong. The sleepy constructor wakes and pushes the button (b in Fig. 3) on the back of the clock which normally turns off the alarm bell. This button still performs the same function but now turns the radio permanently on until it is switched off at the set. If the button (b) Fig. 3, is not pushed in, then after a lapse of some twenty minutes the wheel (a) will lift again breaking continuity and switching the radio set off thus affording battery economy. ■

THOUGHTS ON TUNERS

Hugh Wagner

THERE must be many readers who have built a high quality amplifier, fed it from some kind of tuner, and been disappointed at the results. The writer, after building a second high quality main amplifier to obtain more definite evidence of the superiority of the semiconductor type over the conventional valve type, thought it might be interesting to try out various tuners on both the amplifiers.

F.M. does not exist, as yet, in this country (Malaysia), but a.m., fortunately, is capable of very good results as we are not troubled with closely packed stations in the medium wave band. The transmitters, therefore, are able to take full advantage of the available bandwidth.

Under these conditions, an ordinary superhet tuner would not be able to do justice to the quality of the transmissions unless one could stagger its i.f. transformers to give a wider pass band. The tuner normally used with the valve amplifier was a commercial 3-transistor high quality superhet provided as a built-in extra in a well-known tape recorder. The writer was able to obtain the printed circuit board and build up his own, choosing all components carefully. With the aid of a 'scope and m.w. wobbulator, the i.f.t.'s were set for a wider pass band than had been provided by the makers. Results were judged good by all who heard it.

A crystal set was tried using a 50ft. aerial. Quality was good but there was too much man-made noise coming in as well, so further trials were abandoned. The tuner finally chosen for both amplifiers was a slightly modified version of that excellent circuit by E. J. Wotton (P.W. Feb. 1961) who had adapted the direct coupled transistor receiver described by W. Cleland (P.W. Nov. 1959). The audio from Tr4 was fed to the main amplifier (Mullard Experimental 5-watt high quality transistorised amplifier) via a 3:1 intervalve coupling transformer, the c.t. being ignored. A Radiospares 7:1 Q.P.P. transformer was also tried but this gave too much bass, and a rather shaky high frequency response. With some amplifiers, however, this might prove to be the better choice.

Due to the extremely low d.c. level in the transformer, distortion due to core saturation could be disregarded. This proved true in practice; the quality furnished by this arrangement was very high, with a silent background and no monkey chatter, in contrast to the average superhet receiver.

The quality of the tuner is sufficient to warrant making it detachable from the main amplifier, and building it into a small case, using a hearing aid Mercury cell for power, and an ER1600 type earpiece. Several versions of E. J. Wotton's circuit have been built, the smallest fitting into a tiny plastic box $2\frac{1}{8}$in. long by $1\frac{1}{16}$in wide and $\frac{11}{16}$in. deep. Naturally, there was no volume/tone control and only one station could be tuned, using two 15pF tube trimmers. Small cut down toothpaste tube caps were fixed as control knobs.

To sum up, while a good transistor superhet tuner with staggered i.f.t.'s can be relied upon to provide sensitivity and good quality, it was found that this type of tuner could not surpass the performance of E. J. Wotton's t.r.f.

Several types of transistor were tried in the converter position, in an attempt to reduce conversion noise; this effort met with some success; but the work entailed would not normally be carried out by the average person, and certainly not by the manufacturer, except during developmental work.

The exact position of the tap was found to differ with different transistors, even of the same type. The writer used Litz wire, and put on several taps, one every five turns, starting at the tenth turn. It was then easy to find the optimum position. The higher up the winding one goes, the greater the sensitivity and the poorer the selectivity. The quality also is affected, and a tap towards the *bottom* of the coil will give the best quality.

It is not mandatory to use Litz wire, and No. 32 enamelled will do almost as well. The writer used Litz wire because he has become fairly adept, through years of fiddling and cursing, at removing the enamel from the fine strands and soldering them! ■

ZENER DIODES

Comprehensive range 3v. to 50v. in three power ratings all 5% tol. 350mW 3/6 each. 1·5 watt 5/- each. 7 watt 7/6 each.

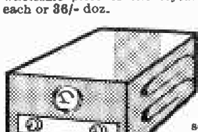
SCR's (THYRISTORS)

Piv	50V	100V	300V	400V
1 amp	6/6	7/6	12/6	15/-
3 amp	7/6	8/6	14/6	17/-
25 amp	30/-	35/-	47/6	60/-

SEMI-CONDUCTOR BARGAINS

Type No.	Price	Type No.	Price	Type No.	Price
2N1727	15/-	MAT101	8/6	OC71	3/6
2N1728	10/-	MAT120	7/9	OC72	5/-
2N1742	25/-	MAT121	8/6	OC75	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
ACY17	8/6	OA79	2/6	OC81	5/-
ACY18	5/6	OA81	2/6	OC81D	5/-
ACY19	6/6	OA85	2/6	OC82	5/-
ACY20	5/6	OA90	2/6	OC83	5/-
ACY21	6/-	OA91	2/6	OC84	6/-
ACY22	4/6	OA200	3/3	OC139	8/6
AF114	7/-	OA202	4/3	OC140	12/6
AF115	6/6	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	15/-	OC200	9/-
AF118	10/-	OC26	7/6	OC201	12/6
AF139	12/6	OC28	15/-	OC202	13/6
AF186	17/6	OC29	17/6	OC203	12/6
AFZ12	15/-	OC35	12/6	OCP71	15/-
ASZ21	15/-	OC36	15/-	ORP12	8/6
BC107	14/6	OC42	6/6	ORP60	10/-
BY100	4/6	OC44	4/-	SB078	6/6
BYZ13	7/6	OC45	3/6	SB305	8/6
MAT100	7/9	OC70	4/-	SB251	10/-

MINIATURE RELAYS with removable covers. Very sensitive (will close on only 20 mA). Coil resistance 10,000 ohms—contacts are three sets; triple set for change over pair to open circuit and the third pair to close circuit—perfect order unused (removed from equipment), 7/6 each.
Vacuum Cleaner Flex. Non-kinkable ribbed rubber, most pliable but very tough. 24/36 Cores. Normally 1/9 per yard, offered at £3 per 100 yard coil, post and insurance 8/6.
Sub Miniature Silicon Diodes. General purpose type with gold plated leads, 1/- each, 10/- per doz.
Silicon Rectifier, equiv. BY100. 750 m.a. 400v., new, perfect. 6 for £1, post free.
MAINS TRANSFORMER. Upright mounting with primary tapped 200, 220, 240 v. H.T. secondary is 250-0-250 v. at 100 mA. and it has two L.T. secondaries of 6.3 v. 1¼ amp.—unused (removed from equipment), 15/- plus 3/6 post and insurance.
"C" CORE POTTED OUTPUT TRANSFORMER. Made by the famous "Parmeko" company these are the best money can buy, we can offer a bargain 15 watt rating, centre tapped primary with secondary for 3 ohm speaker. Potted and in black stove enamelled case for upright mounting these will make your amplifier or rig look perfect at only 12/6 plus 3/6 carriage and insurance—hurry for these.
½ MEG. POTS. By Erie, standard ¼in. spindle, 1in. long, 7d. each in doz. lots, otherwise 10d.
½ MEG. POTS WITH D.P. SWITCH. Again by Erie. Standard size spindle 1in. length. 10d. each in doz. lots, otherwise 1/3 each.
MINIATURE PICK-UP. For pop records—this is made by Cosmocord—has a crystal cartridge and long play sapphire stylus—offered for less than the wholesale price of the stylus only—namely 3/9 each or 36/- doz.



BUILDING SOMETHING?

Most useful power pack with 250-0-250v 100 m.a. H.T. plus 2 x 6·3v. secondary windings and standard primary fused is housed louvred metal cabinet, size approximately 10in. x 10in. x 7in., on the front is a 2in. flush moving coil meter. Also five preset controls. Within the unit is a power pack, a lot of clear space for anything you want to fit. Below is an assortment of tag panels and components. All unused. 29/6 plus 10/- carriage and insurance.

STUPENDOUS OFFER–£11 for £2

Only recently sold for £10.9.6. Note these features: ● Long & Medium Wave ● Long dial ● Push pull output ● A.V.C. and feed back ● Ferrite aerial ● Six transistors ● Cabinet size 4¾in. x 3in. x 1½in. with carrying strap. You get everything you need and instructions. 39/6 plus 3/6 p. & p. or supplied with made up chassis 10/- extra. Battery 1/9 extra. Data separately 2/6.

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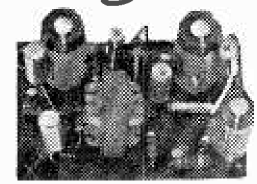

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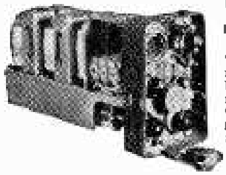

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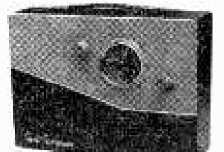

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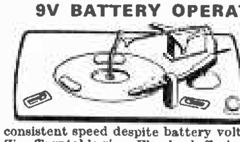

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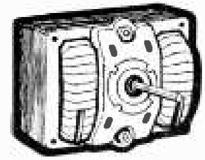

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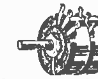

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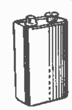

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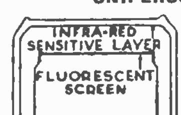

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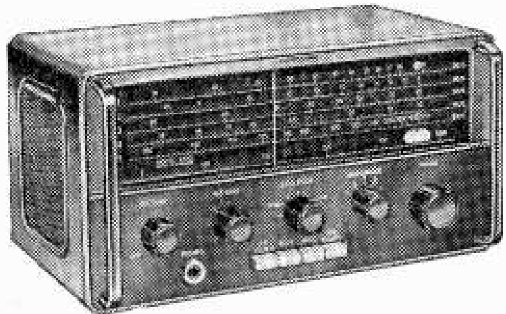

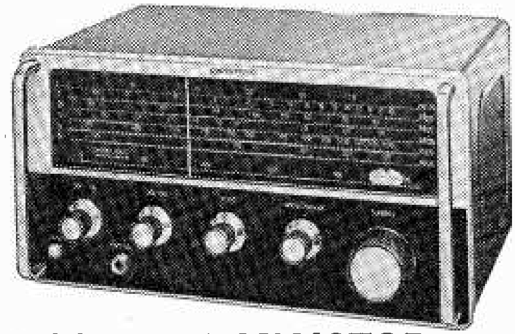

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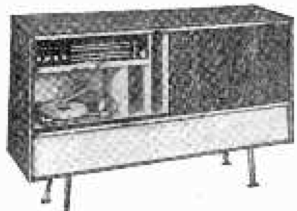

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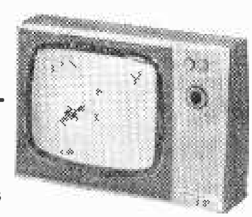

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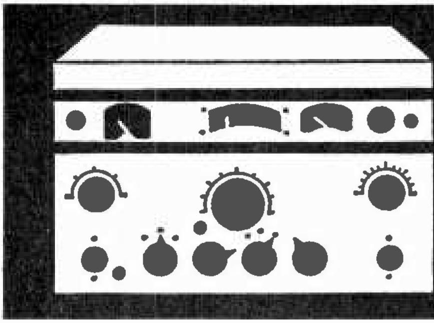


GUIDE TO SURPLUS COMMUNICATIONS RECEIVERS

K. ADKINS

This guide is intended to provide basic information of ex-service radio communications receivers that were available on the United Kingdom surplus market between 1960 and 1966. The equipment is of British, American or Canadian origin and in most cases was manufactured during the last war, or in the immediate post-war period. The report does not include receivers originally part of transceiver equipment, such as the 19 set or SCR522.

Much of this equipment can be used as purchased, no modification being necessary. Most ex-service receivers benefit from modification however, and detailed modifications are given from time to time in amateur radio periodicals. The more usual modifications are mentioned in this guide.

Some receivers require an external power supply unit which can usually be purchased separately. This is also indicated, where applicable. Certain American models with built-in power supplies were intended to operate from the American 110V mains system. These receivers can be used in this country with a suitable 110/230V transformer.

The condition of ex-service receivers varies considerably. Some, which are literally "surplus to requirements", are sold brand new in their original packing. Others may be disposed of after having served their "useful" life, but may still be in good condition. It should be noted that a receiver which is advertised as "brand new" and which has been in storage for several years, may not necessarily perform better than a second-hand one, which may have been recently realigned.

In order to give some guidance to the condition of receivers released in the period covered, a grading system has been adopted. This is as follows:

Grade 1. Brand new, unused and guaranteed.
Grade 2. Good used condition. Usually in perfect working order.
Grade 3. Fair or poor condition. May not be in working order.

For each receiver, the period of availability, condition, and retail prices prevailing at the time are given. It is emphasised that the information given is intended to be a guide to what was available between 1960 and 1966. For current availability, radio periodicals should be consulted.

The fact that a receiver may not be currently available from retail sources does not mean that the receiver is unobtainable. Perusal of the small advertisements in amateur radio periodicals will often be worth while. Prices, when sold privately, are usually a little less than the retail prices, although a good receiver in short supply may maintain a steady value for several years.

In fact most equipment will not greatly lose its value, as it is placed on the market for only a small fraction of its original cost to the services.

Although there are a few shops in the Provinces and Greater London area that sell ex-service receivers, the established hunting ground for surplus electronic equipment is the West End of London, especially in the Lisle Street, Leicester Square and Tottenham Court Road areas. When a receiver comes on the market, one will almost certainly be able to buy it in London.

Generally speaking, the supply of ex-service receivers would seem to be drying up. There is certainly not the range and quantity in the shops now that there was a few years ago. However, it can be expected that surplus equipment will continue to be released from time to time. Reliability is of prime importance in the design of service receivers, and those that have already been released will no doubt be in use in amateur circles for many years hence.

Only the essential information is included in this guide so that an unfamiliar receiver may be quickly evaluated. For more detailed information and alignment instructions, etc., the official handbook or manual should be consulted. These can often be obtained from the small advertisements in amateur radio periodicals, although they are sometimes supplied with the receiver when purchased new.

This report, written particularly with the amateur in mind, has been compiled after a lengthy study of the market in surplus communications receivers, and it is hoped that it will be of use to anyone contemplating the purchase of this type of equipment. The survey has been undertaken independently, and there is no connection between this report and any supplier or retailer of surplus radio equipment.

It is regretted that it is not possible to accept queries concerning the current availability of surplus communications receivers and neither can modification details be provided, as this information can be obtained by consulting the amateur radio periodicals. Much of the equipment detailed in this guide was not available on the surplus market in the summer of 1966, although readily available on the second-hand market.

Finally, although the information given in this report has been checked as far as possible and is believed to be complete, it is inevitable that there have been some omissions, and possibly some mistakes. The author would be most grateful to have any inaccuracies pointed out.

AR88D AR88LF

The AR88D, manufactured by R.C.A., first appeared about 1940. They were made in large numbers for service use, and they have always been very popular with the amateur. The mechanical design and construction is superb. The receiver covers 540kc/s to 32Mc/s in six bands. It has mechanical bandspread with a logging scale. The set contains a built-in power supply, suitable for 110V or 230V. The AR88D contains 14 valves, as follows:

1st R.F. Amp.	6SG7.	Det/A.V.C.	6H6.
2nd R.F. Amp.	6SG7.	Noise limiter	6H6.
Mixer	6SA7.	Audio Amp.	6SJ7.
Oscillator	6J5.	Output	6K6.
1st I.F. Amp.	6SJ7.	B.F.O.	6J5.
2nd I.F. Amp.	6SJ7.	Voltage Reg.	VR150.
3rd I.F. Amp.	6SJ7.	Rectifier	5Y3.

The i.f. is 455kc/s. The sensitivity is from 1·5 to 2·5 microvolts per 500mW. The audio output is 2·5 watts to a 2·5Ω loudspeaker or 600Ω line, or high impedance headphones. Other features are auto and manual volume control, and auto and manual noise limiter. Other panel controls are r.f. and a.f. gains, b.f.o., and variable selectivity with crystal filter. The receiver measures 19¼in. x 11in. x 19¼in.

Modifications. Realignment will vastly improve the performance of a receiver that has been in storage for a long time, and the AR88D is no exception. As with many receivers of this type, a common modification is to replace the r.f. stage valves with miniature types, but is should be stressed that this is not an easy job, and may not effect a great improvement. For s.s.b. use, a worth while modification is to increase the b.f.o. injection.

Availability. A constant supply of AR88D's seems to be available. Most of them fall into the category of grade 2; very few are available brand new. Prices of grade 2 receivers range from £30 to £50, depending on the exact condition. Grade 1 receivers, when available, are about £70 or £80. In 1961 or thereabouts, a few were available completely rebuilt with new P.V.C. wiring. These were priced at £75.

AR88D's are readily available on the second-hand market. AR88D spares, such as i.f. transformers, have been quite easy to obtain in the past, and some were still available at the time of writing this. The AR88D manual is quite common and can often be purchased for £1 when buying an AR88D. It should be quite easy to obtain a manual second-hand.

AR88LF

The AR88LF is similar to the AR88D, the main difference being the frequency coverage 75kc/s to 550kc/s, and 1·5Mc/s to 30Mc/s. The i.f. is 735kc/s. The LF model has only two tappings on the mains transformer. These are 230V and 115V, but the 230V tapping should be adequate for most mains supplies in this country. The other difference of any importance is that the output valve is a 6V6 instead of a 6K6.

