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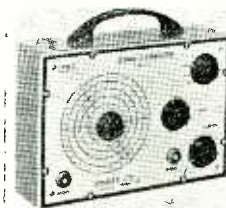
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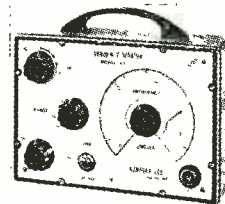
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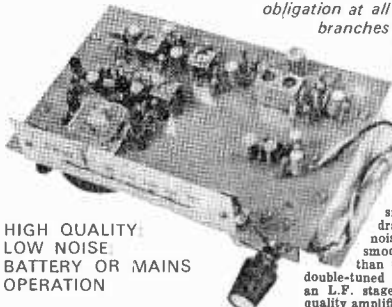
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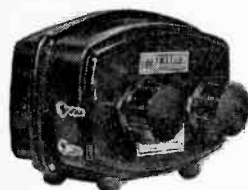
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185 3/3	6C4 3/3	6L6G 7/-	10F18 9/-	25Z4 6/3	813 80/-	DL94 5/9	ECL83 9/9	EZ81 5/-	PCF808 11/6	U14 7/-	VR105/30
1T4 2/6	6C5G 4/-	6L18 7/6	10L1 10/-	25Z5 7/-	866 10/-	DL95 6/6	ECL86 8/9	EZ80 5/-	PCF808 11/6	U19 30/-	VR105/30
3A4 3/6	6C6 3/6	6Q7G 9/-	10LD11 10/-	25Z6 11/-	934 4/-	DL96 6/-	EP9 20/-	EZ82 9/6	PCF808 11/6	U25 10/6	VR105/30
3A4 6/6	6C8G 8/-	6Q7GT 9/-	10P13 14/-	25D7 5/-	1625 5/-	DM70 5/-	EP36 3/-	EZ83 10/-	PCF808 11/6	U26 10/6	VR105/30
3Q5 6/6	6C6D6 22/6	68A7 7/-	11E3 27/6	30C1 6/6	4022AR15/-	DY86 6/6	EP37A 7/6	KT36 22/6	PCF808 11/6	U78 3/6	VT25 29/-
3R4 3/6	6CH6 5/9	68C7 6/6	12A7 4/6	30C15 11/6	5763 10/6	DY87 7/9	EP39 6/-	KT61 17/6	PCF808 11/6	U191 11/6	VT31 59/-
3V4 5/9	6CW4 12/-	68G7 4/-	12A7T 3/9	30C17 12/-	7193 1/8	E880C 12/-	EP41 8/6	KT66 20/6	PEN44 20/-	U251 12/6	VU111 6/-
5R4G 8/9	6D6 2/9	68H7 2/6	12A7 3/9	30F14 13/6	ATT4 1/9	EABCS0 5/9	EP50 2/-	KT81 10/-	PEN14 20/-	U301 13/-	VU120 12/6
5U4G 4/-	6E8 5/9	68J7 5/-	12A7 3/9	30P14 14/-	ATT4 1/9	EABCS0 5/9	EP50 2/-	KT88 27/6	PEN45 6/-	U403 6/-	VU508 30/-
5V4G 5/-	6F1 9/-	68L7GT 4/9	12AX7 5/9	30P15 12/6	ATT5 7/-	EAF42 7/6	EP55 6/6	KTW61 4/3	PEN46 2/9	U801 18/6	W81M 5/-
5Y3GT 5/-	6F5G 5/-	68N7GT 4/9	12BA8 8/-	30P17 12/-	ATT7 4/6	EB41 4/6	EP86 6/3	KTZ41 8/-	PL36 9/-	UABC80 5/6	X79 41/-
5Z4G 8/-	6F6G 4/-	68Q7 8/-	12BE6 5/3	30P19 14/-	AU5 6/-	EBC33 7/-	EP89 5/6	M14 17/6	PL81 7/6	UAF42 8/9	XH1-5 5/-
6/301.2 11/3	6F8G 4/6	68Q7 8/-	12C8GT 7/6	30P19 14/-	AU5 6/-	EBC33 7/-	EP91 3/3	M16 12/6	PL82 6/6	UBC41 8/-	XF1-5 5/-
6A7 15/-	6F8G 4/6	68Q7 8/-	12C8GT 7/6	30P14 14/-	AZ1 8/9	EBC41 8/3	EP92 2/6	MSP4 12/6	PL83 6/-	UBC81 7/6	XSG1-5 10/-
6A8G 12/6	6F11 12/6	6U5G 7/6	12E1 19/6	30P14 14/-	AZ31 7/9	EBC90 3/3	EP98 6/-	MU14 4/-	PL84 6/6	UBF80 5/9	Y63 7/6
6AC7 3/-	6F13 5/-	6V6M 8/-	12J5GT 2/3	30P14 14/-	CBL31 15/-	EBF80 6/6	EP183 6/6	MX40 12/6	PL500 14/6	UBF89 6/6	Tubes
6AK5 4/6	6F14 12/6	6V6G 3/6	12K7GT 7/3	35A5 17/-	CCH35 21/-	EBF83 7/-	EP184 6/6	N37 10/-	PX4 18/6	UCC84 8/6	3EG1 40/-
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6AU6 6/-	6J6 3/-	7C5 10/-	12SH7 2/9	37 5/-	DOC90 8/-	ECC82 4/9	EL84 4/6	PC86 9/-	PY801 7/-	UCL93 8/9	VCR97 35/-
6B8G 2/-	6J7M 8/6	7C6 6/-	12SK7 2/9	42 4/6	DF33 8/-	ECC83 5/9	EL90 5/6	PC88 9/-	R2 4/-	UF41 8/-	VCR517R
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6BA6 4/6	6J7GT 8/6	7H7 5/-	14H7 9/-	50C5 5/9	DF91 2/6	ECC85 5/-	EL95 6/-	PC97 7/6	R19 7/-	UF89 6/-	VCR517C
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Tracking pressure (depending on cartridge)
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Compliance 5.2×10^{-6} cm/dynes

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Standard UA70 player £12.18.3*

C1 Ceramic Cartridge

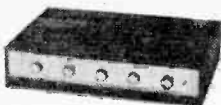
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*Inc. P.T. surcharge

HI-FI AMPLIFIERS — TUNERS — RECORD PLAYERS

20+20
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AA-22U



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TRANSISTOR MIXER. MODEL TM-1. A must for the tape enthusiast. Four channels. Battery operated. Similar styling to Model AA-22U Amplifier. Kit £11.16.6. Assembled £16.17.6

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10W
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MA-12



9+9W
STEREO
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S-99



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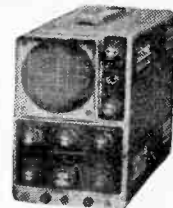
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OS-2



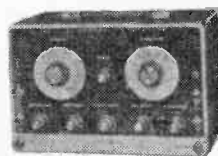
VVM, 1M-13U



V-7A



RF-1U



HFW-1

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VALVE TUNERS



TUNERS
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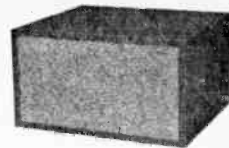
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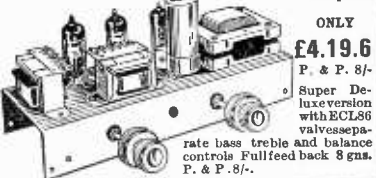
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High imp. For desk or hand use. High sensitivity, 18/6. P. & P. 1/6. ACOS HIGH IMPEDANCE CRYSTAL STICK MIKES. Listed at 42/-. OUR PRICE 21/-; P. & P. 1/6.

Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser. 35/-; P. & P. 3/-.

NEON A.C. MAINS INDICATOR. For panel mounting, cut out size 1½ x 1 x ¾in. deep inc. terminal. White case with lens giving brighter light. For mains 200/250v. 2/6 each. P. & P. 6d. (6 or more post free).