Modifications. See AR88D. In addition, the replacement of the single filter with a half lattice filter, will give improved performance. This modification could also be applied to the AR88D.

Availability. Here again, most AR88LF's were released in grade 2 condition. AR88LF's are perhaps somewhat less common than AR88D's. Very rarely are they available in grade 1 condition, although as in the case of the AR88D, some were sold in 1961 for £70, rebuilt with P.V.C. wiring.

AR88LF's can be obtained on the second-hand market, and the position regarding spares is similar to the AR88D. The AR88LF manual is much scarcer than its AR88D counterpart, although no doubt the AR88D manual would be of use for alignment of the AR88LF receiver.

BC312 BC342

These receivers were used by the United States Army Signal Corps. The two receivers are identical apart from the power supply but for convenience only the BC312 will be mentioned by name. Both receivers have a very good reputation, but they are rather scarce in this country. There have been several versions of the two receivers, differing only in minor respects. These are designated BC312A, BC312C, BC342M, BC342N, etc.

The mechanical and electrical construction of this receiver is superb, and reliability under adverse conditions was obviously a major factor in the design. The frequency range is 1·5 Mc/s to 18Mc/s in six bands, and the i.f. is 470kc/s. The valve line up is as follows:

6K7 1st R.F. Amp.	6K7 2nd I.F.
6K7 2nd R.F. Amp.	6R7 Det/A.G.C./Audio.
6C5 oscillator.	6C5 B.F.O.
6L7 mixer.	6F6 Output.
6K7 1st I.F.	5W4 Rectifier.

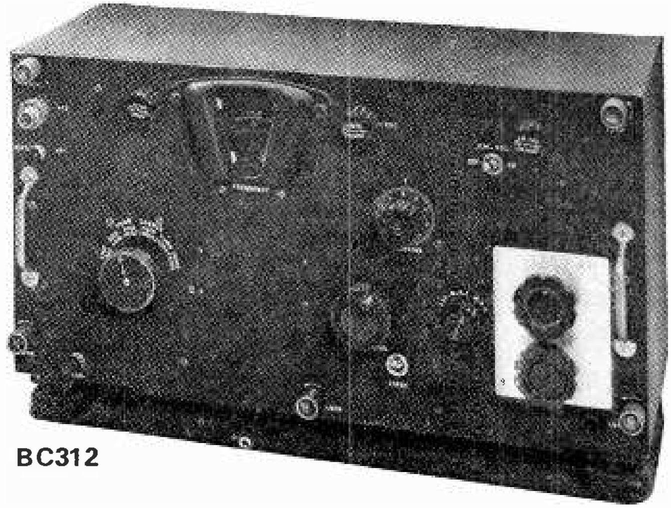
Drift is minimised in this receiver by stabilisation of the oscillator. The tuning mechanism is directly calibrated with fast and slow vernier tuning. Other controls are antenna trimmer, b.f.o. control, and a.v.c./m.v.c. control. Sensitivity is 4 microvolts at 1·5 Mc/s and 2 microvolts at 18Mc/s. Bandwidth at 2Mc/s is 14kc/s at 20dB down. Output impedance is 250 or 4,000Ω. The size of the BC312 is 10in. high x 18in. wide x 10in. deep, and it weighs 65 lb.

As stated earlier, the BC312 and BC342 differ only in their power requirement. The BC312 operates from 12V d.c. and the BC342 from 115V a.c.

Modifications. The BC312 can be modified for mains operation by replacement of the internal 12V power unit with a mains version. This will involve rewiring of the valve heaters. The BC342 will operate from the British 200—250V a.c. supply, if a suitable step down auto-transformer is used.

Several modifications have been published for these receivers. The r.f. stages can be made more efficient by suitable alteration of the component values. Similarly, the crystal filter could be modified as it severely reduces the sensitivity.

The audio section of the BC312 can easily be modified in several ways. The headphones should preferably be connected after the first audio stage. The output transformer should be changed so that a normal 3Ω speaker can be used. For more output, the 6R7 det/a.v.c./audio valve should be replaced with a 6Q7, although the cathode bias resistor must be altered if this is done.



BC312

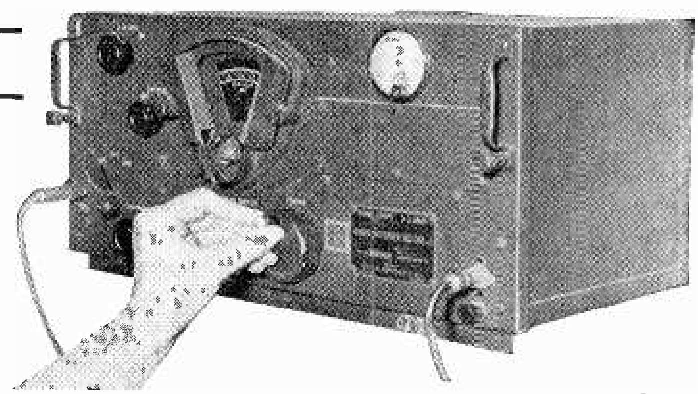
Other well-known modifications are the addition of a noise limiter, "S" meter, and a separate r.f. gain control. These modifications apply to both the BC312 and the BC342.

Availability. As this is an American receiver, relatively few have been released in this country. But nevertheless a surprisingly large number of them exist, although they do not change hands very often. One generally considers oneself lucky to get one.

Since 1960 there have been two releases of these receivers in this country, both in very limited quantity. In 1961 both versions could be obtained for about £22 to £25 in grade 2 condition. In 1962, 1963 and 1964, they were unobtainable from British sources, but a few were again placed on the market in 1965 for £22 in grade 2 condition, although they are believed to have been reconditioned.

They are not currently available on the surplus market, but it should be possible to obtain one second-hand. Owing to the popularity of these receivers, and the large numbers of them in existence, especially in the USA, it should not be too difficult to obtain a manual.

BC348



The BC348 receiver was used by the United States Air Force, and was designed to operate from a 28 volt d.c. supply. It is extremely compact. The receiver exists in many versions, denoted by a suffix letter, although they are electrically and mechanically similar.

The receiver covers 200kc/s to 500kc/s and 1·5Mc/s to 18Mc/s. The i.f. is 915kc/s. The BC348 contains 8 valves as follows:

6K7 1st R.F. Amp.	6K7 1st I.F.
6K7 2nd R.F. Amp.	6F7 2nd I.F. and B.F.O.
6C5 oscillator.	6B8 3rd I.F. and Det.
6J7 mixer.	41 Audio.

Output impedance is 500Ω or 4,500Ω.

Modifications. The BC348 is quite a popular receiver, especially in the USA, and several modifications have been published.

The first and obvious modification is to replace the 28 volt d.c. power supply with a 200-250 volt power unit, although it is more usual to build this as an external unit, in order to avoid excessive heat in the receiver. The valve heaters will have to be rewired for 6·3 volt operation.

The output transformer should be replaced with one that will match a 3Ω loudspeaker. An "S" meter is a useful addition.

An extra audio stage can be added to the BC348, with advantage. The addition of a noise limiter is also recommended. Separation of the audio and r.f. gain controls, which are originally on a common shaft, is well advised.

Availability. Although the BC348 is very popular in this country and is well sought after, no record could be found of any release of these receivers in the last six years. It is therefore assumed that those receivers that exist were released before 1960. As such, the BC348 does not, strictly speaking, come into the scope of this report, but it was included as it is so popular and is usually associated with the BC312 and BC342. It should be quite easy to obtain one second-hand for about £10 to £15. BC348 manuals probably exist in small quantities.

CONTINUED NEXT MONTH

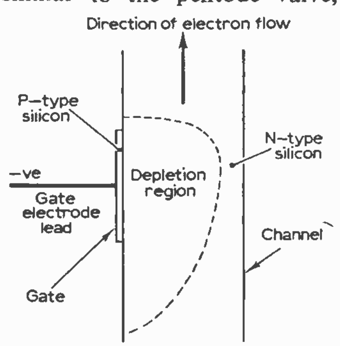
get acquainted with F

GREAT strides have been made in the transistor field in the last ten years or so. Performance figures have improved and prices have fallen so that the home constructor can design the majority of his equipment around semiconductors. Now a new type (well, new to most readers) of semiconductor device is appearing on the market at a realistic price—the field effect transistor. It is so-called because an electric field due to a reverse voltage on a controlling electrode, (called a gate) governs the magnitude of the current flowing between the device's two other electrodes. This action is illustrated in Fig. 1.

The effect of reverse biasing the gate is to cause the p-type region to become depleted of positive carriers (i.e. holes) and thus an electric field is created which extends beyond the p-n junction and into the main current path in the n-type silicon (called the channel). Figure 2 shows the symbol for an n-channel f.e.t. in which the current carriers in the channel are negative (i.e. electrons). It will be seen that the other electrodes are called the source and drain. The device can be considered as a semiconductor triode for it is a very close analogue to the thermionic valve. Its characteristics are, however, similar to the pentode valve, comparing the corresponding electrode behaviour. Thus, if a particular reverse bias is established on the gate, varying the drain to source voltage produces a current graph very similar to the pentode valve Ia versus Va for constant Vg set of curves, see Figs. 3 and 4. The main difference occurs in the magnitude of V_{DS}, which is usually about 1/10 of Va.

PRINCIPLE OF OPERATION

Figure 1 only shows the principle of operation, for in a practical f.e.t. the gate would extend around more of the channel and in some high-performance types a so-called interdigitated form of gate is fabricated in the main silicon structure. As the voltage applied to the gate is a reverse voltage, the current flowing in the gate-to-source circuit is extremely low, of the order of 10^{-9}A (i.e. in the nanoamp region). Thus, the gate-to-source input resistance is very high. The d.c. resistance values range from hundreds to thousands of megohms, but owing to the rather high input capacitance, mainly associated with the lower priced types, the input impedance (mostly capacitive reactance) falls to a few megohms at audio frequencies and to several kilohms at radio frequencies. Tuned input circuits



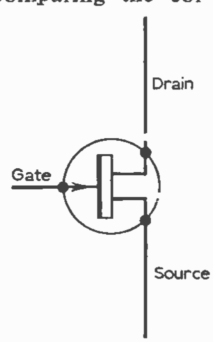


Fig. 1 (left): Note how the gate controls source-to-drain current through the action of the depletion region.
Fig. 2 (right): Symbol for the n-channel f.e.t.

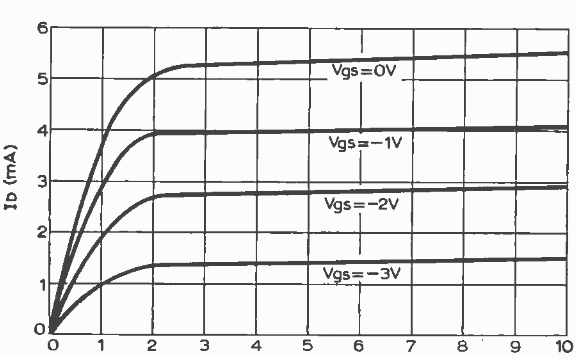


Fig. 3: I_D—V_{DS} characteristics for a f.e.t.

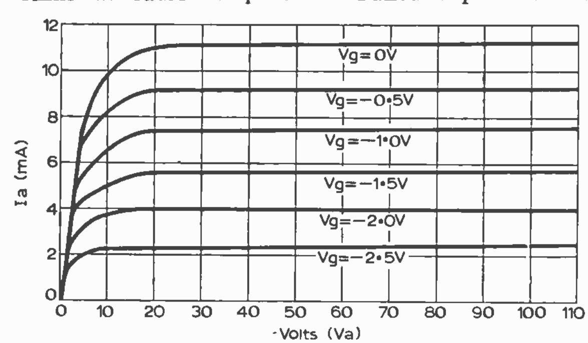


Fig. 4: I_a—V_a characteristics for a pentode valve. Note the similarity of these curves with those shown in Fig. 3.

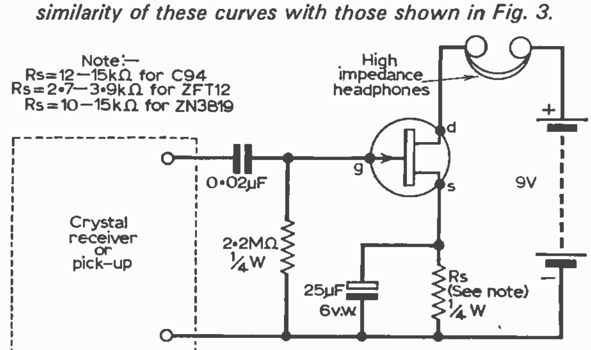


Fig. 5: Simple single stage audio amplifier. Types C94 (Semitron), ZFT12 (Ferranti) and 2N3819 (Texas) field effect transistors are suitable so long as the value of Rs is correctly chosen—see note in top left-hand corner

E.T'S R.FINCH

are necessary to "accommodate" the input capacitance in order to obtain worth-while amplification at radio frequencies. Using a high 'Q' parallel tuned circuit as the input to the gate allows a high degree of circuit magnification to be obtained as the very high input resistance of the f.e.t. presents practically no load to the tuned circuit. In this respect it is similar to the thermionic valve when the grid is negatively biased. This does not affect the "natural" selectivity of the tuned circuit in much the same way as the negatively biased grid valve amplifier or detector stage. Circuits developed for the valve can thus be used directly or adapted for the f.e.t.

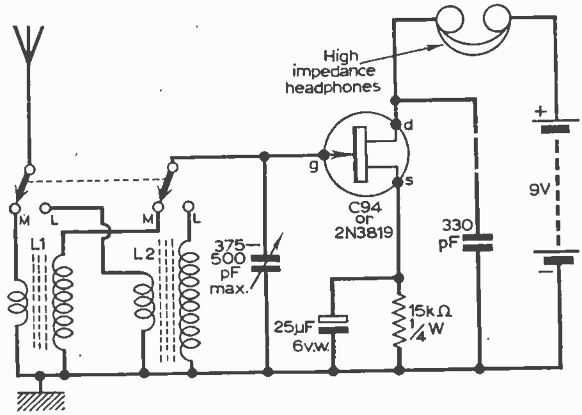
TWO VARIETIES

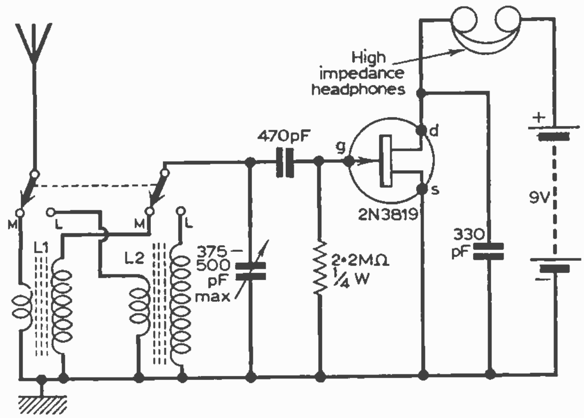
Before describing practical f.e.t. circuits, it should be mentioned that, like ordinary transistors, they can be obtained in two varieties, called n-channel (already mentioned), and p-channel. In the latter type the current carriers in the channel are holes, and the reverse bias applied to the gate is positive in polarity. To appreciate the similarity of f.e.t.'s to valves the simple audio amplifier stage shown in Fig. 5 can be built up using the f.e.t.: types C94 or ZFT12. Voltage lines are, of course, very much lower.

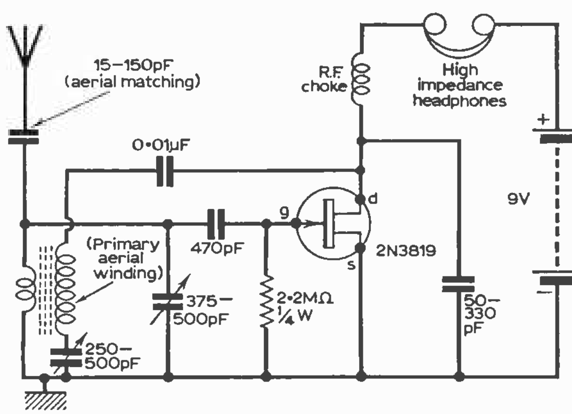
The drive to the input of the f.e.t. stage could be from a simple crystal set. As the parameters of f.e.t.'s, like those of transistors, vary over a value range of about 3-1, it may be necessary to use resistance values above or below those indicated to achieve optimum results. In the simple audio amplifier stage of Fig. 5, the source should be adjusted to give a drain current of ¼ to ½ mA so as to provide the best match for the headphones.

'ANODE BEND DETECTOR'

The next circuit to be described, an anode bend detector, is again similar to its valve counterpart, see Fig. 6. Perhaps by analogy it should be called a drain bend detector: The coils used are the same as for a valve version. No special precautions as regards to layout need be observed, other than the connections between the f.e.t and tuning coil should not be too long (breadboard type of construction is quite satisfactory). For good results a







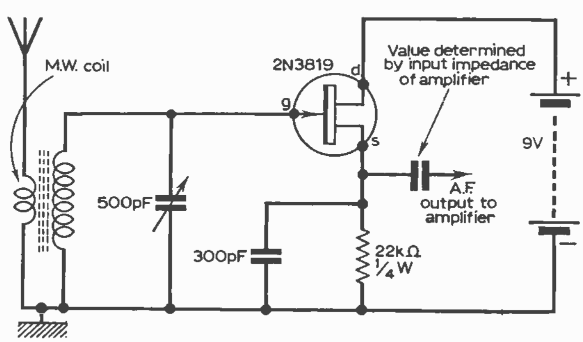


Fig. 6: Detector/amplifier for medium and long waves.

Fig. 7: F.E.T. equivalent circuit of the leaky grid detector.

Fig. 7a: "Leaky grid" detector with positive feedback to increase sensitivity and selectivity. The feedback winding may need to be reversed for maximum signal.

Fig. 8: Infinite impedance detector. This is claimed to produce less harmonic distortion than any other triode detector.

fairly high aerial is required to present sufficient signal strength to the detector. A water-pipe earth is satisfactory.

'LEAKY GRID' DETECTOR

The counterpart to the leaky grid or grid detector valve circuit was tried, but results were not as good as from the previous circuit. There are probably two reasons for this. In the valve the electrons are shot off from the cathode with a certain amount of thermal energy and thus a certain proportion of them reach the nearby grid even when this is slightly negative. These thermal electrons produce a standing bias on the grid, and the r.f. modulated carrier adds to and subtracts from the steady potential with a greater decrease of anode current than increase, producing rectification. The second reason is that the valve possesses a relatively low input capacitance. This is of the order of 2pF, whereas the corresponding input capacitance of a f.e.t. may be 20pF. Thus the carriers are not encouraged to reach the gate in a f.e.t. when the gate-to-source voltage is zero, as is the case in a circuit corresponding to the leaky grid detector. But the second reason is probably the more important for the rather large input capacitance shunts the gate-to-source diode and considerably reduces its rectifying efficiency. However, for those readers who would like to try another type of old established (and at one time the most popular) detector circuit, a suggested form is shown in Fig. 7. A similar circuit with positive feedback (reaction) is shown in Fig. 7A.

One advantage the anode bend detector has over the leaky grid detector is that it does not load the tuned circuit, thus the selectivity of this variety of detector is better than the leaky grid, or diode detector as used almost exclusively in superhet receivers.

The next circuit shown is a modification of the anode bend or "drain bend" detector. This is the so-called infinite impedance detector. It derives its name from the fact that the multiplication of input capacitance (due to the Miller effect) is absent as the circuit is really a cathode follower configuration. The input impedance at r.f. is higher than in the anode bend circuit. One reason for using an infinite impedance detector is that it produces less harmonic

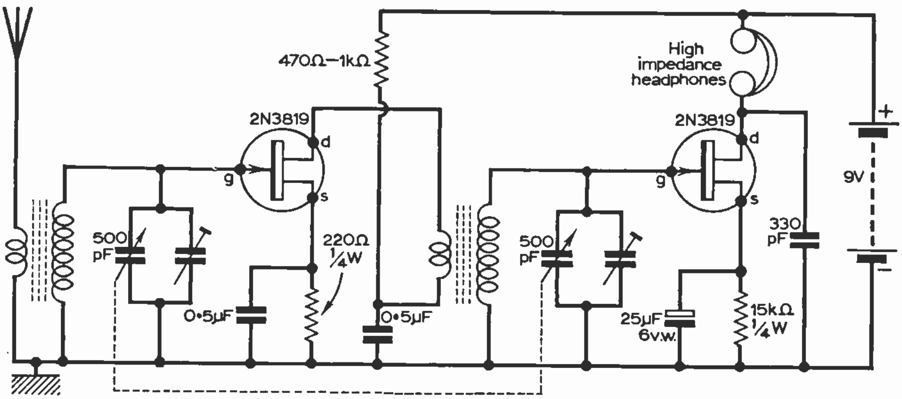


Fig. 9: Simple receiver comprising an r.f. amplifier and a drain bend detector.

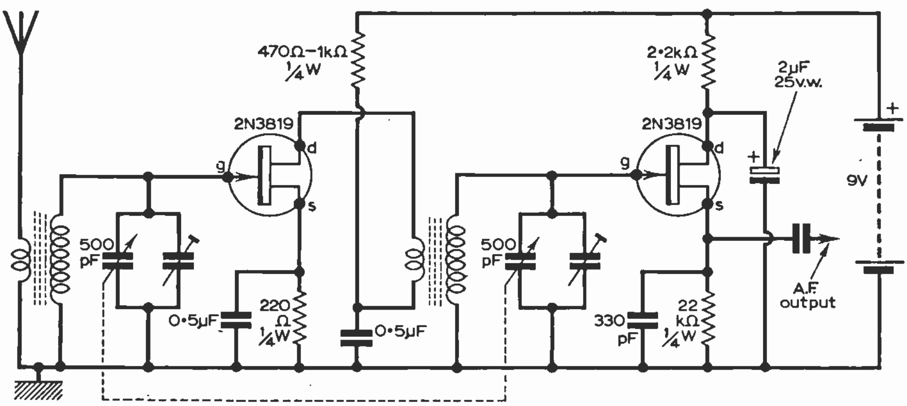


Fig. 10: Another simple receiver. This time comprising an r.f. amplifier and an infinite impedance detector.

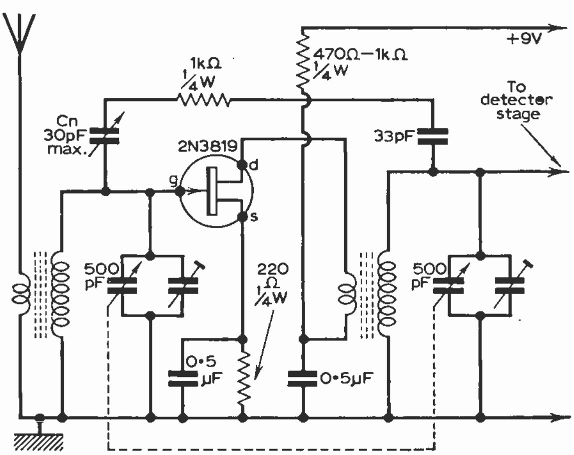


Fig. 11: Note how neutralisation is provided in this one stage front end. The secondary of the 2nd. r.f. transformer may need to be reversed if adjustment of the variable capacitor Cn does not stop oscillation.

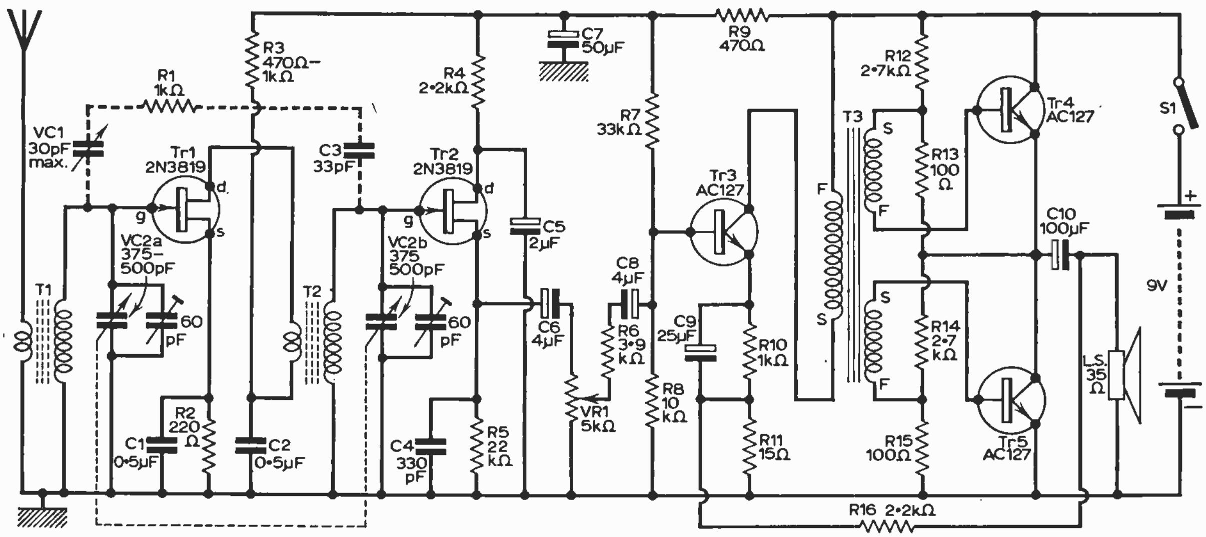


Fig. 12: Hybrid receiver using field effect transistors in the front end and conventional transistors in the audio stages.

distortion than any other triode detector circuit. The f.e.t. can be used in this circuit to the same advantage. Since there is no voltage gain, but an impedance transformation from very high to fairly low impedance (which implies that there is current gain) it may provide a useful output if it has to be carried some distance. Figure 8 shows the f.e.t. used as an infinite impedance detector.

R. F. AMPLIFIER

Coming now to the use of the f.e.t. as a radio frequency amplifier, one may refer to the basic valve circuits. Figure 9 shows an r.f. stage followed by a drain bend detector, while Figure 10 shows an r.f. stage followed by an infinite impedance detector. If a f.e.t. with a high Yfs* (forward admittance in common source) is used in the r.f. stage, the circuit will most likely be unstable over part if not all of the tuning range: to positive feedback from drain to gate. One way of stabilising the stage is to reduce the drain current by increasing the value of the drain decoupling resistor. A better way is to provide some kind of neutralisation, see Figure 11. The secondary of the 2nd r.f. transformer may need to be reversed if adjustment of Cn does not stop oscillation. Excellent selectivity will be obtained with these circuits. The ability to separate adjacent stations is much better than that of a similar two stage conventional transistor t.r.f. receiver. This is due in part to the non-loading properties of both r.f. and detector stages, and in part to the square law transfer curve of the f.e.t. The low resistance output of Figure 10 allows it to feed directly into a transistor audio amplifier to combine a f.e.t. front end and conventional transistor output see Fig. 12. With the recommended speaker impedance, an output power of approximately $\frac{1}{4}$ watt is obtainable.

For those whose special interest lies in short waves, the simple receiver of Fig. 6 may be adapted using the appropriate coils. For the popular 25 metre band these may be home made using 6 turns for the aerial coil, and 13 turns for the secondary, on a $\frac{3}{4}$-in. former (22 swg wire, spaced by its own diameter). If a special low capacitance tuning capacitor is not available, a twin-gang 0·0005μF may be used by connecting one section in series with the other, see Fig. 13. The moving plates are already joined by the framework of the twin-gang, so the series connection halves the capacitance change for the same angle of rotation, as compared with the normal method of connection.

All of the circuits described are straightforward. This has been done for two reasons. Firstly, f.e.t.'s are still rather expensive, compared with conventional types of transistors, and complexity of circuitry tends to lead to wiring errors which can prove costly. Secondly, familiar circuits lead to a rapid understanding of technique when a new component (namely the f.e.t.) replaces an existing one.

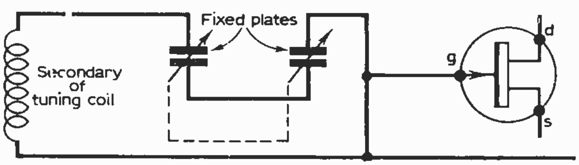


Fig. 13: Method for reducing capacitance.

Using f.e.t. types now available a hybrid f.e.t.—conventional transistor portable radio receiver could be built with a better performance than those in current use. It would probably use f.e.t.'s in the frequency changer, i.f. and low level a.f. stages, with a conventional transistor output stage.

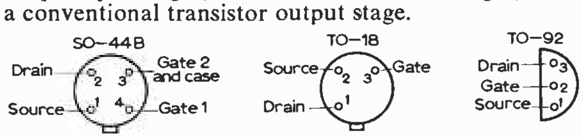


Fig. 14: Base connections, reading left to right, ZFT12. C94 and 2N3819.

Development is proceeding fast on devices for the medium power range. F.e.t. tetrodes with transconductances up to 10mA/V and low reverse feedback capacitance (less than 2pF) are just coming on to the market. It will not be too long before they come within the reach of the home constructor ■

*Formerly called gm (i.e. mutual conductance) by analogy with the thermonic valve.

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

CENTRAL AMERICA

Cuba *Radio Habana Cuba* (Apartado de Correos 70-26, La Habana Cuba) now transmits in English as follows: 2010-2040 15,285; 2050-2150 15,270/15,300; 0100-0450 6,170; 0100-0600 11,760; 0330-0600 6,135; 0630-0800 9,655.

Netherlands Antilles *Trans World Radio* (Bonaire) reported using 9,695 for the 0230-0355 English TX.

SOUTH AMERICA

Colombia *Radio Nacional* (Apartado Nacional 1824, Bogota) now active again over HJZP on 15,335.

Ecuador *La Voz de los Andes* (HCJB) (Casilla 691, Quito) reported using 15,385/17,880 to Europe 2000-2200. English is at 2100-2130. A different QSL card is being offered every two months throughout 1967.

EUROPE

Albania *Radio Tirana* (Rue Ismail Quemal, Tirana). Schedule appears to change almost weekly. English seems to be: 0000-0030 11,715; 0230-0300 9,715; 0400-0430 7,265; 0630-0700 9,715/11,715; 1500-1530 7,265/1,214; 2000-2030 7,265/9,390; 2200-2230 9,390. Another TX 9,725 is reported to have replaced 6,157. A new outlet noted in the m.w. band is 1,394.

Andorra *Radio Andorra* (Obispo Catala 40, Barcelona 17, Spain) in a verification letter states that an English service is under discussion. At present the station transmits in Spanish and French from 0500-2400 on 719/5,995.

Bulgaria *Radio Sofia* (4 Boulevard Tsankov, Sofia) now uses 11,800/6,070 for English to Europe at 1930-2000 and 2130-2200.

Czechoslovakia *Radio Prague* (Praha 2, Vinohradska 12) now uses 6,055/11,990/15,310/17,840/21,735 at 1530-1625 and 5,930/7,345/11,990/17,840/21,620 at 1730-1825 for English to Africa.

Denmark *Radio Denmark* (Shortwave department, Radio House, Copenhagen V) in Danish at 2200-2245 and Spanish 2245-2315 to South America on 15,165. English DX programmes are now on Wednesdays at 0805, 1305, 1505 and 1935.

France *O.R.T.F.* (Maison de l'O.R.T.F., 116 Avenue du President Kennedy, Paris 16) now uses 9,500/7,160 for the 0515-0530 English transmission. Kabyl is now aired at 1900 and Arabic at 1915-2200 on 7,280/9,585.

Germany (West) *Deutsche Welle* (Bruederstrasse 1, Postfach 344, 5 koln) has made frequency changes in the following English TX: 0300-0340 9,530/11,945; 1550-1620 15,435/17,875; 2145-2205 11,925/15,275; 0130-0250 9,640/11,945; 0445-0545 9,735/11,945; 1045-1055 11,905/15,315; 1900-1910 15,245/17,785. There are also English transmission at 1045-1055 on 9,765/11,905; 1900-1910 15,380/11,925.

Germany (East) *Radio Berlin International* (116 Berlin Nalepastrasse 18-50) reported with the following unconfirmed English schedule: Over 5,960/7,180/9,525 at 1730, 2015, 2200 and 2300; over 17,765 at 1200, 1315, 1415 and 1600; over 11,920 at 0100, 0230, 0345, 0445 and 0615; over 21,620 at 1215, 1600; over 15,245 at 1915.

Holland *Radio Nederland Wereldomroep* (P.O. Box 222, Hilversum) now using 6,020/17,810/21,480 for its 1430-1550 English transmission.

Hungary *Radio Budapest* (Budapest) has a revised English schedule: 2130-2230 21,685/17,890/15,160/11,910/9,833/7,220/7,210/6,234/3,995; 2330-2400 6,234/3,995/539; 0030-0130, 0300-0400, 0430-0500 15,160/11,910/9,833/7,220/6,234. In addition at 0800 and 1015 there is an experimental DX programme TX over 17,890/15,160/11,910 beamed to the Far East and Asia.

Italy *R.A.I.* (via del Babuino 9, Rome) has a revised English schedule: 0100-0120 15,410/11,810; 1935-1955 11,925/9,710/7,275; 0425-0440 7,275/6,050; 2025-2045 11,925/9,575/7,235; 2200-2225 17,740/15,310/11,905; 0350-0410 21,560/17,770/15,310.

Norway *Radio Norway* (Oslo). Latest schedule is: 0300-0430 9,645/11,735/11,850/1,578; 0700-0830 11,850/15,175/17,775/21,655/21,730; 1100-1230 7,240/15,175/17,825/21,655/21,730; 1300-1430 and 1500-1630 15,345/17,825/21,655/21,670/21,730; 1700-1830 11,850/17,825/21,655/21,670/21,730; 1900-2030, 2100-2230 15,345/17,825/21,655/21,730; 2300-0030 11,735/15,175/15,345/21,655/1,578. On Sundays the last half-hour is in English.

Poland *Radio Warsaw* (Warsaw). English for Australasia now over 15,275/11,815/9,675 at 0730-0800, 0830-0900. To Africa 1200-1230, 1300-1330 7,125/11,800 (11,815 announced)/15,275; 1900-1930 9,675/11,885; 2200-2230 7,125/7,145/9,540/9,675/11,800.

Portugal *Radio Portugal* (Rua San Marcal 1-A, Lisbon) now airs its DX programme weekly on Mondays in all English transmissions. A 10kW relay station is now in operation at Sao Tomé (Portuguese West Africa) which carries the English service for Africa at 2145 over 4,807.

Rumania *Radio Bucharest* (Bucharest) now uses 9,570/11,940 at 1930-2030 and 9,570/7,225/155 at 2230-2300 for English to Europe.

Sweden *Gothenburg Radio* (Omsala). This station (see June P.W.) is a maritime station. It has been testing on SA6 11,120 at 0700, 1223 and 1715. Good reports are welcome and quickly verified.