BRAND NEW T.V. U.H.F. TUNER AND SOUND AND VISION I.F. PANEL

By world famous maker. Suitable for use in conversion of TV sets to BBC2 (625 line reception). OFFERED (less valves) AT THE BARGAIN PRICE OF ONLY 27/6. Post paid. (The components are worth far more than our price for the complete unit and due to the very high value we regret that no correspondence can be entered into regarding this item).

QUALITY RECORD PLAYER AMPLIFIER

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC85, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 3in. d. x 6in. h. Ready built and tested. PRICE 69/6. P. & P. 6/-.

ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE 89/6. P. & P. 7/6.

DE-LUXE QUALITY PORTABLE R/P CABINET

Uncut motor board size 14½ x 12in. Clearance 2in below. 5½in. above. Will take above amplifier and any B.S.R. or Garrard Autochanger or Single Player Unit (except AT60 and 8P25) Size 18 x 15 x 8in. Price £3.9.6. Carr. 9/6.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU/12 £2.6.6 Carr. 5/6.

GARRARD 8P25 De Luxe £12.0.0 Carr. 5/6.

B.S.R. GU7 with unit mounted pickup arm. £4.18.8 Carr. 5/6.

AUTO CHANGERS

Latest B.S.R. U425 Super 8lim. £6.2.6

GARRARD 1000 with special Hi-Fi cartridge £6.18.6

GARRARD 2000 2710.0. GARRARD 3000 £8.15.0

GARRARD AT90, £10.10.0 Carr. 6/6 on each.

All the above units are complete with t/o mono head and sapphire stylus or can be supplied with compatible stereo head for 12/6 extra.

BRAND NEW CARTRIDGE BARGAINS!

ACOS GP 69/1 MONO CARTRIDGE. For E.P. and L.P. Complete with stylus. ONLY 18/6. P. & P. 1/-.

BRAND NEW 3 OHM LOUDSPEAKERS

5in., 12/6; 6½in. 15/-; 8in. 22/6; 10in. 27/6; 7in. x 4in. 18/-; 10in. x 6in. 27/6.

E.M.I. 8in. x 5in. with high flux magnet, 21/-.

E.M.I. 13½ x 5in. with high flux ceramic magnet, 42/- (15 ohm 45/-). P. & P. 5in. 2/-, 6½ x 8in. 2/6, 10 x 12in. 3/6 per speaker.

SPECIAL OFFER!

Limited number of 12in. 10 watt "R.A." Speakers: 3 ohm 25/-; 15 ohm 27/6. P. & P. 3/6.

E.M.I. PLASTIC CONED TWEETERS, 2½in. 3 ohm. Limited number 12/6 each. P. & P. 1/6.

BRAND NEW HEAVY DUTY 12in. SPEAKERS.

Response 45 c/s-13 Kc/s. 1½in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at 89/6. P. & P. 5/-, Also 25 watt Guitar Model available at £5.5.0. And 35 watt Guitar Model £8.5.0.

VYNAIR AND REXINE SPEAKER AND CABINET

FABRICS. Approx. 54in. wide. Usually 25/- yard. Our PRICE 13/6 per yard length. P. & P. 2/6 (min. one yd.) S.A.E. for samples.

SPECIAL OFFER!

GENUINE HIGH QUALITY TYGAN FABRIC. 48in. wide. Our price 10/- per foot run. P. & P. 1/6. 30/- per yard run. P. & P. 2/6.

SEMI SHROUDED DROP THRO' MAINS TRANSFORMER. Tapped pri. 200/250 v. Sec. 300-0-300 v. at 110ma. and 6.3 v. at 3 amp. (E/8 screen). Stack size 3½ x 3½ x 1½in. 30/-; P. & P. 3/6.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240 v. Sec. 9-0-9 v. at 500 ma. 11/-; P. & P. 2/6.

MAINS TRANSFORMER. For transistor power supplies. Tapped pri. 200-250 v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6.3 v. at 5 amp for dial lamps etc. Drop thro' mounting. Stack size 1½ x 3½ x 3½in. 27/6. P. & P. 4/6.

MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1½ x 1½ x 1½in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/- P. & P.

7-10 watt OUTPUT TRANSFORMERS to match pair of ECL 86's in push-pull to 3 ohm output. ONLY 11/-; P. & P. 2/6.

MINIATURE PRECISION AIR-SPACED TWO GANG TUNING CONDENSER. 176 + 176 p.p.f. size 1½" w x 1" d x 1½" h with vanes open. Built in trimmers 5/-; P. & P. 1/-.

TWIN TELESCOPIA AERIAL. Comprising two 3-section heavily chromed rods. Closed 12in. each extending to 32in. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket, coax lead and plug. Suitable for F.M. or TV. 12/6. P. & P. 2/6.

SPECIAL HARVERSON OFFER! FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dorrner and Wadsworth Ltd. Supplied ready fitted with two 0005 tuning condenser for AM connection. Prealigned FM section covers 86-102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (EL19) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-, Order quickly! Limited number also available with precision geared 3:1 reduction drive, 30/-; P. & P. 3/-.

MATCHED PAIR AM/FM I.F.'s

Comprising 1st I.F. and 2nd I.F. discriminator (455kc/s 10.7Mc/s). Size 1 x 1½ x 2½in. high. Will match above tuner head. 11/- pair. P. & P. 2/-.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PCC84 and PCP80 valves 34-38 Mc/s I.F. Blaculite for Channel 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P. & P. 3/9.

GORLER F.M. TUNER HEAD

88-100 Mc/s, 10.7 Mc/s I.F. 15/- plus 2/- P. & P. (ECC85 valves 8/6 extra).

3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only

£4.5.0

P. & P. 6/-

HSL 'FOUR' AMPLIFIER KIT

A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.



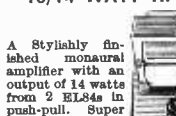
● Heavy duty double-wound mains transformer with electrostatic screen. ● Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss. ● Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very

low distortion factor. ● Suitable for use with guitar microphone or record player. ● Provision for remote mounting of controls or direct on chassis. ● Chassis size only 7½in. wide x 4in. deep. Overall height 4½in. ● All components and valves are brand new. ● Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ● Supplied complete with valves output transformer (3 ohms only) screened lead, wire, nuts, bolts solder etc. (No extras to buy). PRICE 79/6. P. & P. 6/-.

Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).

This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

10/14 WATT HI-FI AMPLIFIER KIT



A Stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-16Ω speaker and 3 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6 (Free with parts) All parts sold separately. ONLY 27.9.6. P. & P. 8/6. Also available ready built and tested complete with std. input sockets, £25.0.0. P. & P. 8/6. Carrying case for above 28/6. P. & P. 7/6.

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66% RECORD PLAYING UNITS

Ready for plugging in to Amplifier or Tape Recorder.
RP2 Consisting of Garrard SP25 fitted Goldring
CS90 high compliance ceramic Stereo/Mono
cylinders with diamond stylus, above. Only **19½ Gns.**
plinth & cover. Normally £25. Carr. 15/-
RP3 As above but with Goldring Lenco GL68 Trans-
cription unit and CS90 Cartridge. Normally
over £33. Terms avail-
able both units. Only **26½ Gns.**
Carr. 15/-

TAPE AMPLIFIERS 4-5 Watts Output
Suitable for use with Magnavox 363 Decks. Switched
equalization, 220-250V Mains A.C.
Originally 13 Gns. Size 11" x 21" x 6" **£6.19.11**

AUDIOTRINE HI-FI SPEAKER SYSTEMS

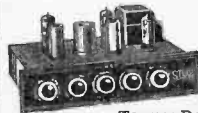
Consisting of matched 12in. 1200m line,
15 ohm high quality speaker; cross-over
unit and Tweeter. Smooth response
and extended frequency range ensure
surprisingly realistic reproduction.
Standard 10 watt rating. **5 Gns.**
Senior 20 watt rating. **6 Gns.**
122/10 speaker 7 Gns. Carr. 8/9. Carr. 6/9



Tweeters R.A. 3 ohm or 15 ohm 25/9

15 watt HI-FI TRANSISTORISED AMPLIFIER TYPE A15

with integral pre-
amp tone control
stages. Output for 3,
7.5 and 15 ohm spkrs.
Kit includes Printed
Circuit and all parts
Type semi-conductors
Heat sink and full wir-
ing instructions or with printed circuit
fully wired and tested £12/9. Frequency
Response: ±1dB 20-20,000 c.p.s. Harmonic
Distortion: 0.1%. Hum and Noise:
-80dB. Sensitivity: 2mV. Bass Control:
+9dB to -14dB at 40 c.p.s. Treble Con-
trol: +8dB to -13dB at 10 Kc/s. Will
operate from batteries giving 24v. Suit-
able Power Pack Kit 47/9 or ready built 69/9



Terms: Dep. 38/- and 9 monthly payments 25/5 (Total £13.4/9).