Contributors this month included A. Cook, R. Patrick, Radio New York Worldwide, I.N. Newport, Mrs. M. D. Collyer, National Radio Club of Malta, O. M. Brechin, J. K. Bradley and A. E. Roxburgh.

NOT a very exciting month this time. Many s.w.l's bemoaned the absence of anything worth while and criticisms were even levelled at faithful old twenty. Ten metres has proved a right little r.f. cemetery in spite of hopes that it would be even better than last month. On forty metres, even the commercials were a couple of "S" points down so things must have been bad. Eighty and 160 have been very active in my area but only with locals, usually s.s.b. gatherings of the elite.

I will be /P again from July 1st to 9th, all reports welcome. News has just arrived that there will be a station on Clipperton Island soon (FO8), also Cocos Island (TI9) and Malpelo Island (HKØ) will be emitting r.f. on twenty c.w. and probably s.s.b.

WHEN

Many listeners write in to say that they don't hear anything like the DX mentioned in some of the logs, and would like to know just when to listen. Ten metres is a little difficult to predict exactly as the openings come and go. This is true of the other bands and there are times when even twenty metres is completely dead. The following are suggested as a guide (not as a dogmatic statement) for the times when the bands are open. 160, 0400-0600; 80, 2200-0600 with Oceana (VK/ZL) usually around 0500; 40, 2100-0500; 20, 2000-0800; 15, 1400-2300; 28, 1000-2000. This doesn't mean that you won't hear anything outside these times, but propagation figures indicate that the times quoted are the most likely.

LF

V. Budas GM3VTD (Glasgow), 640, 20ft. end-fed heard these on 40 s.s.b.—CN8AW, CT1BB, DJ4AY, DL8PG, EI5P, EI8AT, GW3MTL, I1KDB, K4HUL, K5ZSX/MM, KZ5KI, LA9VK, OY7J, PY7APZ, PY7MIN, TZ1CF, WA—1FSF/4, 2AZ, 2BHK, 3BOY, 4CIV, 4EEQ, XW8OG.

ISWL G11195/BRS 28198 (Sussex), EA12 20 metre dipole roamed 7Mc/s for these on s.s.b.—CN8AW, CN8BB, PY1JV, PY4ND, PY6NW, PZ1CF, TI2NA, W8DKV, WB4EOL, YV1PI, YV3KX, YV4QQ.

Paul Baker (S. Wales) reckons that there is less QRM on forty, especially around 2200 and hears Pacific DX early mornings. His s.s.b. log reads—CN8AW, CN8BV, OHØNI, PY7AIN/Ø, UW9AF, VK2-RO, ABZ, 4PZ, W1ZJ/P, W3FBK, YV—1PW, 7DK, ZL2BCG.

HF

Well, some people have listened at just the right times as the following logs prove.

D. Varley (Notts), CR170A plus PR30, RQ10 Q multiplier, folded dipole indoors at 20ft. says Ten is a'buzzin. He logged these mostly on a.m.—LU7BC, LU8DB, LU4EZ, PY2BIR, PY2DJJ, PY4AP, UA4PGV, UA6AXW, UA9FFB, UA9FOB, UB5BWR, UF6FFZ, UL70B, YO7VJ, ZC4MO, ZE2JA, 9G1DM.

L. Rowland (Cheshire) says that 15 is wide open most days and is usually still going strong after 2200. His Trio 9R—59 and 150 ft. end-fed managed to hook — CE—2OS, 3KNY, 3PR, 3ZN, CN8MT, CN8FC, CP6GX, CR6GM, EL2O, EP3AM, EP3RO, HC1WJ, HC4SX, JA1EOD, KG4AN, KP4BCL, KV4FA, KZ5JS, KZ5SL, MP4BBW, MP4PBO, MP4TBR, PY1TX, PY2RU, PY6BM, PY7GVP, SVØWKK, W6BTE, WB6RLF, W6ZPX, W7GXE, XW8DJ, YV5YVS, ZD3I, ZS2H, ZS6ADF, ZS6AKO, ZS6BRI, ZS8L, 4X4AM, 4X4VB, 5A3TN, 5A4TH, 5R8AS, 5Z4JW, 9G1BY, 9H1S, 9H1AG, 9M2BO, 9M6JP, 9Q5CZ, 9V1MT.

E. Care (London), CR70A plus PCR30, folded dipole did very well on 28Mc/s. On a.m. he logged —CE3PT, CR6AB, HI8XL, LU3PHA, LU7FAG, MP4BGL, OD5AT, PY1AGP, PY2JM, PY4AP, PY8SV, UF6HI, UL7OB, UT6FGF, ZC4GV, ZC4MO, ZE1CZ, ZE2JA, ZS2OP, ZS6AFG, ZS6RO, 4X4IH, 5N2ABA, 9Q5JW, 9Q5ZD. On s.s.b. the best were—HC1KB, K6JBA/MM (in the Red Sea), KP4GPU, LU1BH, MP4QAB, OA4JR, OD5FA, PY1DVH, PY2AVA, PY7PAJ, VP2CI, VP9FB, W6BCB, W6BIC, ZC4SS, ZS1VX, ZS6GH, 5A4TZ, 5Z4SS, 9J2VX, 9Q5BD, 9U5DP, 9V1FF.

J. Preece (Cheshire), PCR3, 60ft. l.w. listened on 15 a.m. for—CE3UQ, CN8MJ, CR4BA, CR6HK, CT2AP, CT3AM, CX8XD/MM, FM7WN, HK5AZA, KL7FX, KR6BF, MP4BBA, PJ4AF, PY8SV, SU1AL, TG4GT, UN1KAM, VP9DL, YV3FB, ZC4MO, ZL2UD, ZS6LF, 4X4LL, 4Z4AO, 5N2ABN, 6W8PAZ, 9G1FL, 9H1M, 9Q5BR, 9X5CC.

D. Henbry (Sussex), 0V0 receiver, Joymatch into a 7ft. vertical at 30 feet. On 14Mc/s s.s.b. David logged—CR4BC, CR5SP, HI8LAL, HK3LT, HV3SJ, KR6MB, KZ5US, TR8AG, UA1CK/JT1 (this is a rare one), VK3ARX, VP6WR, VP8IU, VQ9EF, VS9ALV, XW8AX, YS2CS, ZD3G, ZD9BH, ZC8ML, 3V8BZ, 5H3JR, 5Z4IR, 6O1AU, 7Q7BN, 9K2AM, 9Q5HF, 9X5CE. How about a circuit for the 0V0 OM?

W. Smith (Lancs.), P.W. progressive s.w. superhet, 60ft. end-fed. On fifteen s.s.b. Bill heard—CT1LN, EL2F, G3OUL, K1SOU/MM, K5QWZ, K8KKV/MM, KØRTH, KP4BDP/P, KV4CX, MP4MAX, OD5BZ, SVØWH, UB5WF, VQ9BC, WA1BJY, W2—BAI, PFL, PPG, W4AQV, W5HZ, W6CDJ, W7GXC, W8KVT, W9IRJ/VE3, WØSII/P, ZB2AZ, ZS6AKO, 4S7PB (Ceylon), 4X4AM, 5A3TZ, 5H3JR, 5Z4JX.

HERE AND THERE

TT8AD and TT8AB both at Fort Larry Tchad on 15 a.m. mostly speaking French. ST2SA at Port Sudan on 15 a.m. I1TRA on Ischia Island in the Bay of Naples is on 15 s.s.b. I used to work Tom on Sundays on 20 a.m. 3V8BZ on 20 s.s.b. from Tunisia. 9H1M is on from Gozo Islands on 15 and 10 a.m. News of 4W1's (Yemen) on 20/15/10 all on s.s.b. Rallies, etc., this month include — July 8th-9th. 1·8Mc/s contest; 9th RSGB National Mobile Rally at Gilwell Park, Chingford, N.E. London; 9th, South Shields mobile rally; 16th, Colchester Mobile Rally, Colchester Zoo; 16th, D/F Qualifying event; 16th, Worcester Mobile Rally; 23rd, 4 metre /P contest; 23rd, Cornish Mobile Rally near Newquay; 30th, D/F qualifying event; 30th, Saltash Mobile Rally, near Saltash; Deadline for logs this month is 20th.

electronic metronome

BY A. JAY

AN article has already appeared in PRACTICAL WIRELESS, describing a five-valve instrument with provision for accentuating the number of beats to a bar, on page 1062 of the March 1964 issue. The function of the earlier unit, which compared in size and price to a 10-watt amplifier, is practically duplicated here in a device the size of a pocket radio, and cheaper to build than the old mechanical metronomes.

The principle of operation is practically the same as in the earlier model. The basic beat repetition rate is set by a relaxation oscillator, but the new design makes use of a radically new device, the unijunction transistor. In contrast to the common bipolar transistor, there is only one junction in this device, and strictly speaking it is more a specialised diode than a transistor. The device incorporates a short silicon bar through which a current is passed. The contacts to the bar and the bar itself exhibit ohmic conduction, so that there is a linear voltage drop along the bar. The junction is formed approximately halfway along the bar, and if it is held at a lower potential than the point on the bar where it makes contact, no current will flow. However, immediately the voltage exceeds this level, the junction becomes forward biased, and not only conducts but injects charge carriers into the bar so that the resistance drops rapidly to a very low value. The two ohmic terminations to the bar are called the bases, and the connection to the junction the emitter; by analogy with the terminations of a bipolar transistor. There is no collector since this would imply a second junction.

R-C Oscillator

Figure 1 shows a simple R-C controlled oscillator relying on the properties of the unijunction transistor. The resistor R1 permits C1 to charge slowly, so that the reverse bias across the junction falls and eventually becomes forward. The device then begins to conduct, and the current from the emitter to B1 discharges the capacitor until the voltage across it is almost zero. Conduction then ceases, and the cycle repeats. Obviously, the frequency of the oscillations is fixed, as in all relaxation oscillators, by the time constant of the circuit R1-C1.

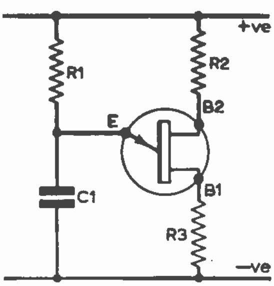
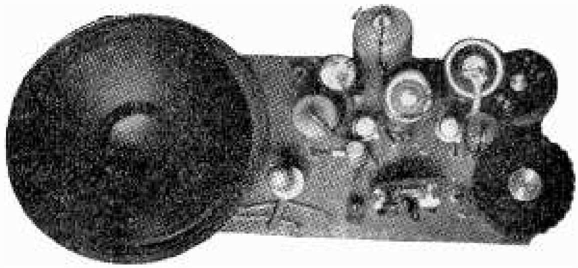


Fig. 1: Unijunction r-c oscillator.

In the original circuit, the twin triode multivibrator which provided the basic beat was followed by a "flip-flop" or monostable multivibrator, also employing twin triodes. This circuit accentuated the beats

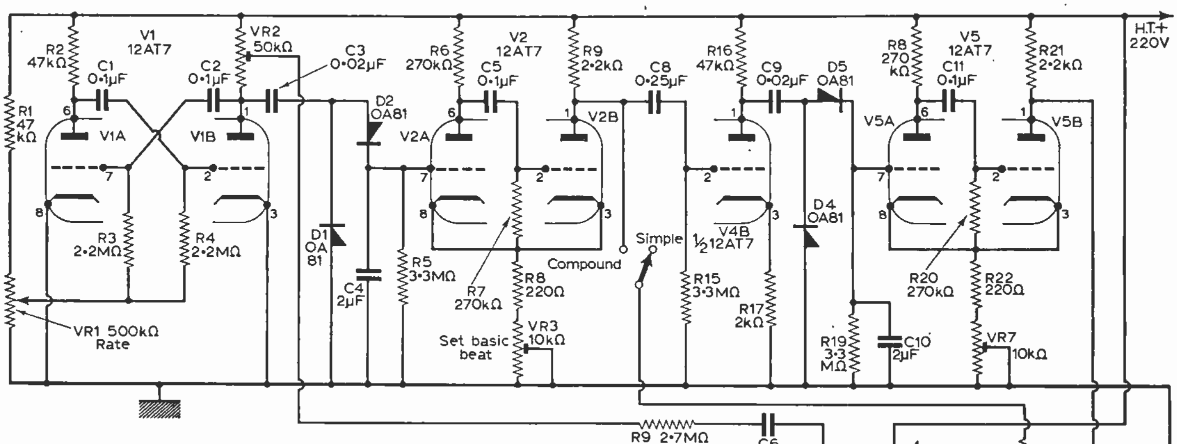


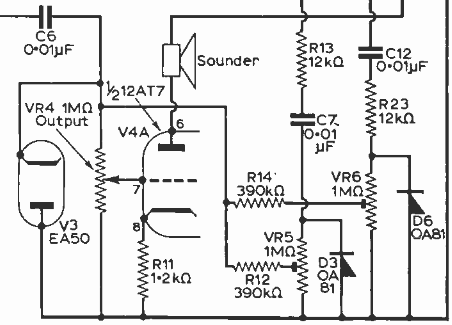
representing the beginning of each bar of the music being played. Therefore it had to be "triggered" or forced to conduct momentarily, on recurrent, equally spaced beats, e.g., every fourth, for 4/4 or common time. This was ensured by biasing the first valve beyond cut-off, with its grid fed from a "diode pump". Pulses from the oscillator passing through the diode pump charged up a capacitor until the valve began to conduct. One "multivibrator" cycle was then performed, giving a pulse at the output, before the circuit relapsed into the stable state. The number of primary pulses required to trigger the monostable pair depended on the depth of the reverse bias which the diode pump circuit had to overcome before it could initiate a cycle.

The output of the monostable added to that of the primary oscillator, so that the pulses on which it triggered were reinforced, and had a distinctive sound in the loudspeaker. The writer of the original article added a further stage with a second monostable circuit in order to point the fourth and seventh beats in "compound time" i.e. 6/8 or 9/8, but this is really unnecessary, as the first accentuation circuit can be set for marking up to the sixth beat, and anyway most musicians are as happy with simple marking for compound time. The constructor who understands the theory explained in these notes will easily be able to extend the principle to a more elaborate system if he should so wish.

Monostable system

The above statement of the ideas underlying the accentuation circuit has been expressed to bring out the parallel with the semiconductor circuit of the 1967 model. The monostable system to be employed is, of course, a second unijunction. It is normally in the "off" state, but its emitter is connected across the storage capacitor of a diode pump circuit. Positive-going components of the output pulse of Tr1 (Fig. 3) easily pass D1, while D2 shorts any negative-going components to earth. C3 therefore accumulates a charge over a number of cycles, and eventually reaches the firing voltage of Tr2, whereupon a reinforcing pulse is produced. The charge





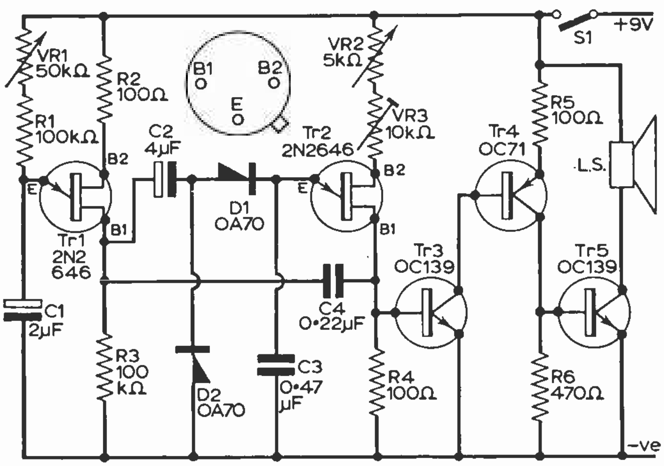


Fig. 2: Reprint of the "advanced metronome" circuit. which was first published in this journal in March 1964.

Fig. 3: Circuit diagram of the solid-state metronome described in this article is shown on the left. The transistor pin connections are shown inset between Tr1 and Tr2.

required to fire Tr2 depends on the voltage at which the bias across the junction goes forward, and this is controlled by reducing the potential on B2, so that the junction potential must also drop. VR2 was chosen so that in the prototype at maximum resistance it lowered the junction potential so far that the unit triggered on every input pulse, while at minimum. The preset in series limited accentuation to no higher than one in every six. With the prototype it was found possible to go even higher, but no musician would require this, and adjustment for the number desired becomes too critical.

The accentuation pulses produced by Tr2 are direct coupled into the base of the first audio amplifier transistor, Tr3, while C4 adds in the basic beats from Tr1. The audio amplifier is rather unusual, being direct coupled throughout. There are no negative feedback loops or any of the procedures usually adopted to ensure audio fidelity, since nothing but pulses are required. The accent is solely on output during beats, with quiet background. Economy is a keynote, and this project is a useful opportunity to dispose of a few surplus transistors.

Construction

Circuit board procedures are adopted for assembly. Although the writer favours etched circuits, only slight redesign would be required for use of Veroboard, and the pattern to be laid down by a constructor who prefers "Cir-Kit" could follow closely the layout of Fig. 4. In the prototype, this pattern was painted on to the copper foil of a paxolin-copper laminate and etched with ferric chloride solution. The result is a really "tailor-made" circuit board, and really very little extra time and effort is involved, since other tasks can be attended to while the paint is drying or the copper dissolving. Component mounting holes can then be drilled and the components mounted in the usual manner. There should be no difficulty in obtaining results from the unit, but for a safety precaution it would be advisable to monitor the current drawn by the circuit when it is switched on for the first time; it should not exceed approximately 15mA.

Operation

In operation it will be found advisable to adjust first VR1, the frequency control potentiometer. Only then may VR2 be used to select the accentuation ratio. The use of a variable resistor to perform this function may be questioned, with the suggestion that a switched selector system would be more convenient. This was considered and rejected, since it would require a preset adjustment for each ratio, involving extra expense and a larger circuit board. Also, imperfections on the junctions of the diodes of the pump circuit and the unijunction Tr2 are equivalent to a high resistor shunting C3, so that if the rate of accumulation of charge is slow, e.g. for a ratio of one in six, and slow beats, it is possible for the ratio to be slightly dependent on the setting of VR1. This is strictly a "worst case" event, but even so, all difficulty can be avoided with the simpler arrangement of a variable ratio control, used in accordance with the operating procedure already outlined.

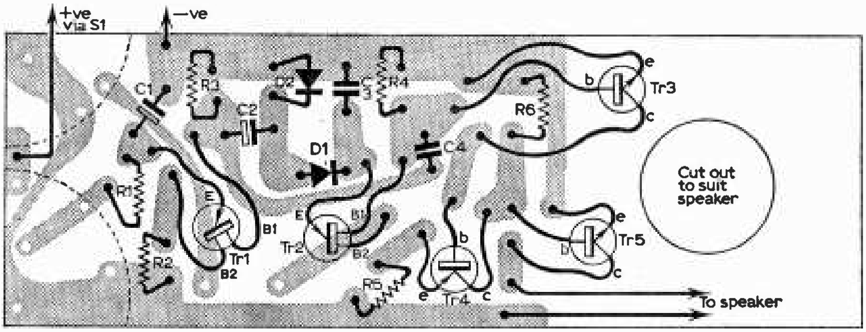


Fig. 4: Data for the printed circuit board and layout.

An adequate range of beat rates is available for all musical purposes with the values specified for R1 and VR1; however, should the constructor have in mind any other applications which would require a higher range, VR1 may be increased to 100kΩ, and R1 reduced to 47kΩ. The values chosen were specified so that the musician would have a fine control over the range of his requirements, without any waste space at either end of the motion of the control.

The cabinet chosen to house the instrument was simply the plastic shell of an old pocket radio, the original loudspeaker of which was then available for the audio section. For real economy a larger case is preferable, to accommodate, say, a PP9 battery, which would give many months of even frequent use. The final result, then, is that this project provides a low-cost introduction to the theory and practice of unijunctions, and at the same time produces a useful precision instrument. ■

★ components list

Resistors:

R1	100kΩ	R4	100Ω
R2	100Ω	R5	100Ω
R3	100Ω	R6	470Ω

Semiconductors:

Tr1	2N2646	Tr5	OC139
Tr2	2N2646	D1	OA70
Tr3	OC139	D2	OA70
Tr4	OC71		

Capacitors:		**Potentiometers:**	
C1	2μF	VR1	50kΩ
C2	4μF	VR2	5kΩ
C3	0·47μF	VR3	10kΩ
C4	0·22μF		

Miscellaneous:
Loudspeaker 30Ω or higher, SPST switch, circuit board, solder, wire, etc.

MORE ABOUT "CLAUSE 7"

GPO's VIEWS

I think that in your June editorial on Clause 7 of the Wireless Telegraphy Bill you have somewhat over-simplified the problem. In a developing art such as radio we must not only consider what is currently available but also what may be produced in the future. To take one example, recent reports from the United States say that the Federal Communications Commission has given notice of moving the frequency for low-powered walkie-talkies from 27Mc/s to about 50Mc/s. When sets are mass-produced for the new frequency they could cause even more trouble here than the present citizens band sets which are being used illegally.

We obviously need to be able to offer a measure of consumer protection, partly for the unsuspecting person who might be led to obtain apparatus which we cannot licence but particularly in providing a safeguard for people who hold licences. At 50Mc/s we should, of course, be very concerned to protect television reception.

Our intention is simply to deal with the problem of apparatus—usually an overspill from other markets—which works on the wrong frequencies for this country. The orders to be made under Clause 7 will make this clear. Since we are not prepared to issue licences for this apparatus the idea of sale against production of a licence seems a peculiarly roundabout and inappropriate way of achieving the desired result. We prefer to tackle the problem at source rather than to allow import/manufacture, and then try to block the outlets.—T. A. O'Brien, Director of Public Relations, G.P.O., London, E.C.1.

[The wording of Clause 7 does not restrict legislation to walkie-talkies, whether on 27 or 50Mc/s, but provides widespread powers to prohibit the sale, manufacture, importation and use of any radio equipment deemed to be **undesirable to the Government of the day.** *There is nothing over-simplified about this fact. And this blanket power is the basis of our concern.*

With regard to the last paragraph of Mr. O'Brien's letter, this seems to be somewhat ironic considering the importation and resale of walkie-talkies has been allowed to continue unmolested for at least seven years and the free sale of other transmitting equipment on non-amateur frequencies since the end of the war!

PRACTICAL WIRELESS *is not alone in remaining uneasy about this Bill, despite statements from the G.P.O.*]—Editor.

practical wireless

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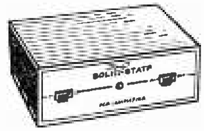

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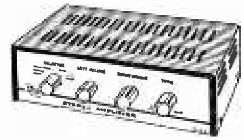

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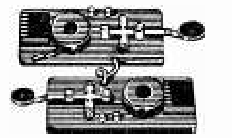

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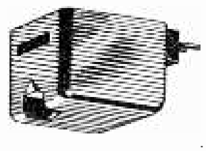

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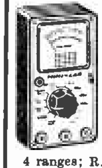

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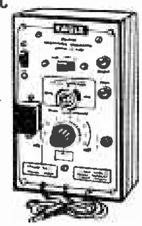

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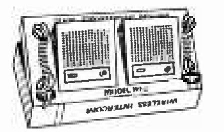

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6F8G	4/6
6F11	7/-
6F13	5/-
6F14	12/6
6F23	10/6
6G6	2/6
6H6	2/-
6J5M	6/6
6J5G	2/6
6J5GT	4/6
6J6	3/-
6J7M	7/6
6J7G	4/9
6J7GT	6/6
6K6GT	5/-
6K7M	5/9
6K7G	1/9
6K7GT	4/6
6K8M	8/6
6K8G	3/-
6K8GT	7/-
6K25	20/-
6L1	9/6
6L6G	7/-
6L18	5/-
6Q7G	6/-
6Q7GT	8/6
6SA7M	7/-
6SC7	7/-
6SG7	5/-
6SH7	3/3
6SJ7	5/-
6SK7GT	4/9
6SL7GT	4/9
6SN7GT	4/6
6SQ7	6/-
6U4GT	12/-
6U5G	7/6
6V6M	8/-
6V6G	4/6
6V6GT	6/6
6X4	3/6
6X5G	4/6
6X5GT	5/6
7B6	10/-
7B7	7/-
7C5	10/-
7C6	6/-
7D5	8/-
7H7	6/-
7R7	17/6
7S7	17/9
7Y4	7/6
9BW6	7/-
10C1	12/6
10C2	12/6
10F1	9/-
10F3	12/-
10F9	9/9
10F18	9/-
10L1	8/-
10LD11	15/-
10P13	14/-
11E3	42/-
12AT6	4/6
12AT7	3/9
12AU6	5/9
12AU7	4/9
12AX7	5/9
12BA6	5/6
12BE6	5/3
12C8GT	4/6
12E1	17/6
12J5GT	2/6
12J7GT	7/-
12K7GT	6/-
12K8GT	8/-
12Q7GT	4/6
12SA7	6/6
12SG7	4/3
12SH7	3/-
12SJ7	3/9
12SK7	4/9
12SR7	5/-
14H7	9/-
19AQ5	5/-
20D1	10/-
20F2	14/-
20L1	15/-
20P4	17/-
20P5	16/-
25A6	5/9
25L6GT	5/6
25Y5	6/-
25Z4	6/3
25Z5	7/-
25Z6	8/6
28D7	5/-
30C1	6/3
30C15	11/6
30C17	11/6
30F5	12/-
30FL1	13/6
30L15	12/6
30L17	12/6
30P12	10/-
30P19	13/-
30PL1	14/-
30PL13	14/-
30PL14	14/-
35A5	12/6
35L6	5/9
35W4	4/6
35Z3	10/-
35Z4GT	5/6
35Z5	5/6
37	5/-
42	6/-
50B5	6/6
50C5	5/9
50CD6G	31/-
50L6GT	6/-
75	7/-
78	5/-
80	5/-
85A2	7/3
150B2	9/6
150C4	7/6
801	6/-
807	7/-
813	75/-
866A	13/6
954	4/6
1625	5/6
4022AR	50/-
5763	10/-
7193	2/-
7475	4/-
ATP4	2/8
ATP5	7/-
ATP7	5/6
AU2	80/-
AU5	7/6
AZ1	8/-
AZ31	9/-
CBL31	15/-
CCH35	21/-
CL33	20/-
CY31	10/-
DAC32	7/-
DAF91	4/-
DAF96	6/3
DCC90	7/-
DF33	8/-
DF70	7/-
DF91	3/-
DF92	2/6
DF96	6/3
DH77	4/-
DK32	7/9
DK91	5/-
DK92	8/-
DK96	7/-
DL66	15/-
DL92	4/9
DL93	3/6
DL94	5/9
DL95	6/6
DL96	7/-
DM70	5/-
DY86	6/-
DY87	6/-
E88CC	12/-
EA50	2/-
EABC80	6/6
EAF42	8/6
EB41	4/6
EB91	3/-
EBC33	7/-
EBC41	8/3
EBC90	4/-
EBF80	6/6
EBF83	7/-
EBF89	6/6
EBL1	14/-
EBL21	10/-
EBL31	27/6
EC90	2/9
ECC81	3/9
ECC82	4/9
ECC83	5/9
ECC84	6/-
ECC85	5/-
ECC88	7/-
ECF80	6/6
ECF82	7/-
ECH21	12/6
ECH35	11/-
ECH42	9/-
ECH81	5/3
ECH83	7/-
ECL80	6/6
ECL82	6/3
ECL83	9/6
ECL86	8/9
ECLL800	30/-
EF9	20/-
EF37A	7/-
EF39	6/-
EF41	8/6
EF50	2/6
EF80	5/-
EF85	6/6
EF86	6/3
EF89	5/-
EF91	3/6
EF92	2/6
EF98	9/-
EF183	6/-
EF184	6/-
EL32	3/6
EL33	12/6
EL34	9/6
EL41	8/6
EL42	8/6
EL84	4/3
EL90	5/6
EL95	5/-
ELL80	20/-
EM80	7/-
EM81	7/-
EM84	7/-
ESU150	20/-
EY51	7/-
EY86	6/6
EZ35	4/6
EZ40	7/-
EZ41	8/-
EZ80	5/-
EZ81	5/-
GZ30	10/-
GZ32	9/6
GZ34	10/-
KT36	17/6
KT61	12/6
KT66	16/-
KT81	35/-
KT81 (7C5)	10/-
KT88	25/-
KTW61	10/-
KTZ41	6/-
ML4	17/6
ML6	6/-
MSP4	10/-
MU14	7/6
MX40	12/6
N37	10/6
N78	15/-
N108	15/-
NGT1	3/6
NGT7	55/-
OZ4	4/6
PC86	8/6
PC88	8/6
PC97	7/6
PCC84	5/6
PCC89	10/-
PCC189	9/6
PCF80	6/3
PCF82	6/-
PCF84	8/-
PCF86	8/-
PCF801	9/6
PCF802	9/6
PCF805	10/9
PCF806	12/-
PCF808	11/6
PCL82	7/-
PCL83	8/6
PCL84	7/-
PCL85	8/6
PCL86	8/6
PENA4	20/-
PENB4	20/-
PEN45	7/-
PEN46	2/9
PL36	9/-
PL81	7/6
PL82	6/6
PL83	6/-
PL84	6/6
PL500	13/6
PX4	14/-
PY33	8/6
PY81	6/-
PY82	5/6
PY83	6/-
PY800	7/-
PY801	7/-
R2	7/6
R19	7/-
RG5/500	80/-
S130	25/-
SP4	8/-
SP41	3/6
SP61	3/6
SU25	19/6
SU2150	12/6
T41	15/-
TDD4	10/-
U10	7/6
U14	7/6
U19	35/-
U25	10/6
U26	10/6
U78	3/6
U191	11/6
U251	12/6
U301	13/-
U403	6/6
U801	17/-
UABC80	5/6
UAF42	8/9
UBC41	8/-
UBC81	7/6
UBF80	6/3
UBF89	6/6
UCC84	8/6
UCC85	6/6
UCF80	8/6
UCH42	8/6
UCH81	6/3
UCL82	7/-
UCL83	8/9
UF41	8/-
UF89	6/-
UL41	8/9
UL84	6/-
UM80	6/-
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UU7	13/6
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LETTERS...

P & P charges

NO Messrs. Plater and Deverell (P.W. June issue) labour is specifically EXCLUDED from P. & P. The over-the-counter price includes an allowance for labour. The wrapping and postal charge are all that the extra money should cover.

I have bought two kits in the last month. The first was dreadful, containing used components, and was returned. On it the firm made a clear profit of 1s. 6d. from the P. & P. charge. The other worked first time and is perfectly satisfactory. The firm made NO profit from the P. & P. Draw your own conclusions. — **R. B. Anderton** *(London, S.E.3).*

It wouldn't work

At first sight, Mr. Tinson's suggestion (P.W. June issue) that the BBC could synchronise all its Home Service transmitters on one channel may sound plausible.

Apparently, however, he does not seem to realise that although the BBC can and do synchronise, for example, 10 transmitters on 1214kc/s (m.w. Light) they cannot guarantee that the signals from all will arrive everywhere in the country at the same time, and they don't—especially after dark!

For this reason, to cover the country with synchronised transmitters would require more transmitters than separate frequency stations. No, I am afraid that the problem of the shortage of medium wave channels still remains. — **J. Williamson** *(Dumfriesshire, Scotland).*

You must have the flair

In your April issue a reader complains of kits he has made up which do not compare with readymade goods.

I do not make up anything, but I bought a tuner from a retailer readymade. This is the outfit which is sold in parts for the DIY man who can save himself a pound or two if clever enough to build it.

If Mr. Lenner was clever enough to assemble one of these kits, I am sure he would be as pleased with it as I have been with mine over the last three to four years.

But I think one needs to choose the type of thing to build oneself. It is obviously no good trying to build anything ambitious on a first trial, and if you haven't the flair for it (like me) it is no good EVER doing so!— **S. J. Barlow** *(Kingston, Surrey).*

Elusive 12AH8

The 12AH8 valve employed on the Progressive Short Wave Receiver (P.W. February 1966 issue) seems to have completely disappeared from the market. Recently I underwent hours of fruitless searching until one of the smaller shopkeepers in South Ealing informed me that the ECH81 could be substituted with some minor alterations in the connections.—**H. K.** *(Ealing, London, W.5).*

[*Details of the modifications for replacing the 12AH8 by a ECH81 were published in the September 1966 issue of this journal*]—Editor.

Hertz and the pirates

With regard to Mr. Newport's letter in the March issue of P.W., I found the article on Pirate prosecutions more comprehensive than either the papers or radio and TV.

I agree with Mr. W. Lee in the same issue that it does appear quicker to say "cycles" and write c/s than it is to say "Hertz" and write Hz. Hertz is already honoured with the short Hertzian waves, why should he be honoured again I am only a newcomer to the "trade", but I will continue to use c/s as long as I can. — **G. Worsnop** *(Seascale, Cumberland).*

Not 'Practical'

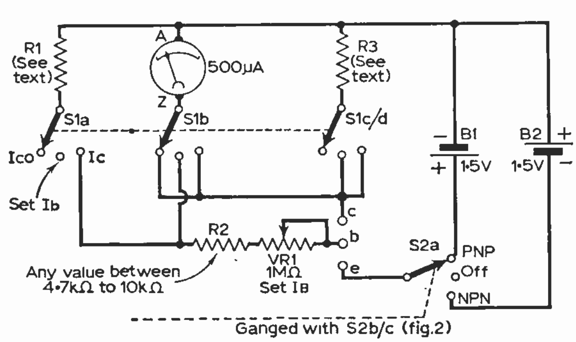
With reference to your attitude on Commercial Radio, which though Law abiding, is hardly "Practical".

Firstly, regarding available air space, the Home Service using eleven frequencies make this point invalid for a start.

Secondly, as the Service Manager of a Harrow radio manufacturing company, it seems to me obvious that with only the BBC on the air, any set available will be good enough. Interest in new sets, kits and circuits would fade with the "Pirates" putting all of us out of business.

The BBC and GPO have surely enough heavy guns on their side—at least let the radio magazines and manufacturers have the sense to defend their own interests.—**R. N. D. Houghton** *(Harrow, Middlesex).*

SIMPLE TRANSISTOR TESTER



It is regretted that errors appeared in the article Simple Transistor Tester by G. A. Bobker, PRACTICAL WIRELESS June issue, 1967.