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

PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON
EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE.
Employing valves ECC83, ECC83, ECL86, ECL86, ECL86, E281.
Response: ±2dB 20-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 5 millivolts
maximum. Harmonic Distortion: (each channel): 0.2%. ★Four-position tone
compensation and Input Selector Switch. ★Stereo/Mono switch.
★Will amplify direct from Tape Heads. ★Neon panel indicator. ★Handsome Perspex Frontplate.
★Separate Bass "Lift" and "Cut" and Treble "Lift" and "Cut" controls. Output transformers are high-
quality sectionally wound to required specification. Output matching for 3 and 15 ohm spkrs. on 14 Gns.
each channel. Complete set of parts, point-to-point wiring diagrams and instructions. Carr. 12/6
Or factory assembled, tested and supplied with our usual 12 months guarantee. Carr. 12/6
Or Deposit £3 and 9 monthly payments 43/2 (Total £22.4/6). Send S.A.E. for leaflet.



Carr. 12/6

R.S.C. TFM1 TRANSISTORISED VHF/FM RADIO TUNER

Total cost of parts
with detailed wiring
diagrams and instruc-
tions.
Carr. 10/- **12½ Gns.**

Or factory built
15 Gns. Or in Teak
finished cabinet as
illustrated 19 Gns.
Terms: Deposit 25
and 9 monthly pay-
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Total £22.11.0.



★ High-sensitivity ★ 200-250V. A.C. Mains
operation. ★ Sharp A.M. Rejection.
★ Drift-free reception. ★ Output suitable
for any amplifier (approx. 500 m.v.).
★ Simple alignment instructions. ★ Output
available for feeding tuning meter.
★ Output for feeding Stereo Multiplexer.
★ Tuner head using Silicon Planar Tran-
sistors. ★ Designed for standard 80 ohm co-axial input.
Made to visually match our Super 15 and 30 amplifiers and of the same high
standard of performance and reliability. The pre-wired tuning head facili-
tates speed and simplicity of construction. Printed circuitry. Only first grade
transistors and components used. Our latest product giving you the best at
half the cost of comparable units. Stereo Multiplexer available.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy cast
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Latest high efficiency ceramic magnets.
Dual Cone for extended frequency range.
Plastic treated surround giving
low fundamental resonance. Respon-
se 40-18,000 c.p.s. Impedance
3 or 15 ohms. Carr. 5/6.



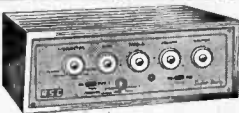
HF81D 8in. 10 WATT 4 Gns.
HF101D 10in. 12 WATT 5 Gns.
HF100D 10in. 15 WATT £25.10
HF121D 12in. 20 WATT £26.10
HF127D 12in. 30 WATT 9 Gns.

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

FULLY TRANSISTORISED 200/250V. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 9-4 ohms.
Maximum instantaneous Peak power output 28 watts.
PRINTED CIRCUIT CONSTRUCTION.
LATEST MULLARD TRANSISTORS. AD149, AD149,
OC127Z, OC81Z, OC44, OC44, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R.
Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITY: Magnetic P.U. 4 mV. Crystal or
Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head
2.5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to -14dB at 10 Kc/s.
BASS CONTROL: +12dB to -15dB at 50 c.p.s. HUM LEVEL: -75dB.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s. 0.25%.
NEGATIVE FEEDBACK 12dB.
Complete Kit of parts with full constructional details and
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Supplied factory built 15 Gns. Carr. 12/6. Terms: Deposit 49/- and 9
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Teak veneered cabinet as illustrated. 19 Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND
SUPPLIED BY LEADING BRITISH MANUFACTURERS.

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SPECIFICATIONS COMPARE MORE
THAN FAVOURABLY WITH SIMILAR
AMPLIFIERS AT TWICE THE COST



11 Gns.

R.S.C. SUPER 30 STEREO AMPLIFIER

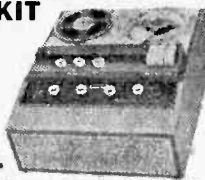
A DUAL CHANNEL VERSION OF THE SUPER
15. Employing Twin Printed Circuits. Close tolerance
Ganged Pots. Matched Components.
CROSS TALK: -62dB at 1,000 c.p.s.
CONTROLS: 5 position Input Selector, Bass Control,
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Mono Switch, Tape Control, 5wch. Mains Switch.
INPUT SOCKETS (Matched Pairs). (1) Magnetic P.U.
(2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/
Microphone. Operation of the Input Selector Switch
assures appropriate equalisation.
Rigid 18 s.w.g. Chassis. Size approx. 12in. Wide, 3in. High
and 8in. Deep. Neon Panel Indicator. Attractive Facia
Ganging and Balance Control, apply also to Super 15.

THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH
ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic,
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SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY
USING WITH FIRST RATE ANCILLARY
EQUIPMENT. All required parts, point to point wiring
diagrams and detailed instructions. Carr. 13/9
Or factory built 25 Gns. Or deposit 83/9 and 9 monthly payments 56/9
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£4.14.9 and 9 mthly paymts 65/10 (Total £24.7.3). Send S.A.E. for leaflet.

18½ Gns.

AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST: CAN BE ASSEMBLED IN AN HOUR. **ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.** Incorporating the latest Magnavox Tape Deck. The Audiotrine High Quality Tape Amplifier with switched equalisation for each of 3 speeds. High Fidelity P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a handsome Portable Cabinet of latest styling finished dark grey leathercloth. Size 14 1/2 x 8 1/2 in. and circuit. Purchased separately would total approx. \$34. Performance equal to units in the £50-£60 class. Deposit **26 1/2 Gns.** 4 gns. and 9 mthly payments 59/6 (Total 29 1/2 gns.). 4 Track Model 3 gns. extra. Carr. 19/6



LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 11in., 3 1/2in., 7 1/2in. 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. **10 1/2 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**

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, C234. Separate Bass and Treble Controls. Sensitivity 12 millivolts to that any kind of Microphone or Pick-up is suitable. Designed for Clubs, Schools, Theatres, Dance Halls or Outdoor Functions, etc. For use with Electric 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. 50 c/s. A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts **12 Gns.** Carr. 12/6. Supplied factory built with EL34 output valves. 12 months guarantee for 15 gns. If required performed 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 £17.10.5).

JASON VHF/FM TUNER Complete kit with valves. **£6.19.11** polished walnut finish. Model M for 10" speaker **59/11** Model S for 12" spkr & tweeter **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, E281. 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 -80dB. 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, Electric Guitar, etc. Reserve Power provides 300v. 30m.a. and 6.3v. 1.5a. for Radio Tuner or Tape Pre-amp. Size approx. 12 x 9 x 7 1/2 in. For A.C. mains 200-250v. 50 c/s. Output for 4 and 15 ohm speakers. Kit complete to last nut. Chassis **£8.15.0** 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 CASH:** Kit 11/6. **ASSEMBLED UNITS:** Deposit 36/- and 9 monthly payments of 25/9 (Total £13.8.3). Send S.A.E. for illustrated leaflet of Cabinets, Speakers, Mikes, etc.