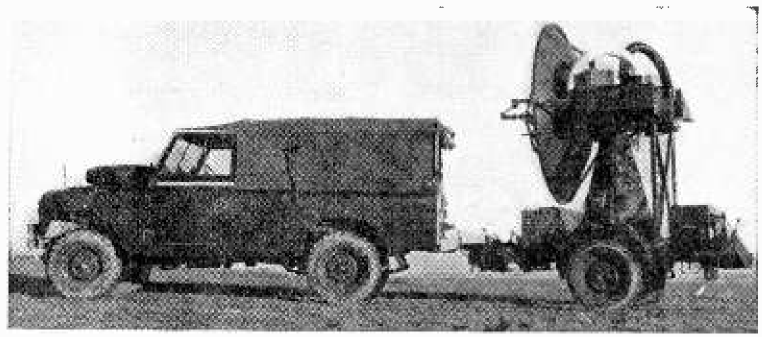
The second and third positions of Slc/d and the collector terminal should share a common connection, and not as shown in Figs. 1 and 4. Switch S2 is a 3P 3W.

Note that the line on page 121 which reads— ". . . and turn the function switch to the off position" should be ignored.

In order to assist would-be constructors we give (left) the corrected circuit complete with all relevant values.

We thank all those readers who wrote in drawing our attention to these errors.—*Editor.*

IDEX

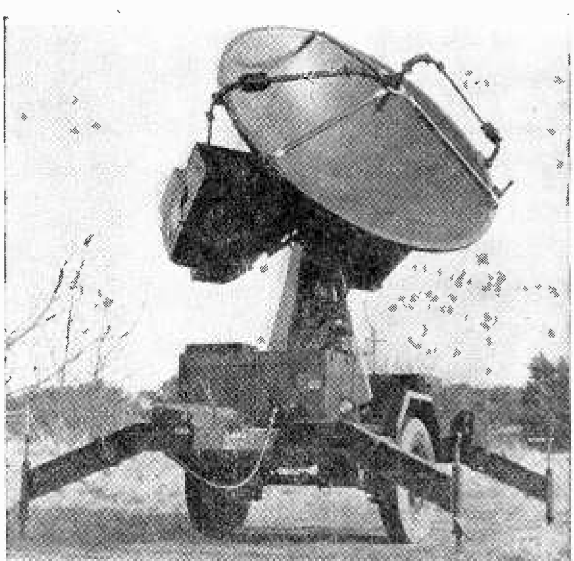


IT'S the British again! This time the gentlemen of the Signals Research and Development Establishment at Christchurch in Hampshire. On Friday, May 12th, 1967, the boffins of SRDE gave a highly successful exhibition of their latest prodigy, IDEX.

IDEX is a pocket-sized mobile communications terminal which can be set up and operated by two people. It comprises a transmitter and receiver operating in the 7—8Gc/s region. It is complete with a 6ft. parabolic dish aerial, has its own power supply, and can be towed almost anywhere. IDEX, it was claimed, could be set up and operational within thirty minutes of arriving at a site.

IDEX can work via the satellites and in this way its range is almost world wide. At present there are 15 satellites girdling the earth some 20,000 miles up above the equator. These are near enough stationary and as they drift about 1° per hour their position can be accurately determined.

In order to demonstrate what their mini-skirted midget could do, the boffins explained the plan. A big brother called SCAT, with a 40ft. dish, was located around half a mile away. Two men would drive up towing little IDEX, set up the generator, transmitter and receiver, locate, and beam the dish on to satellite 2.7 which had been "booked" for the afternoon. Finally, set up a communication link with SCAT via the satellite. It was hastily pointed out that although the signals would travel some 20,000 miles into space to the satellite and back another 20,000 miles to SCAT (and vice-versa) only half a mile away as the r.f. crow flies, SCAT could, in fact, be anywhere—Africa, India, America etc. The demonstration would show the principles and to prove no cheating, the IDEX aerial would be moved off the satellite and back again showing up immediately as an interruption in the signals.



IDEX — *I*nitial *D*efence Communications Programme *EX*perimental Ground Terminal

1420. Two men in a Land Rover arrived at the site towing IDEX on a small trailer. (See photograph).

1421. Legs of the trailer lowered into position and locked. Land Rover driven away leaving IDEX and generator all alone.

1425. A telephone rang on the table in the middle of the field. We were told that the particular satellite we were using was called 2.7.

1429. IDEX was alive, her 6ft. concave eye was scanning the heavens for 2.7. The press is getting excited, the boffins mutter in groups.

1431. The meters at the rear of IDEX blink and kick, the whole apparatus seems alive now.

1432. A simple compass is set up to check and line up the dish. There seems something ironical here as this complicated electronic monster is accurately aligned with the aid of an ageing compass mounted on a shaky tripod with one of its legs secured with the aid of a jubilee clip.

1436. The dish elevates and seeks. It can see something high above the clouds which we can't.

1438. Satellite 2.7 located.

1440. We all gather round the terminal unit with bated breath. The satellite beacon signal has been located.

1441. We exchange tuning signals with SCAT.

1442. Shrieks of delight. Someone shouts "He's sending B's", and the teleprinter chattered happily.

The boffins informed that IDEX was far from being fully developed. A year or so ago the dish size was 40ft., this year it was only 6ft. Next year, who knows, perhaps those James Bond gadgets are not so far fetched after all. Certainly as far as SRDE knows, this is the smallest portable unit of its kind to date.

So ended a very pleasant day. The modesty of the staff, the achievement, the obvious success. One left Christchurch with the feeling that one was fortunate, indeed proud to be British. ■

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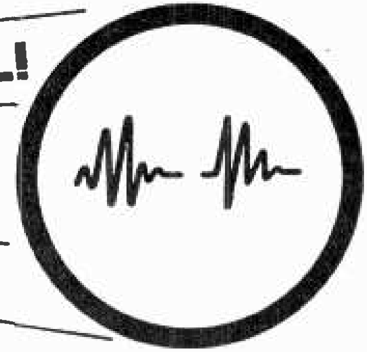

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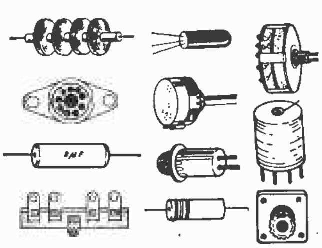

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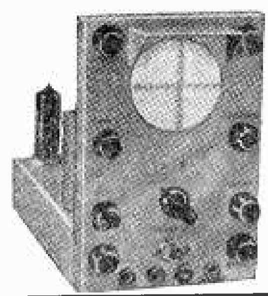

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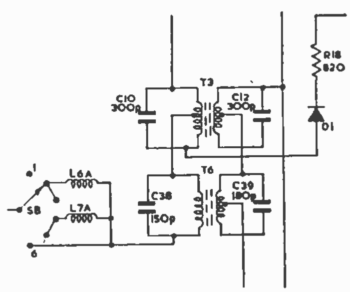

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making a popular recorder earn its keep

THE Philips tape recorder model EL3541, together with the equivalent Cossor CR1602 and Stellaphone ST454, still rates as one of the most versatile and efficient mains-operated examples in its price-bracket. It was, in fact, selected as "Best Buy" in the magazine *Which?* in 1961.

Articles by L. McNamara in the September 1965 and January 1967 issues of PRACTICAL WIRELESS show how to extend still further the facilities available. But there is one simple adjustment that makes the instrument into a very useful record player when used in conjunction with a turntable and pick-up, or even as a separate amplifier for a second stereo channel.

It should be noted that, when set to the P.A. position, the recorder's amplifier offers two input sensitivities—of 3mV into 100Ω and of 200mV into 1mΩ—and is therefore capable of accepting signals from the lowest output pick-ups, and of amplifying with relatively little background hum. This renders the instrument very useful for the musical person who has to travel around, as the recorder plus a turntable is easily portable, and provides a quality of reproduction that obviates the need for leaving really high-priced equipment lying about in digs or hotels.

Yet, for satisfactory record reproduction, or for use as a second channel amplifier, it is necessary to incorporate a switch to isolate the motor, as this can be quite audible if left running.

The diagram of Fig. 1 shows the wiring of the motor as presented by the manufacturer. (Important: this applies only if the recorder is set to operate at 220 volts or 245 volts. Where the 110 or 127 volt settings are required, on no account carry out the following modification.)

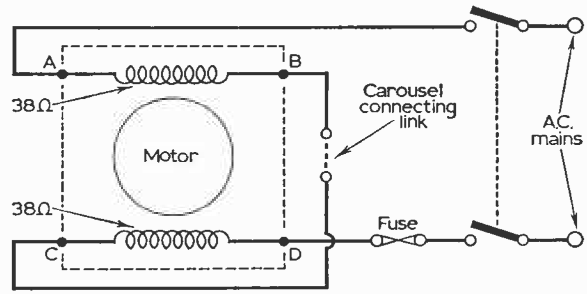


Fig. 1: Motor viewed from underneath, with the extra switching superimposed.

The two field windings are simply run in series, with the connecting link provided at the voltage selection carousel. Unsolder the leads at points B and C. A quick check with an ohmmeter will indicate the correct wires by a nil reading, They will probably be the green and red leads, but it is best to check—just in case!

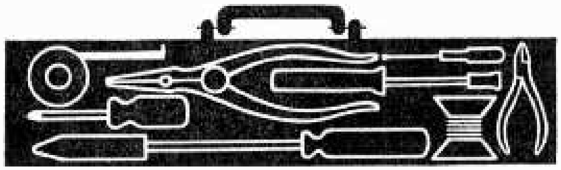
Cover the loose ends of each of these leads with insulating tape, and tuck them carefully away. Then solder fresh leads to B and C, connecting the free ends to an insulated single-pole mains make-and-break switch. The latter can be fitted wherever convenient, preferably inside the microphone compartment, where it is near the P.A. switch. Now the recorder can be operated with the motor switched off.

Maureen M. Harvey

repairing radio sets

PART 5

GORDON J. KING



After H. W. Hellyer's discourse on dial drives last month, it is now my turn to take up pen and discuss audio section faults in valved equipment. So far we have passed through the average radio set from the aerial to the detector, taking in the r.f. amplifier, frequency changer, i.f. stages and a.g.c., and experience has taught that in these stages of the receiver the more difficult-to-find fault is harboured.

Fault-finding in the audio stages is relatively easy once it has been proved that this is where the fault lies. This is always the most difficult part of servicing radio receivers—locating the fault area.

Let us start by supposing that the set is completely dead. The first move is to find out as quickly as possible just where the fault lies (not necessarily the actual guilty component). Although a set may fail to respond to a transmission, this should not be taken to mean that the set is completely dead for the audio stages may be working! We can at least find out with the least delay whether the power supply is active by (i) seeing whether the valve heaters are alight (ii) listening closely at the loudspeaker for signs of residual mains hum and (iii) feeling the temperature of the h.t. rectifier (if this is a valve) and the output valve.

HEATER CHAIN

Check (i) is obvious, of course, and this proves that mains current is getting to the set, that the on/off switch and fuse (if fitted) are in order and that all the valve heaters are intact. It should be noted, though, that non-lit heaters in an a.c./d.c. type of set may not be definite proof that the mains input is defective because the heaters of all the valves (and dial light) are connected in series across the mains supply with the heater current being limited by the mains dropper resistor, as shown in Fig. 5-1.

Thus, if one series element goes open-circuit, such as one heater, mains dropper, on/off switch, fuse or dial bulb, the remaining intact heaters will fail to light, rather like the effect when one bulb in a series of Christmas tree fairy lights fails. A.C.-only sets using a mains transformer usually have parallel-connected heaters, which means that one (or more) could go open-circuit without affecting the lighting of the remaining intact ones.

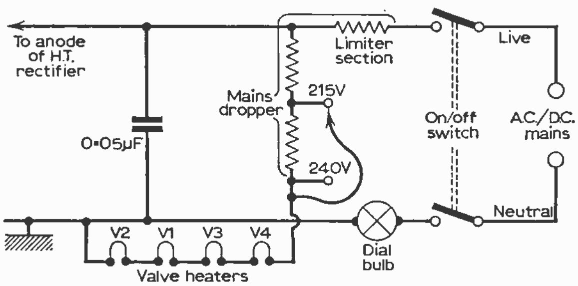


Fig. 5-1: The heater supply circuit in an a.c./d.c. set. Also showing the h.t. rectifier anode feed, via surge limiter.

Check (ii) is often the first (after checking valve heaters for glow) made by technicians coming up against an apparently dead set. Normal level of residual hum from the loudspeaker indicates (a) that the loudspeaker is working (b) that the loudspeaker transformer is working (c) almost certainly that the output valve is passing current (i.e., reasonable emission) and (d) that h.t. supply is reaching the output valve. It will be agreed that this is quite a lot of information from one simple listening test!

Check (iii) indicates that the rectifier is, at least, receiving h.t. input from the mains and that the output valve is drawing h.t. current from the rectifier, assuming that the envelope temperatures are not abnormally low or excessive. Abnormally low temperature could mean that the heater dissipation alone is warming the glass, indicating lack of anode current and anode dissipation.

An excessive temperature in the rectifier could mean excessive current demands due to a leak or short on the h.t. line or feed circuits or even a short in the rectifier itself. In the output valve excessive anode current could be due to faulty grid biasing or a leak in the grid coupling capacitor which would, of course, destroy the biasing, anyway.

NO RESIDUAL HUM

Let us suppose that our "dead" set exhibits no residual mains hum and the rectifier and output valve are running very cool. We can conclude lack of output valve anode current due to lack of h.t. current (cool rectifier). The first test should be to establish that the rectifier anode is receiving mains supply, via the limiter resistor (see Fig. 5-1). A multimeter switched to 250V a.c. will soon prove this. Voltage at the mains side of the limiter but not at the rectifier anode side means that the resistor is open-circuit.

At this stage it would be as well to switch the set off (disconnect from the supply) and check for a short with the rectifier valve removed from the anode tag on its holder to chassis. If there is a short, the filter capacitor, often connected from anode to chassis (the 0·05μF in Fig. 5-1, for instance) will probably be responsible. This must be replaced with the component of like value with a 250V. *a.c. rating.*

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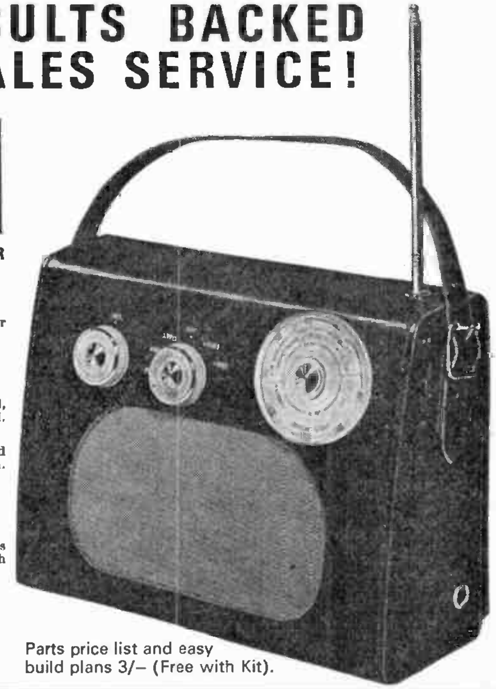

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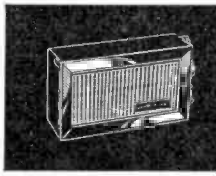

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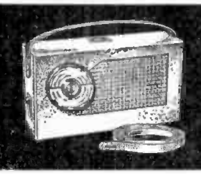

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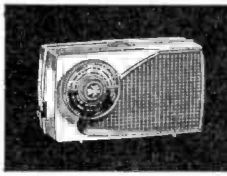

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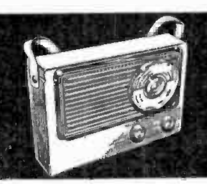

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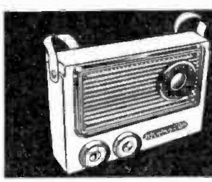

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The set would work without this filter capacitor, but it may give the symptom of hum when accurately tuned in to a station or carrier. This is called modulation-hum, and its presence should first lead to a check of the filter capacitor for open-circuit in a.c./d.c. sets.

A short in the capacitor will immediately blow the surge limiter resistor, often a section of the mains dropper. If there is no short on the anode tag, re-insert the rectifier valve and try again. A short this time means that the h.t. rectifier is faulty and needs replacing. The rectifier, however, would be more likely to be running very hot than cool with this trouble.

If the rectifier is running hot and there is still no residual mains hum, there could be a partial short on the h.t. supply from the cathode of the rectifier.

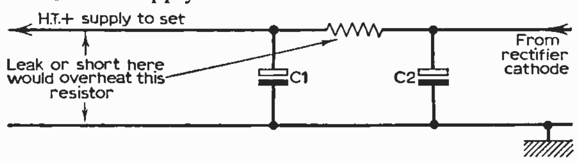

Fig. 5-2: Typical "smoothing" circuit of modern receiver.

A dead short here would blow the valve and/or surge limiter resistor. Most sets nowadays have a filter resistor from rectifier cathode to the h.t. supply (Fig. 5-2) with electrolytic either side, so a short the set side of this resistor would run the rectifier hot, possibly without blowing it, while overheating the resistor itself. D.C. voltage tests along the line would soon prove this trouble.

OPEN TRANSFORMER PRIMARY

If both the rectifier and the output valve are running hot, still without residual mains hum, and the above-mentioned tests have failed to reveal any major fault, the screen-grid inside the output valve should be closely observed. If this appears to be overheating or running red-hot, one need look no further than the anode circuit of the valve for an open-circuit to the h.t. supply. In the vast majority of sets the anode is loaded to the loudspeaker transformer, and an open-circuit primary winding is a typical cause of the symptom.

A rather loudish hum (not ordinary mains hum) accompanying the symptom of a red-hot screen-grid means that the valve anode is starved of h.t. supply due to a short-circuit on the anode. Some inexpensive sets have a capacitor from anode to earth to minimise the effects of third-harmonic distortion (a single pentode stage being very prone to this kind of distortion). The capacitor applies plenty of treble-cut and gets rid of the higher-order harmonics at the same time!