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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 FIDELITY 15in. 30 watt 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". **49 1/2 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. **29 1/2 Gns.** Or Deposit £4.14.6 and 9 monthly payments of 66/- (Total £34.8.6). Carr. 17/6.

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Suitable for use with any of our Amplifiers. Controls are Speed (frequency of interruptions). Depth (for 4 1/2 Gns. heavy or light effect). Volume and Switch. **4 1/2 Gns.**

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Type BML. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 1/2 in. 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 9/12 v. D.C. output. Max A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9.

HEAVY DUTY SELENIUM RECTIFIERS 19/9 12v. 15 amps. F.W. (Bridged). Only

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. **19 1/2 Gns.** Carr. and 9 monthly payments of 43/7 (Total £22.15.3). S.A.E. for leaflet.

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Listed £38.10.0. Brand new **2 Gns.**
15 **WATT** Ex Grand Amplifiers **7 Gns.**
15 ohm output. 2 inputs Carr. 7/6.

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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. **14 Gns.** 42 x 10 x 5in. Or Deposit 44/- and 9 mthly pmts 31/5 (Total £16.6.9) Carr. 10/-
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for Guitar, Vocal or Instrumental Group

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FANE HEAVY DUTY HI-FI SPEAKERS 5 Gns.

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Limited number at fraction of list price 15 ohms. impedance. Brand new, guaranteed.

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300-0-300v. 100mA, 6.3v. 4a. 0-5-6.3v. 2a. 33/8
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For Mullard 510 Amplifier 33/8
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425-0-425v. 200mA, 6.3v. 4a. c.t. 6.3v. 3a. 67/9
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250-0-350v. 80mA, 6.3v. 2a. 0-5-6.3v. 2a. 25/8
200-0-250v. 100mA, 6.3v. 4a. 0-5-6.3v. 2a. 33/8
300-0-300v. 100mA, 6.3v. 4a. 0-5-6.3v. 2a. 33/8
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Suitable for Mullard 510 Amplifier 39/8
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4 TRANSISTOR 2W AMPLIFIER. Size 2 1/2 x 2 1/4 x 1 1/2, 3, 8 or 15Ω output, 9 volt battery operated. Highly sensitive. Price (less battery) 52/6d. P. & P. 1/6d.

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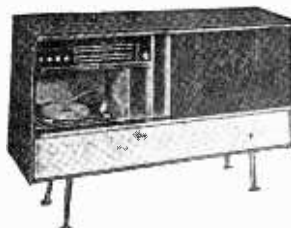
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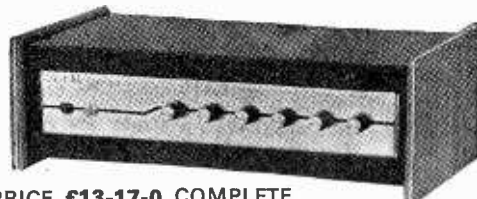
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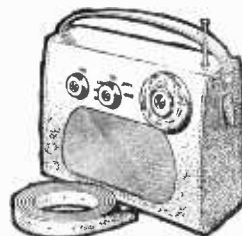
The perfect portable and the ideal car radio. (Uses PP7 batteries, available anywhere.)

● EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, etc.

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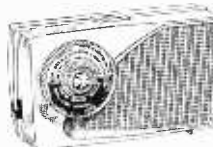
P. & P.
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Parts Price List and easy build plans 3/- (Free with kit)

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★ 8 stages. Six transistors and two diodes. Covers Medium and Long Waves and Extra Band for EASIER tuning of LUXEMBOURG etc. Top grade 3in. Loudspeaker for quality output. Two R.F. stages for extra boost. High 'Q' 6in. Ferrite Rod Aerial. Approx. 350 Milliwatts push pull output. Handsome pocket size case with gilt fittings. Size 6½ x 3½ x 1½. (Uses long-life PP6 battery). Carrying strap 1/6 extra.



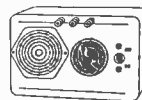
This amazing receiver may be built for only

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Checks gain of R.F. and Audio Transistors. Also checks for noise level and duds. All parts ready to be assembled in attractive grey case with red grille, complete with Dial, Knobs, and Dynamic Speaker. Simple assembly instructions free with set of parts. 29/6. P. & P. 2/6.



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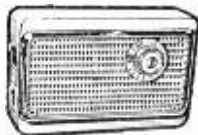
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"Home, Light, A.F.N., Luz, all at good volume." G.P., Durham.

● 7 stages—5 transistors and 2 diodes

Fully tunable over Medium and Long Waves. Incorporates Ferrite rod aerial, tuning condenser volume control, new type fine tone super dynamic 3in. speaker, etc. (Uses 1289 battery with red speaker grille. (Uses 1289



Attractive case. Size 6½ x 4½ x 1½. (Uses 1289 battery, available anywhere.)

● Extended M.W. band for easier tuning of Luxembourg etc.

Total cost of all parts now only

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P. & P. 3/6. Parts Price List and easy build plans 2/- (Free with kit)

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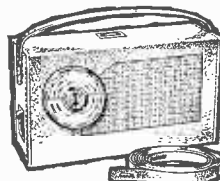
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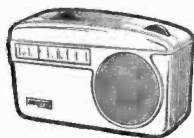
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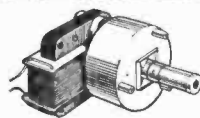
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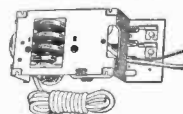
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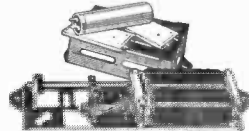
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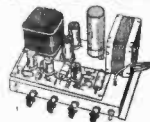
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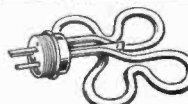
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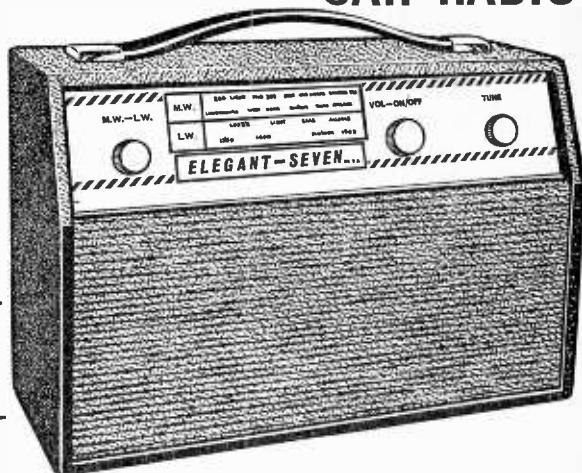
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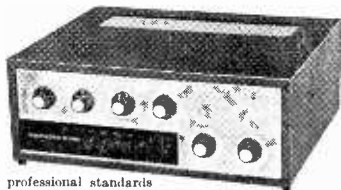
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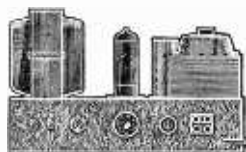
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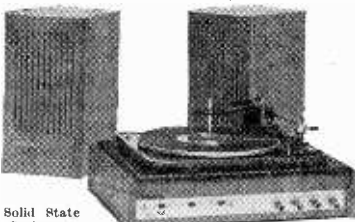
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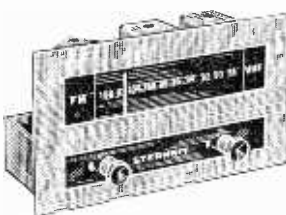
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PRACTICAL WIRELESS

VOL 43 No 2

issue 724

JUNE 1967

Clause 7—No person shall make equipment undesirable to Government if new Act becomes law.

AT first glance, the changes to the Wireless Telegraphy Act outlined in the recently published Bill appear to be a bold attempt to remedy some long outstanding ills. Strong measures are suggested for dealing with TV licence dodgers and evaders of car radio licences. But the section dealing with illegal radio transmitting merits a much closer investigation.