Better circuits may have a tone-control or fixed resistor in series with this capacitor, so if a short develops the effects are less dramatic. With a tone control, the track will burn out when the knob is fully advanced and with a fixed resistor the short-circuit current through it is barely enough to cause even slight temperature increase.

Another cause of lack of residual mains hum is an open-circuit screen-grid feed on the output pentode. Sets which use a screen-grid feed resistor and bypass capacitor to chassis should have the resistor checked for open-circuit and the capacitor for short-circuit. In the latter case, the resistor would tend to overheat since its relatively low value would pass substantial short-circuit current.

DON'T FORGET THE LOUDSPEAKER

Finally, for the same symptom, attention should be directed to the loudspeaker itself and its connection to the secondary of the loudspeaker transformer. Sometimes the transformer is fixed (bolted or riveted) to the loudspeaker chassis; if not, it is located somewhere on the chassis near the output valve.

It is by no means rare for the speech coil winding of the loudspeaker to go open-circuit, but this can easily be checked by connecting an ohmmeter across the speech coil tags, making sure that the speaker is disconnected on one side from the secondary of its transformer. Otherwise, even though the speech coil may be open-circuit the ohmmeter will register a low resistance through the secondary winding itself. If an ohmmeter is not to hand, a small 1·5-volt battery connected across the tags should result in a click or crackle when the connection is scraped.

Some sets have an extension loudspeaker socket (or pair of sockets) at the rear of the chassis, with a pressure screw, switch or some other device for cutting out the internal loudspeaker if required when running the extension. This switching arrangement is vulnerable, and it should certainly be looked at if the foregoing hints have done nothing about bringing back residual hum in the set's loudspeaker.

Of course, an extension loudspeaker could be tried if one happens to be handy. Most technicians, in fact, have such a loudspeaker permanently in position on a shelf at the rear of the bench connected to a pair of flying leads for immediate test connection.

We must now assume that the dead set exhibits residual hum. This may not be very loud, but it is

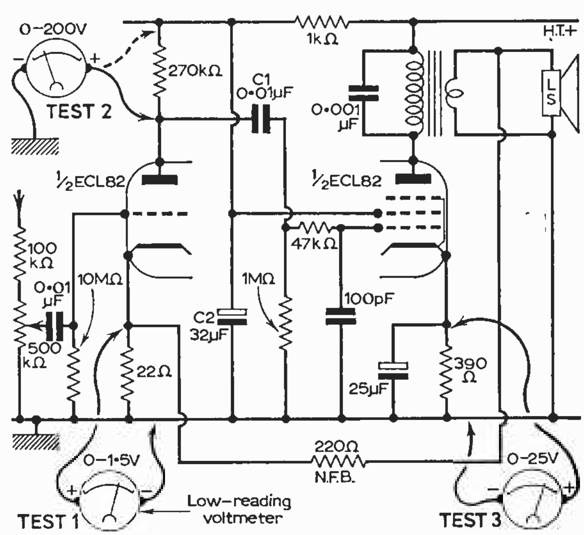

Fig. 5-3: Audio section of recent mains powered a.c./d.c. set. This circuit is sometimes extended to push-pull by the use of two triode-pentodes, the pentodes being the output pair and the triodes as phase splitter and voltage amplifier.

generally heard reasonably well with an ear close to the loudspeaker, depending on the efficiency of the set's smoothing and the nature of the set. Hi-fi sets have very little residual hum output, so this test may not assist much with sets (and amplifiers) of this kind.

We should now move to the input of the audio stages in an endeavour to get a signal in here to see whether it arrives at the loudspeaker. An audio generator or oscillator is an ideal instrument for this purpose, as also is the "audio" (tone) output from an r.f. signal generator. Most signal generators have an audio output socket at the fixed tone of the r.f. modulation, which can be used on its own, sometimes regulated by an audio level control, depending upon the sophistication of the instrument.

The signal should be fed in at the control grid of the first audio stage (directly following the detector) via a length of screened lead, inner conductor to signal "live" and the braid to "earth". Again, it must be stressed that a.c./d.c. sets have their chassis connected direct to one side of the mains supply (see Fig. 5-1), so if transformer mains isolation is not used, it is imperative that the mains be connected so that the neutral side is to set chassis. A.C./d.c. sets must **never** be earthed direct, not even when the chassis is at mains neutral.

BACK TO THE EARLIER STAGES!

With an audio input of between 50 and 100mV, almost full audio output should be developed in the loudspeaker. If there is no output or if a signal of substantially greater level is required to obtain a mere trace of output, the audio section is certainly at fault. If, on the other hand, a solid output is obtained, the fault lies somewhere *before* the audio section (up to the detector), so back to the earlier stages we must go and make tests there as explained in the previous articles (Parts 1 and 3).

The circuit of a typical recent (valve) audio section is given in Fig. 5-3. This comprises a triode voltage amplifier and a pentode audio output stage. In later sets it is conventional to use a single triode-pentode valve of the ECL82 class, as in the circuit. Right through the ages the average radio audio section has consisted of two such stages but in some older sets a double-diode-triode valve was used in front of an ordinary pentode, the two diodes being used for demodulation and a.g.c.

There have been variations of this theme, with diode i.f. pentodes and double-diode-pentode output valves. Now, though, audio circuits have stabilised almost exclusively to the set-up in Fig. 5-3—with minor differences in detail.

Modern triode-pentode valves can deliver up to 3 watts or more (at about 10% total distortion at full power) with an input of 50—100mV, adequate for working from the signal output of a diode detector. A pair of valves can also produce a reasonable push-pull stage with much lower total distortion and higher power, and this technique is used in some of the better class radios and radiograms.

DYNAMIC TESTS

If an audio generator is not available, the sensitivity of the audio section is generally sufficient when working correctly to produce a violent output from the loudspeaker when the tip of a screwdriver, upon the metal side of which is resting a finger, is touched on the valveholder tag or the centre tag of the volume control (with the control turned fully clockwise) corresponding to the grid of the triode section.

The resulting loud hum is caused by the body passing ripple voltage (at very high impedance) to the grid circuit. Alternatively, pure ripple signal can be obtained from the heater line, via a $0{\cdot}01\mu F$ capacitor and $10k\Omega$ resistor to the control grid. If there is no response, then the audio section is dead.

The next best move is to go through exactly the same process again, but this time injecting the signal into the control grid of the pentode section. The sensitivity here may be insufficient for the "finger/screwdriver hum test", but a loud hum should be obtained by injecting ripple from the heater line as before.

If there is no response at the triode, but adequate response at the pentode, the triode stage is faulty. These checks can be undertaken very quickly in practice although they take time to explain.

Triode stage trouble could lie in the valve itself or in the anode supply circuit. The valve can be checked by metering the voltage across the cathode resistor. In Fig. 5-3, however, this resistor is not used for biasing, but purely for the injection of negative feedback from the output transformer. Nevertheless, a correctly emitting triode should give a small voltage across this low value (22Ω) resistor, but a low-reading voltmeter would be needed to record it, as in *Test 1*.

Test 2 would tell how the anode supply is working, but again the voltage here may not be as high as expected owing to the voltmeter loading on the $270k\Omega$ anode feed (load) resistor. However, if the h.t. side of the resistor reads about 200 volts, the anode side should read about 80 volts on a meter of not less than 10,000 ohms/volt sensitivity on the 200V range. If the pointer only just about moves from the zero mark on the scale, the anode resistor has probably gone very high in value or even open-circuit, and it should not take very long to prove this.

On the other hand, trouble in the triode section of the valve could be encouraging the valve to pass excessive anode current, in which case the volts-drop across the $270k\Omega$ anode load resistor would be abnormally high.

The biasing of the triode section is interesting. In all diodes and valve grids loaded into a very high resistance ($10M\Omega$ in this case), the residual diode (grid) current, created by electro-chemical effects within the valve, produces a voltage of sufficient magnitude across the high value load to bias the valve without the usual cathode resistor. The 22Ω cathode resistor on the triode in Fig. 5-3 is solely for negative feedback, as already mentioned.

If the triode section appears normal d.c.-wise, yet signal still fails to pass through it to the output pentode, the only vulnerable component left in circuit is the coupling capacitor C1. This rarely causes complete failure of the set, although it can be responsible for other symptoms, as we shall see.

Let us now suppose that our earlier dynamic tests (with audio signal and hum) failed to produce response at either the triode or pentode grid, yet residual hum is present. This would imply trouble in the pentode stage, and the pentode section could be

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faulty, as also could the h.t. feed elements. However, this trouble would be likely to prevent residual hum, but one cannot be absolutely sure that the pentode stage is intact when residual hum is present.

TESTS IN THE OUTPUT STAGE

Thus, much of what is now about to be said could also apply to a set devoid of residual hum (i.e., completely dead in all respects). The first check should be for cathode voltage, as in *Test 3* in Fig. 5-3. A normal reading here is about 12 to 14 volts with a 170-volt h.t. line and a cathode resistor of about 390Ω. Assuming that the cathode bypass electrolytic is not shorting, lack of cathode voltage signifies that the output pentode is failing to pass current. This could be due to a bad valve, of course, or a break in the h.t. feed to the screen-grid.

We have seen that an open anode circuit produces other symptoms, and in this event there would still be cathode voltage due to the heavy screen-grid current, but it would be below normal. In Fig. 5-3 the 32μF electrolytic on the screen-grid serves as a smoother in conjunction with the 1kΩ resistor in the h.t. feed. A short in this capacitor, therefore, would have the results indicated in Fig. 5-2. It would also put the set out of commission.

We have now covered most aspects of complete failure in the audio circuits, but there are many other symptoms that result from troubles in this area of the set. These will now be detailed.

Excessive Mains Hum: If present with the volume control turned right down, a smoothing electolytic (C1 and/or C2 in Fig. 5-2 and C2 in Fig. 5-3) will almost certainly be responsible. If possible, check by paralleling a known-good capacitor of correct voltage rating and capacitance across the suspect. If the hum develops progressively in intensity as the volume control is turned up, suspect a condition causing hum to be injected in from the earlier stages. Also check the audio valve(s) for heater/cathode leakage.

Low Audio Sensitivity: Check audio valves for emission and replace if low. Check the cathode bypass electrolytic for low value of open circuit. Open-circuit here produces current negative feedback, having a degenerative effect on sensitivity.

Intermittent Volume changes: Check the audio coupling capacitor (C1 in Fig. 5-3) for intermit- ★5 tency. It is best to change this component if there is any doubt as to its goodness. (Record Symptom 5, on P.W. Fault Finding Record.)

Small Distortion: Check negative feedback circuit and components. Check output valve for emission and voltage amplifier anode load resistor for value increase. Check voltage amplifier valve for grid-current, especially in circuits using the grid-current method of biasing, shown in Fig. 5-3 and explained earlier.

Large Distortion: Check audio valves for emission and replace if low. Check the coupler C1 for leakage. This is best done by monitoring the cathode voltage as in *Test 3* while connecting and discon- ★9 necting C1. If the cathode voltage rises when C1 is connected, then it is most certainly leaky electrically and must be replaced. (Record Symptom 9.)

Large Distortion and Low Volume: Check the voltage amplifier anode load resistor for value increase.

Motor-Boating: Check the cathode bypass electrolytic of the output valve, the screen-grid capacitor ★7 and other associated electrolytics for decrease in value or for open-circuit condition. (Record Symptom 7.)

Low-frequency Instability: Check any small value (pF values) capacitor on the control-grid, screen-grid and anode electrodes of the audio valves for open-circuit. For instance, open-circuit of the 100pF capacitor on the control-grid of the pentode stage in ★6 Fig. 5-3 could cause the symptom. Check negative-feedback loops and components for value increase. Check smoothing and bypass electrolytics. (Record Symptom 6.)

Very Severe Distortion and Lack of Bass: Check the speech-coil of the loudspeaker for movement. ★8 If necessary re-centre the loudspeaker speech-coil in its magnetic gap. (Record Symptom 8.)

Lack of Treble and Low Volume: Check loudspeaker transformer for shorting turns, preferably by substitution. Check cathode electrolytic on output valve. Check all audio coupling capacitors for value increase.

RADIOGRAM FAULTS

Any of the faults and effects described in this and the previous articles could, of course, develop in a radiogram as well as any ordinary radio. However, there are some faults which occur only in radiograms, and these are mainly concerned with the record reproduction.

If gram reproduction is impaired while radio is normal, one can be almost certain that the trouble lies in the record, pick-up or associated filter/feed networks. If both radio and gram reproduction is impaired, however, the audio stages are to blame, and testing along the lines suggested in this article should restore both to normal. It is unusual for audio trouble to affect radio reproduction and not gram, though this can happen if the radiogram carries a separate audio channel for record reproduction only. The economics today prohibit this technique, but it was employed in some of the earlier, rather expensive radiograms.

Weak volume and distortion are the most common record reproduction complaints, excluding those, of course, concerned with deck mechanics. The first thing to do is to make sure that the record itself is free from fault, and it is a good idea to keep one or two test records available of known quality.

The next thing is to suspect the pick-up cartridge. Most radiograms use crystal or ceramic cartridges, and these, especially the former, deliver substantial signal voltage allowing connection straight into the grid circuit of the voltage amplifier, via the radio/gram switching. Provided this type of cartridge is loaded into a circuit of not less than 1MΩ (preferably 2MΩ) equalisation is not necessary.

If the input load is less than this, however, there is a bad drop in bass response, but most well-designed radiograms incorporate a simple matching pad (RC network) between the cartridge and the amplifier input to secure the best output response from the cartridge used. For this reason, therefore, the correct replacement cartridge should be used.

It is often difficult to decide whether the cartridge or stylus is responsible for the poor gram reproduction. Weak output accompanied with distortion (radio all right) almost always indicates a faulty cartridge, and this can sometimes be proved by applying a very small side-pressure to the pick-up-head while it is playing a disc, first one side and then the other. If this restores volume and decreases the distortion, the cartridge is faulty.

High distortion but not necessarily low volume, with a tendency for the pick-up to skate across the disc, indicates a worn stylus. It is important that the correct replacement stylus be used. The effects resulting from a cartridge and/or stylus defect are given in Record Symptom 10.

★10

It should be noted that mono-only records will eventually cease to be made and that all issues will then be stereo ones. As there is no such thing as a "compatible record" (mono/stereo), radiograms will have to be equipped with cartridges of sufficient vertical compliance to track the complex stereo groove without damage and with the minimum distortion. Compliance, incidentally, is the reciprocal of stiffness—thus, high compliance means low stiffness.

Already such mono cartridges are being developed for ordinary radiograms ready for when the time comes. Indeed, radiogram owners even today may want to convert to allow the mono reproduction of stereo discs. This can be achieved by using a stereo cartridge (of similar characteristics to the existing mono one) and connecting the left and right channels in parallel.

These remarks, of course, do not apply to stereo radiograms, which already have suitable cartridges.

BATTERY AND MAINS/BATTERY AUDIO

Finally, a few words about audio troubles in battery and mains/battery valved portables. The audio section of such receiver is given in Fig. 5-4. The convention is again followed, but the voltage amplifier is a pentode instead of a triode. Also, a diode is fitted in the pentode for detector and a.g.c. The audio signal developed across the anode load of

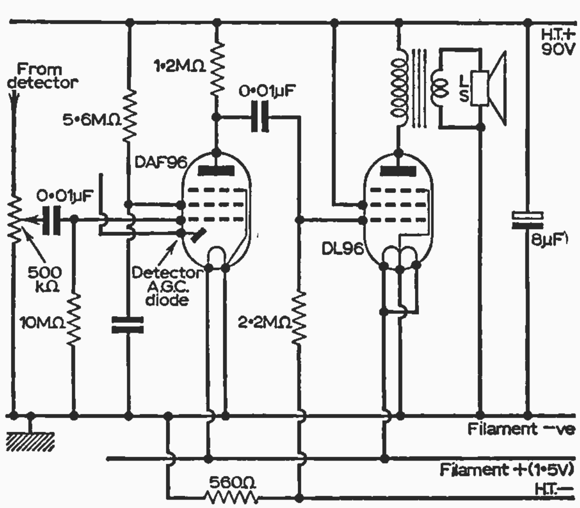

Fig. 5-4: The audio section of a battery portable.

the voltage amplifier is fed through the coupler to the grid of the output pentode.

The voltage amplifier pentode is biased partly by grid-current (10MΩ grid resistor and partly by the l.t. voltage. That is, the potential difference between the control grid and the heater, or part of the heater. output pentode is mainly biased by the volts-drop across the 560Ω resistor connected in series with the h.t. negative supply). H.T. current for the whole set flows through this resistor, so the voltage across it is dependent on the current taken by other sections of the set.

The voltage is negative with respect to chassis and the filament of the output pentode, and the valve is biased by its control-grid being returned to the negative side through the 2·2MΩ resistor. This technique is common in this type of set. Common faults include:

Distortion: Caused by low batteries, low emission or over-run valves, increase in value of anode and screen feed resistors, very slight electrical leak in coupling capacitors, alteration in the value of the 560Ω biasing resistor and change in bias voltage due to other parts of the set taking abnormal h.t. current.

Low Sensitivity: Caused by low emission valves, increase in value of the screen-grid voltage amplifier feed resistor or leak in associated bypass capacitor. Increase in value of anode load resistor. Low batteries.

Motor-Boating: Caused by open-circuit h.t. line bypass capacitor.