This journal has long campaigned for action to resolve the ludicrous situation whereby it is perfectly legal to import, offer for sale and buy 27Mc/s walkie talkies and yet impossible to use them without breaking the law. The Board of Trade, the GPO and radio dealers have for years shrugged off responsibility with some agility.

In the new Bill, the PMG introduces provisions presumably to deal with this situation and that of radio bugging devices. Presumably, we say, because in the potentially explosive Clause 7 it states that "where it appears to the PMG to be expedient", the provisions should "apply to wireless telegraphy apparatus of any class or description" and that "no persons shall manufacture any apparatus of that class or description whether or not for sale".

This loose phraseology could be interpreted to cover any form of radio apparatus deemed to be "undesirable" and amounts virtually to a blanket control over the manufacture, importation, sale and *construction* of radio equipment of any type which the Government considers undesirable.

We do not say that the PMG intends to use the sweeping powers implicit in the seven sub-sections of Clause 7, nor even that he has considered them in detail, but the fact remains that if this Bill becomes law as it stands, these powers will not only be available to the present administration but to all future PMGs.

In seeking to deal with specific problems the PMG has wielded a bludgeon. If classification is difficult it would have been better to isolate the real objectives by making it illegal to sell or buy *any* transmitting equipment except on the production of a suitable transmitting licence. This way, innocent bystanders would not get involved. Unless, of course, the PMG has more sinister motives.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

Leader	97
News and Comment	98, 122
Audio Fair Report	104
On the Short Waves <i>by John Guttridge and David Gibson, G3JDG</i>	129
Practically Wireless <i>by Henry</i>	133
New Books	145

CONSTRUCTIONAL

The "Denette" <i>by P. Matthews</i>	100
Keying the Ten-Five Tx <i>by A. S. Carpenter, G3TYJ</i>	103
Dual Function Signal Generator <i>by H. Webster</i>	115
Simple Transistor Tester <i>by G. A. Bobker</i>	120
Vibrato and Tremolo Units <i>by A. J. Bassett</i>	124
4-Channel Mixer/Amplifier <i>by F. L. Thurston</i>	134

GENERAL ARTICLES

Repairing Radio Sets, Part III <i>by Gordon J. King</i>	107
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JULY ISSUE WILL BE PUBLISHED ON JUNE 9th

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes London, W.C.2. Subscription rates, including postage: 36s. per year to any part of the world. © George Newnes Ltd., 1967. Copyright in all drawings, photographs and articles published in "Practical Wireless" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

Kits a success

During the past eight years I have built kits supplied by seven of your regular advertisers and I cannot fault one of them. In all cases the instructions were clear and easy to follow.

I think those who make claims that their kits can be built in an hour are not helping their own cause. Who wants to build a kit in an hour anyway? It is a hobby and how much better to make the interest last for a few days at least. There are sure to be setbacks, then out comes the test-meter and the interest is extended further.

Most early efforts fail because of poor soldering, through getting resistor values mixed up and switch and coil connections wrong.

I do not grudge the charge of 6d. per valve, bearing in mind the cost to the retailer of cartons, corrugated paper, packer's wages, etc. I would give a vote of thanks to the firms who send me good valves promptly, cheaply and beautifully packed.

P. J. Plater.

Wallington.
Surrey.

★ ★ ★

Mr. A. H. Brough of Staffordshire (P.W. May issue) will probably find that most firms specify P. & P., and packing involves corrugated card, cartons and often stout cardboard boxes, also employment of a packer and checker, all of which has to be paid for to ensure adequate protection in transit.

A. Deverell.

Rickmansworth,
Hertfordshire.

U.S. Citizens' Band

After reading the column "Amateur Bands" in the May 1967 issue, it appears to me that there is some confusion concerning Citizens' Band licences in the United States. As an American now living in England, perhaps I can straighten out the situation.

A Citizens' Band licence may be issued to any U.S. citizen over the age of 18 with no exam. required. A fee of \$8.00 (£2 17s. 2d.) is charged, and the licence allows the bearer to transmit on the 27Mc/s band with a power not exceeding 5 watts. A callsign is assigned which usually consists of a three letter prefix followed by four numbers.

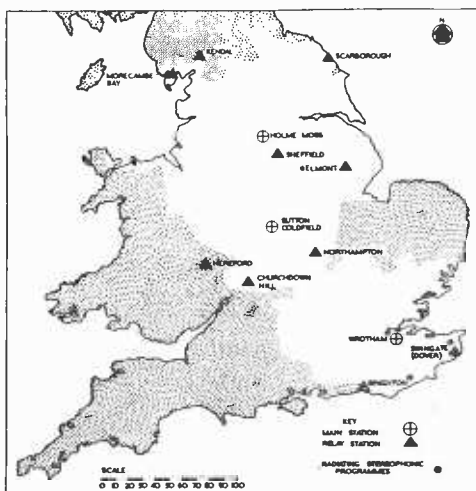
Any person, regardless of age, may use Citizen Band frequencies so long as the transmitter power does not exceed 100mW, and a vertical antenna of not more than 60 inches in length is used. No callsigns are issued to these people, as they are not required to register with the Federal Communications Commission.

D. L. Potash.

Ambleside,
Westmorland.

NEWS AND..

VHF STEREO TRANSMISSIONS



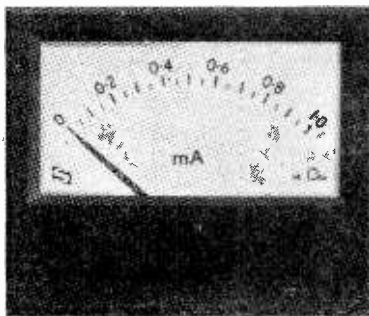
Work is in hand to extend the BBC stereophonic transmissions, at present radiated from Wrotham, Swingate and Brighton, to Sutton Coldfield and Holme Moss and certain relay stations fed from them, early in 1968. The unshaded part of the map indicates the areas in which satisfactory stereophonic reception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

ELECTRONICS CONFERENCE IN GREAT BRITAIN

A Technical Conference and Exhibition devoted to the engineers who build and produce electronic equipment will be held at Brighton in October 1968. This is the first such conference and exhibition ever to be held in this country or Europe.

Called NEP/CON-INTERNATIONAL it has for some time been held twice-yearly in the U.S., and will present a wide-ranging international technical programme. It will cover the most recently developed techniques such as printed circuitry, micro-miniaturisation, component and equipment manufacture etc. Talks will be given by leading engineers from the U.S., U.K. and Western Europe. Also there will be an exhibition where the latest components materials and machines will be on display.

SUB-MINIATURE METER



Sifam Electrical Instrument Co. Ltd., Woodland Road, Torquay, Devon, have introduced a new sub-miniature instrument in the "Director" series of moving-coil instruments.

The new "Director 14" is exceptionally compact, having an overall size of 1.92in. by 1.65in. with a scale length of 1.34in. It is flush mounting requiring a panel cutout of 1.5in. diameter.

The company emphasises that, despite its size, the instrument is a glazed-front, quality unit built to BS89: 1954 accuracies (i.e. ± 2.5 per cent of full-scale deflection). The case is made from a special reinforced plastic with a matt black finish, resulting in an elegant yet highly practical case style, which blends well with modern equipment panels.

...COMMENT

PANEL LIGHTS TO ELECTRIC ORGANS

From Henry's Radio Ltd. comes the 1967 Electronic Components, Equipment and High Fidelity Catalogue. This edition—now over 200 pages—is more comprehensive than those published in previous years and includes details of many new items supplied by Henry's, including their Mayfair Portable Electronic Organ.

Included in this issue are five free discount vouchers which when used enable the customer to obtain 2s. in the pound discount. It is also interesting to note that further discounts are allowed for equipment in the Hi-Fi section of the catalogue.

The price of the catalogue is 7s. 6d. plus 1s. postage and copies may be obtained from Henry's Radio Ltd., 303 Edgware Road, London, W2.



PIRATES—ALL OR NOTHING

Discussing the Marine and Broadcasting (Offences) Bill in the House of Commons recently, Mr. Ian Gilmour unsuccessfully suggested that the Government should restrict the scope and impact of some offences covered by the Bill. He maintained there was no reason why penalties should be imposed on scriptwriters and others who provided material for the pirates. He had not, however any objection to imposing penalties on those who ran the pirate stations. Answering, the Postmaster General, Mr. Edward Short, said to omit the clause from the Bill would enable the pirates to continue receiving advertising revenue, records and tapes, etc., from which they made up their programmes and attracted an audience. It would make the legislation almost ineffective. Publication of information about future programmes of the pirate stations is to be prohibited.

The Bill had been carefully drafted, Mr. Short told the House, to catch only things which served as advertisements. References to past broadcasts would not be affected by the Bill but references to future broadcasts would be. Also anybody in this country giving assistance to the pirates will be liable when the Bill becomes an Act.

Referring to Clause 6 of the Bill (Penalties and Legal Proceedings) Mr. Short moved an amendment to increase the maximum penalty for unlicensed transmitting from £100 to £400. He maintained that £100 was nothing more than petty cash to a successful pirate broadcaster.

ELECTRIC EYE HELPS TO TUNE



From Philips comes a new four waveband portable costing 19½ guineas. Included in the features is an "electric eye" tuning guide which doubles up as a battery condition tester. Another feature is a separate battery cartridge holding four U11 batteries which is released from the radio at the touch of a button. Wavebands covered are long, medium, short and f.m. Output is 380mW, and a telescopic aerial is provided for reception on v.h.f. and s.w. Cabinet measures 9½ x 5 x 1½ in. and is finished in black polystyrene with silver grille.

New members wanted

I am writing on behalf of the Sheffield Amateur Radio Club which urgently needs new members. Anyone interested in any aspect of radio, especially amateur radio and short wave listening would be most welcome at any of our meetings. These are held every Friday evening at 8.00 p.m. at 8 Sandbeck Place, Sheffield 11.

Anyone requiring further information or details on how to reach the club H.Q. should contact me at the address below.

G. Watson. 25 Underwood Road,
Woodseats,
Sheffield 8,
Yorkshire.

Well done Sirs

I am writing this letter to express admiration of two 60-year-old gentlemen whose letters appeared during 1965 stating that they had obtained their Amateur licences. These gentlemen fired my enthusiasm and I started to study for the RAE in October 1965 and passed in May 1966. I then started Morse practice and received my Pass slip recently.

I hope that this letter will encourage others, as I myself am 47 years of age. All study was done at home from library books and guidance obtained from the RSGB Radio Amateurs' Examination Manual and a study of five years' examination papers. The Morse code was also self-taught by means of an oscillator and a tape recorder.

F. Woolliscroft.

Whitley Bay,
Northumberland.

The spirit of readers

You printed a request in your "CQ" column for me in the May issue of this journal and within hours of PRACTICAL WIRELESS being on sale I had a satisfactory reply. In fact, someone personally brought around the "wanted" magazines and many other readers wrote to me.

I. Nicholls.

Kilburn,
London, N.W.6.

U.K. Police State?

I would like to bring to the attention of other readers that if the Government gets its own way on the amendments to the Wireless Telegraphy Act, we shall be told what we can build and what we cannot. This is very wrong and I suggest readers in agreement with me write to the P.M.G. personally—Edward Short, M.P., House of Commons.

C. Rolls.

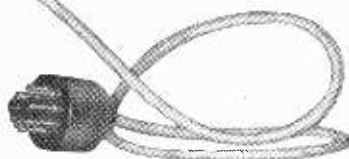
Highgate,
London, N.6.

[We are not very keen on the Government's proposals, for it covers virtually anything: see the Leader page for our views.]—Editor

More News and Comment on Page 122



P.MATTHEWS



THE "Denette" is an easy-to-build receiver designed for use as a small mains portable. It is ideal for the kitchen or den where high quality sound reproduction is not essential. The controls on the prototype are tuning (which could be switched), volume, and fine reaction which is not required for local station reception. Both coarse reaction and tone are pre-set but could be brought out to separate controls on the front panel if desired. With a three foot piece of flex as an aerial the sensitivity is comparable to the average transistor portable, and in Northern Scotland the prototype receives Radio Luxembourg very well after dark.

The receiver contains very few components most of which are not critical, the circuit is thus ideal for experimentation. Both long and shortwave coverage can easily be added by the addition of

suitable coils and a wavechange switch. This modification is described later in detail. Although two modern miniature valves are specified using B9A valveholders, the older octal-based types such as the 6SL7 and 6V6 should function equally well. If these older valves are used then the valvebases should be wired accordingly, since the pin connections are different to the B9A base wiring shown in the circuit and layout diagrams.

CIRCUIT DESCRIPTION

The two-valve circuit contains three stages—detector, a.f. amplifier and output. The power supply unit (p.s.u.) is built on a separate chassis which enables it to be used to power other equipment.

The regenerative detector (V1A) has unusual input circuitry. The signal from the aerial is fed to a capacitive potential divider consisting of C1/C2, through the tuning coil L1 to the grid of V1A. The d.c. continuity between grid and chassis is established by the grid leak R2, and resistor R1 is wired between aerial and earth to prevent a charge building up on the aerial. Feedback is effected by L2 and TC1, the fine control being made by adjustment of VR1. Note that TC1 is insulated from the chassis. Slight detuning is evident because VC1 is across the valve grid-to-cathode capacitance which alters slightly as the valve warms up. Detuning is also affected to some slight degree as the reaction is varied, but these effects are small and are thus ignored. The value of the anode load resistor R4 may be adjusted if regeneration cannot be readily obtained. Other methods of obtaining regeneration

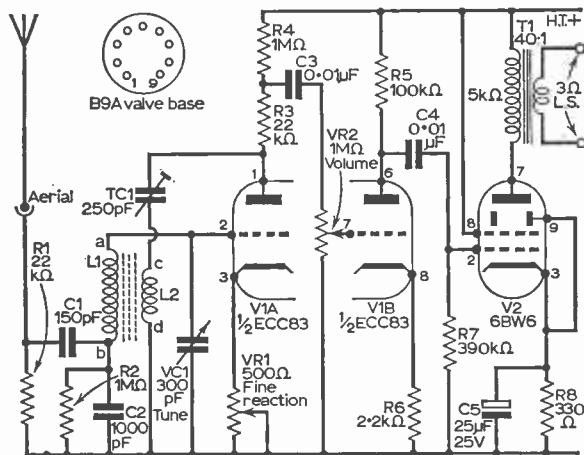


Fig. 1 (above): Circuit diagram of the Denette.

Fig. 2 (below): Suggested power supply circuit.

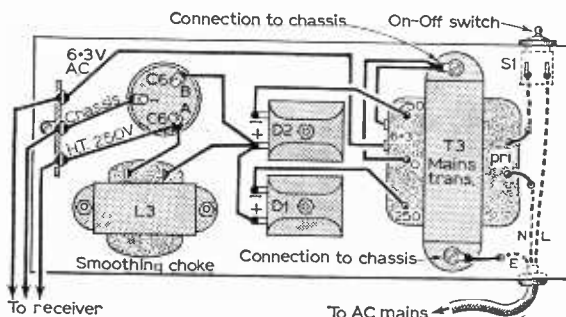
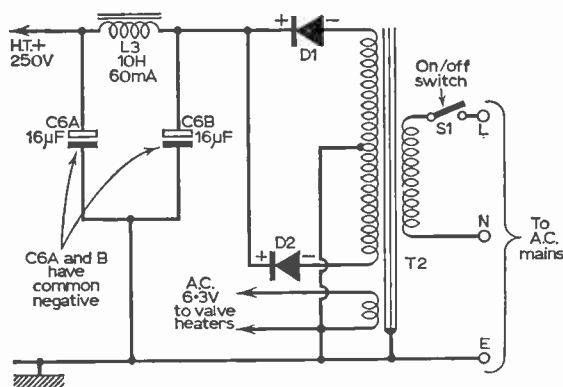


Fig. 3: Layout of the power supply shown in fig. 2.

are possible, however the method used works out very well. For those who like to experiment, the different "textbook" methods could be tried out.