Whistling as H.T. Battery Runs Down: Open-circuit of the main h.t. line electrolytic capacitor (the 8μF in Fig. 5-4) is a frequent cause of this symptom. H.T. battery may also have to be replaced if its "on-load" voltage is less than 60V.

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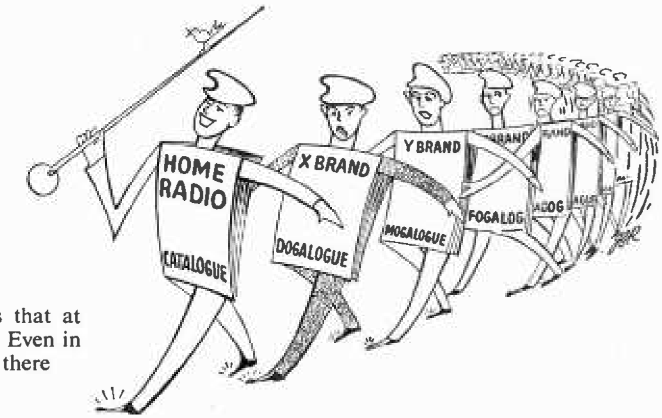

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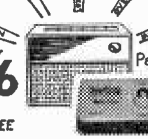

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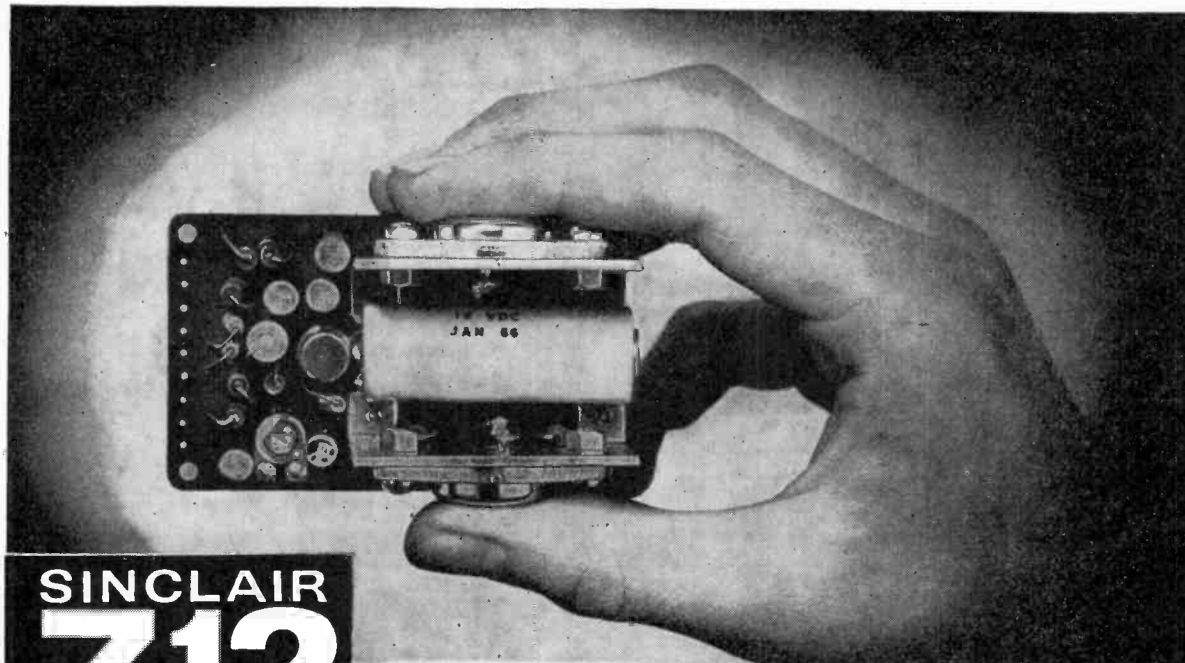

SINCLAIR Z.12

COMBINED 12 WATT HI-FI AMP AND PRE-AMP

- ULTRALINEAR CLASS B OUTPUT
- 12 WATTS RMS CONTINUOUS SINE WAVE OUTPUT (24 W. Peak)
- 15 WATTS MUSIC POWER OUTPUT (30 W. Peak)
- INPUT—2mV into 2Kohms
- OUTPUT suitable for 15, 7·5 and 3 ohm speakers. Two 3 ohm speakers may be used in parallel

Eight special H.F. transistors are used in the Z.12 to achieve results to compare favourably in every way with the costliest equipment you can buy. But the Z.12 is smaller, is more versatile and certainly saves you money. It is preferred not only for mono and stereo hi-fi, but it also enjoys enormous popularity fitted in electric guitars, used for P.A. and intercoms and many other instances where power and dependability are imperative. This superb amplifier with integrated pre-amp is supplied ready-built, tested and guaranteed together with the Z.12 manual which details matching, volume and tone control and selector switching circuits using one Z.12 in mono or two in stereo.

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- 15-50,000 c/s ±1dB
- IDEAL FOR USE WITH BATTERIES

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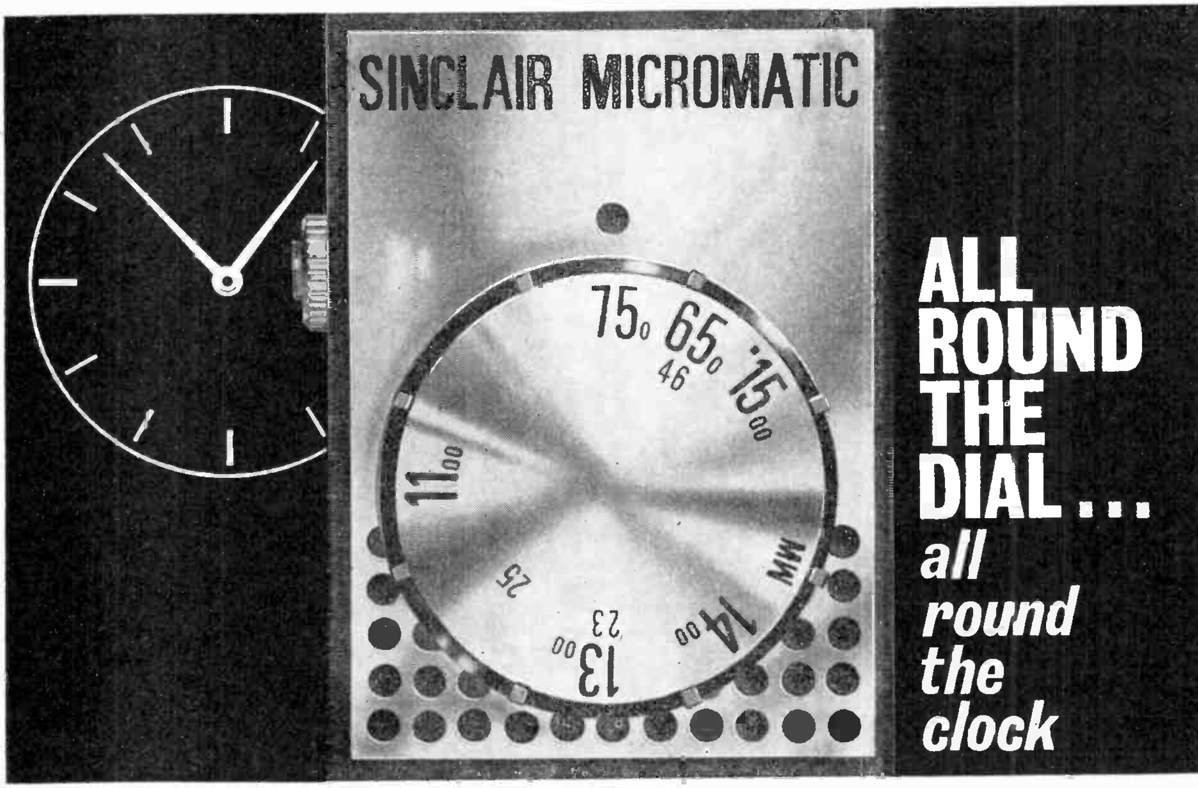

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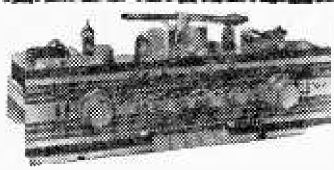

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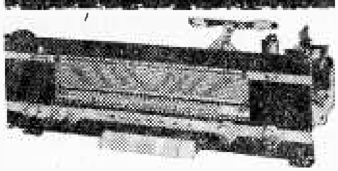

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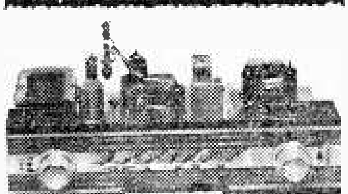

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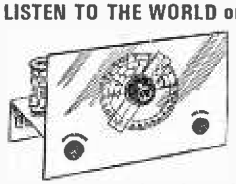

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All parts available separately.

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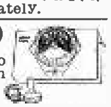

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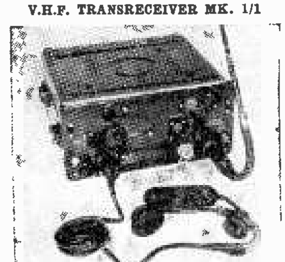
V.H.F. TRANSRECEIVER MK. 1/1



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U76	4/-
U78	4/-
U81	10/-
U191	11/-

U193	7/-
U251	6/-
U281	12/-
U282	12/-
U301	11/-
U403	7/-
U404	5/-
U801	17/-
UABC80	5/3
UAF42	9/-
UB41	10/-
UBC41	8/-
UBC81	8/-
UBF80	6/6
UBF89	7/-
UBL21	10/-
UC92	6/-
UCC84	9/-
UCC85	6/6
UCF80	9/6
UCH21	9/6
UCH42	9/-
UCH43	8/-
UCH81	6/3
UCL81	9/-
UCL82	7/3
UCL83	9/-
UF9	10/-
UF41	8/-
UF42	9/-
UF43	8/-
UF80	7/-
UF85	7/6
UF86	9/-
UF89	7/-
UL41	9/-
UL84	6/6
UM4	10/-
UM80	5/-
UM81	10/-
UU5	8/-
UU7	10/-
UU8	7/-
UU9	7/-
UU10	8/-
UY1N	9/-
UY21	9/-
UY41	6/6
UY82	9/6
UY85	6/-
VP23	3/6
VP41	5/-
VU39	8/-
W81M	6/-
W107	7/-
W729	10/-
X76M	7/6
XC12	6/6
XC15	4/6
XC16	7/-
Y63	8/-
Y65	5/-
Z22	5/6
Z62	5/-
Z63	9/-
Z66	10/-
Z759	23/-
Z803U	15/-
Z900T	13/-

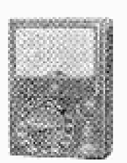
TRANSISTORS

OC16	25/-	OC141	22/6	AF117	6/-	GET116	12/-
OC23	15/-	OC170	6/-	AF118	14/-	GET872	7/3
OC24	17/6	OC171	6/-	AF124	9/-	GET875	9/6
OC25	9/6	OC200	7/6	AF125	8/6	GET880	12/-
OC26	8/-	OC201	17/6	AF126	8/-	MAT101	8/6
OC28	12/6	OC202	13/6	AF127	8/-	MAT120	7/9
OC29	14/9	OC203	10/6	AF178	12/6	MAT121	8/6
OC35	12/6	OC204	15/-	AF186	15/-	V30/30P	20/-
OC36	12/6	OC205	15/-	AFY19	22/6	2G309	5/-
OC42	5/-	OC206	22/6	AFZ11	17/-	2G371A	5/-
OC43	9/-	AC107	10/-	AFZ12	12/6	2G381	5/-
OC44	5/-	AC125	6/6	ASY26	6/6	2G403	6/-
OC45	4/6	AC126	6/6	ASY28	6/6	2N410	3/6
OC70	5/-	AC127	6/6	ASZ20	7/6	2N412	3/6
OC71	5/-	AC128	8/-	ASZ21	15/-	2N697	13/-
OC72	5/-	AC176	7/6	BCY33	8/-	2N753	6/6
OC73	9/-	ACY17	8/6	BCZ11	10/6	2N756	6/6
OC75	6/-	ACY18	5/6	BFY50	6/6	2N1132	27/-
OC76	6/-	ACY19	6/6	BFY52	6/6	2N1134	37/-
OC77	8/-	ACY20	5/-	BSY26	8/6	2N1304	6/-
OC78	5/-	ACY21	6/-	BSY28	9/6	2S002	20/-
OC78D	5/-	ACY22	5/-	BSY65	8/6	2S003	20/-
OC81M	5/-	AD140	16/-	GET103	5/6	2S004	20/-
OC8DM	5/-	AD149	16/-	GET104	8/-	2S005	50/-
OC83	5/-	AF102	18/-	GET106	16/-	2S006	20/-
OC84	5/-	AF114	8/-	GET113	5/-	2S012	140/-
OC122	14/-	AF115	7/-	GET114	4/-	2S018	60/-
OC139	8/-	AF116	7/-	GET115	8/6		
OC140	10/-						

THYRISTORS

1/40, 400 p.i.v. 1 amp, TO5 outline (wire ended). Gate voltage 3·0v. at 10mA max...... 5/-
3/40, 400 p.i.v. 3 amp, stud mounted. Gate voltage 3·0v. at 20mA max................ 7/6
BLUE SPOT, 200 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max.............. 12/6
GREEN SPOT, 400 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max........... 17/6

MULTIMETERS



TYPE MF 15
A.C. and D.C. voltage ranges: 0-10-50-250-500-1000V.
D.C. current ranges: 500µA-10-100mA.
Resistance ranges: 100MΩ-1MΩ.
The meter is also calibrated for Inductance (10-1000H), capacity (0.6µF) and output level measurements. Sensitivity 2000 Ω V. Accuracy ±2.5% for D.C. and ±4% for A.C. measurements.
Dimension: 5¼ x 3¾ x 1⅛in. Price £3.3.0.
Type 108-IT: 24 range precision portable meter. 5000 o.p.v. D.C. Volts: 2.5-10-50-250-500-2500V. A.C. Volts: 10-50-100-250-500-2500V; D.C. current 0.5-5-50-500mA Resistance 2000-20,000 ohms; 2-20 megohms. Power output calibration in A.C. for 600 ohms line. Complete with prods and batteries, £5.5.0. P. & P. 5/-.

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS
1B20K10 100 piv, 2 amps, dimensions 1.4 x 1.4 x .6in. 25/-
1B40K10 100 piv, 4 amps, dimensions 1.4 x 1.4 x .6in. 30/-
1B100M10, 100 piv, 10 amps, dimensions 2¼ x 2¼ x 1in. 85/-
Postage 1/6 per rectifier.

WE REQUIRE KLYSTRONS TYPE 723A/B and 2K25
ALSO VALVES TYPE 813, 845, 810, 4C35, 5C22.
30/- paid subject to test

25 WATT SOLDERING IRONS

200–250 watt exceptionally well made lightweight soldering irons with polished wooden handles and chromium plated body. Angle bit of sufficient length for long life. No breakable plastics used in construction. PRICE 16/- (P.P. 2/-). Spare bits 1/9. Spare elements 3/6.

CATHODE RAY TUBES

DG7-5,	55/-	09J	80/-	4SP11	200/-
DG7-6,	80/-	2AP1	40/-	4SP31	200/-
VCR138	50/-	3BP1	55/-	5BP1	80/-
VCR138A	60/-	3GP1	40/-	5CP1	40/-
VCR139A	30/-	4GP4	100/-	5UP7	60/-
09D	80/-	4SP7	200/-	90EG4P	180/-

ZENER DIODE SELECTION CHART

250-260mW 5%: 4·7v. OAZ200 10/-; 5·1v. OAZ201 9/6; 5·6v. OAZ202 7/-; 6·2v. OAZ203 7/-; 6·8v. OAZ204 7/-; 7·5v. OAZ205 7/-; 8·2v. OAZ206 7/-; 9·1v. OAZ207 9/6; 60·0v. BZY11 6/6; 80·0v. BZY13 6/6. 260mW 15%: 4·3v. OAZ208 6/6; 4·7v. OAZ209 6/6; 6·2v. OAZ210 6/-; 7·5v. OAZ211 6/-; 9·1v. OAZ212 6/6; 12·0v. OAZ213 6/6. 1·5W 5%: 2·4v. Z2A24CF 5/6; 2·7v. Z2A27CF 5/6; 3·0v. Z2A30CF 5/6; 3·6v. Z2A36CF 5/6; 3·9v. Z2A39CF 5/6; 16·0v. Z2A160CF 5/6; 20·0v. ZNB20 9/6; 30·0v. Z2A300 CF 5/6; 33·0v. Z2A330CF 5/6. 2·25W 10%: 4·25v. VR425B 6/6. 2·5W 5% 3·0v. Z3B30CF 6/6; 27v. Z3B270 CF 6/6; 30·0v. Z3B300CF 6/6. 5·25W 10%: 4·25v. VR475A 8/-; 5·75v. VR575BA 8/-; 7·0v. VR7A 8/-; 11·0v. VR11A 8/-; 13·0v. VR13A 8/-. 7·0V 5%: 5·6v. OAZ222 9/6; 6·8v. OAZ224 10/-.

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The Celeste 7-transistor Portable Radio; The Spinette Record Player	(June 1963)	5/-
Transistor Radio Mains Unit; 7 Mc/s Transceiver	(June 1964)	5/-
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(b) We cannot undertake to supply detailed information for converting war surplus equipment, or to supply circuitry.

(c) It is usually impossible to supply information on imported domestic equipment owing to the lack of details available.

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