From the junction of R3/R4 the detected signal passes via C3 and VR2 to the grid of the audio frequency (a.f.) amplifier V1B. This is an a.f. stage of conventional design other than the omission of the cathode by-pass capacitor usually wired in parallel with R6. In order to cut down the bass response when a miniature speaker is used, the cathode decoupling capacitor C5 may be reduced to 2 μ F. This will help prevent undue damage to the small speaker due to bass overloading. This step will not be necessary with the larger type of speaker. When using a small speaker, R8 could be increased to 1k Ω , this will limit the output and effect some economy.

POWER SUPPLY

The power unit is straightforward, using two contact-cooled metal rectifiers in a full-wave circuit. A valve, such as the EZ80, could be fitted in place of D1/D2, but this would require to be fed with 6.3 volts and would also contribute considerable heat. A double-wound mains transformer is strongly recommended and suitable types are readily obtainable from advertisers in this journal. It would be possible to make use of a miniature 220 volt 20/25mA mains transformer of the type used in tuners and preamps. In this case R8 should be increased to 1k Ω in order to reduce the current consumption.

MODIFICATIONS

Although the tuning capacitor VC1 gives satisfactory station separation on the medium and long wavebands, crowding occurs on the short waves. To combat this it is suggested that the s.w. band be split into two sections, and that the effective

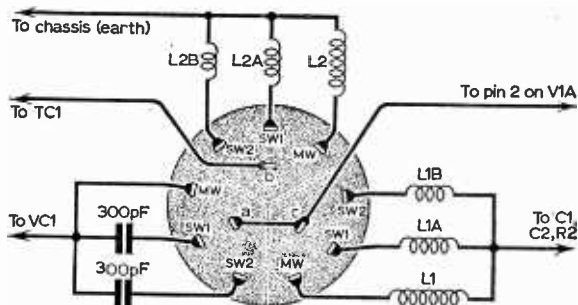


Fig. 6: Rear view of the wavechange switch for three-band coverage.

capacitance of VC1 be reduced. This latter suggestion can be easily performed by interposing a capacitor between VC1 and the junction of terminal a on L1, and pin 2 of V1A. By placing a fixed capacitor in series with VC1 in this way, the effective swing or tuning range of VC1 is restricted to a portion of the band. However, since this small portion of the band is now spread out over the entire 180° swing of VC1 instead of a few degrees, the stations received will be easier to tune. If the extra capacitor is made 300pF to start with, the constructor can experiment from there.

If band switching is required then a suggested method is shown in Fig. 6. As shown, the switch will give three-waveband coverage, the actual wavelengths covered depending on the coils used. Details for suitable coils are given later on.

Other worth-while modifications are a tone control and a socket for headphone reception. The simple top-cut control shown in Fig. 5 works well. The voltage rating of the capacitor between the anode and the headphone socket must be at least 1.5 times the nominal h.t. voltage. Do not fit a

Fig. 5 (below): Suggestions for the inclusion of a tone control, and for using headphones. It would be unwise to use a capacitor of less than 400V working in the phones lead to the anode of the valve.

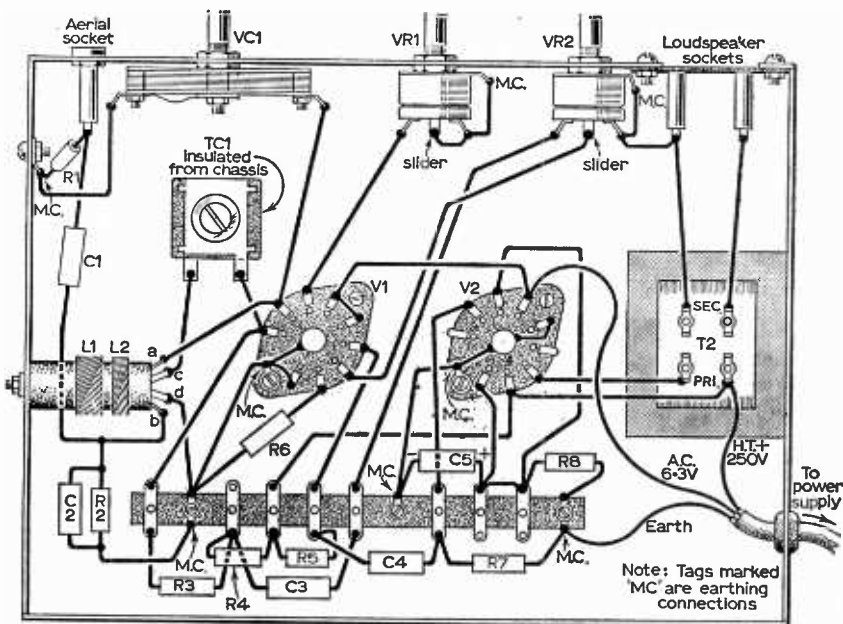
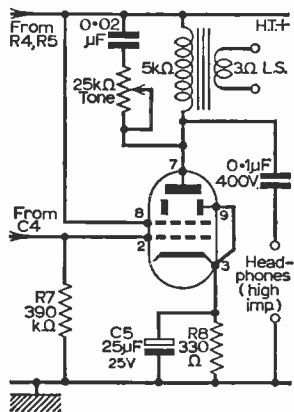


Fig. 4: Layout of components and wiring below chassis. Note that TC1 must be insulated from the chassis. This is essential for the circuit to function properly.

"normally closed" jack socket or this will short the signal to earth when the phones are removed.

CONSTRUCTION

The following procedure is recommended when all the parts, including the chassis have been obtained. Drill the chassis and mount all components securely. Wire up the power unit starting with the mains transformer. Wire the heaters of the valves with twisted leads and plug in both valves. After a careful check of the wiring switch on and note that the heaters inside the valves light up. If they do not, switch off immediately and re-check the wiring.

Switch off, unplug the valves and disconnect the power supply unit from the mains. Proceed with the wiring up of V2 starting with the output transformer working back to R7. Keep all leads as short as possible. Fit one end of C4 to pin 2 of V2

COIL	NO. OF TURNS	WAVEBAND
L1	45	MW
L2	5	
L1a	12	
L2a	1-2	SW1
L1b	5	
L2b	1-2	SW2

The table shows details of the coils. The type of wire and former diameter are mentioned in the text.

and temporarily solder a wire to the other end. After checking the wiring plug in V2 only, connect the loudspeaker and switch on. After the valve has warmed up there should be a slight hum from the speaker, this should increase as the wire on C4 is touched. There should be no whistling or clicking nor any instability. If the stage is functioning properly switch off, remove the wire from C4 and unplug the valve.

Wire up V1B and fit one end of C3 to the volume control VR2. Check the wiring and plug in both valves. Repeat the test for V2. As the wire from C3 is approached a loud hum should be heard. If all is satisfactory switch off, unplug the valves.

Wire up V1A taking every care to keep connections short and direct. Unscrew TC1 to minimum capacitance and set VR1 to maximum resistance. Now check all wiring very carefully as this last stage is more complex. Plug in the valves and the aerial (2 or 3 yards of flex), then switch on. There should be no howling or whistling, if there is reduce the coupling i.e. the distance between L1 and L2. If preferred the number of turns on L2 may be reduced instead. Now screw up TC1 to the point where howling or whistling just commences. Tune in a station, backing down VR1 until oscillation has just stopped. This is the most sensitive position for the set. Retune VC1 if necessary and set the volume control to a convenient level. Switch off taking care not to touch the h.t. line without first discharging the capacitors C6a and C6b to chassis. Check all components to ensure that there has been no overheating. The receiver may now be enclosed in its cabinet.

COILS

The medium wave coil on the prototype consisted of 45 turns of 22s.w.g. enamelled copper

★ components list

Resistors:

R1	22kΩ	R5	100kΩ
R2	1MΩ	R6	2.2kΩ 10%
R3	22kΩ	R7	390kΩ
R4	1MΩ ½ watt	R8	330Ω

Capacitors:

Capacitors:				
C1	150pF	C5	25μF 25V	} electrolytics
C2	1000pF	C6A	16 + 16μF	
C3	0.01μF	C6B		
C4	0.01μF			
TC1	250pF compression trimmer			
VC1	300pF variable, solid dielectric			

Valves:

V1	ECC83
V2	6BW6

Diodes:

D1	Contact-cooled metal
D2	rectifiers 250V 60mA

Potentiometers:

VR1	500Ω	VR2	1MΩ
-----	------	-----	-----

Inductors:

L1	see text
L2	
L3	L.F. Choke 10H 60mA
T1	Output transformer ratio 40:1 suitable for mains pentode.
T2	Mains transformer 250-0-250V 60mA, 6.3V 3A.

Miscellaneous:

Two B9A valveholders, tagstrip, ½in. coil former, chassis, nuts, bolts, solder, wire, 1 Pole 2 Way on/off switch, wire for coils.

COMPONENTS FOR MODIFICATIONS

Tone Control:

25kΩ potentiometer
0.02μF capacitor

Headphone Reception:

Normally open jack socket
0.1μF 400V capacitor

Wavechange:

3 Pole 3 Way rotary switch, Extra coil formers, Wire for coils, Two 300pF capacitors

wire pile wound, with L2, five turns, wound over the top. The former was ½in. diameter fitted with an adjustable dust core. The former size is not critical except that the number of turns will need to be adjusted if the former is a different diameter to that specified. A long wave coil would require 140 turns for L1 and around 13 turns for L2. For short wave coverage less turns will be needed and if the wire used is thick enough no former will be required since the turns can be self-supporting. If the diameter is about one inch and the wire 16-20s.w.g. then between 5-12 turns for L1 and 1 or 2 turns for L2 will give coverage of 19-49 metres. These turns should be wound side by side on the same axis. ■

PRACTICAL ELECTRONICS

special project

★ MINIATURE R/C INSTALLATIONS ★

plus

★ CRO Trace Doubler ★

★ Video Pattern Generator ★

ON SALE MAY 12

KEYING THE TEN-FIVE TX

by A.S. Carpenter

G3TYJ

Double the usefulness of the neat little rig described in the January, 1967 issue

DURING the time this transmitter has been on the air many pleasing and surprising reports have been received on both "Top Band" and "80" metres running but 9W and working into a G5RV multi-band dipole antenna at 28ft. through a Z-match coupling unit. In all fairness, however, it should be stated that results and reports do depend to a great extent on band conditions at any given time. The modest power available can hardly be expected to combat or flatten heavy QRM often prevalent—particularly at week-ends—but under fair conditions the transmitter performs surprisingly well and enables one to enjoy many interesting QSO's.

As originally described the transmitter is a phone rig (A3 emission) only, suitable for Fixed station or /M working, but the versatility can be increased beneficially to include keying thus enabling the user to work c.w. (A1 emission) when necessary.

It is not difficult to include keying facilities in the transmitter; only small changes are required which consist of fitting a voltage stabiliser to the v.f.o. section, adding a suitable key jack socket and adding a switch to disable the modulator.

Modifications

Fitting a voltage stabiliser. The inclusion of a type OA2 voltage stabiliser tube to the v.f.o. is obligatory but necessary if "chirp" is to be avoided; chirp is most likely to be found when the transmitter is working "straight through", viz. on "Top Band". The stabiliser chosen has a B7G base and a holder can be fitted between the v.f.o. valve proper and the front panel.

Theoretically, it would seem sufficient to apply a stabilised voltage to the triode section of the

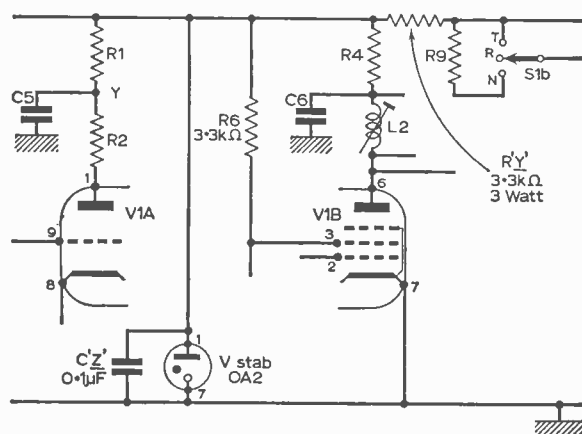


Fig. 1: Skeleton circuit showing position of extra stabilising components.

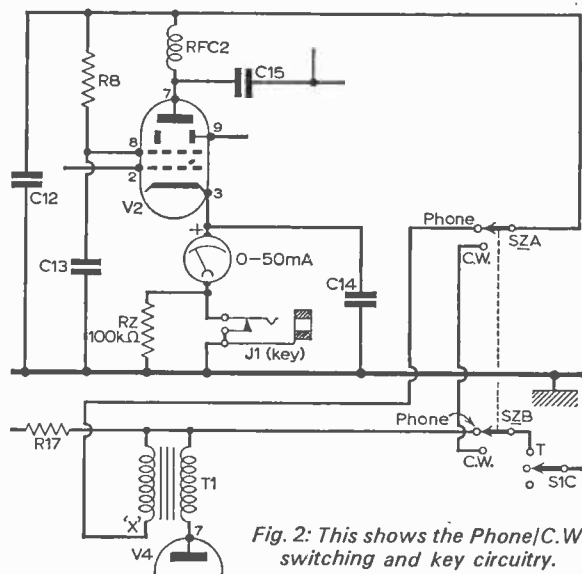


Fig. 2: This shows the Phone/C.W. switching and key circuitry.

ECF80 valve only and this may be tried by connecting the stabiliser to point "Y" of the original circuit. In practice however, it has been found most beneficial to include both sections of the valve.

The modified "bare bones" circuitry is given here in Fig. 1 and as may be seen three additional components are needed, viz. R_y — $3.3k\Omega$, C_z — $0.1\mu F$ and Vstab. Drive is diminished slightly when these items are added but 1mA is available and this is adequate.

Adding a key jack socket. By re-positioning the panel lamp and lens, a standard normally closed-circuit type jack socket may be fitted in the vacated hole. It should be connected between the negative terminal of the 0-50mA meter and the chassis; a $100k\Omega$ fixed resistor is also connected across the key jack sockets.

Disabling the internal modulator. Since the internal modulator is not required for c.w. working an additional switch is needed. Referring to Fig. 2 the added switch, SZA/B, and its connections may be seen; the key jack socket and its resistor are also shown. Other items are identical with the original circuitry with the exception that R_6 is reduced in value to $3.3k\Omega$.

Switch SZ is a DPDT toggle-type item and is easily located at the rear of the chassis above socket Sk4; it may be mounted on a small L-shaped aluminium bracket.

Provided that all wiring is correct lift the connection from pin 7 of the OA2 voltage regulator clear of the chassis and insert a testmeter set to read 0-50mA in series with the stabiliser. Switch to

—continued on page 146

SOME IMPRESSIONS OF THE 1967 INTERNATIONAL AUDIO FESTIVAL AND FAIR AT THE HOTEL RUSSELL, LONDON, MARCH 30 TO APRIL 2, AS SEEN BY THE P.W. TEAM.

Spread among the exhibition stands and hotel rooms were the static displays and live demonstrations of 96 exhibitors, an Aladdin's Cave for the audiophile. Readers familiar with the hustle and bustle of the Fair will appreciate the difficulty in seeing everything in the time available. The following notes are not intended as a comprehensive survey, but mainly impressions on trends.

Amplifiers, Tuners and Stereo

IN this field the steady migration towards semi-conductors continues. Some years ago, H. J. Leak, in his presidential address to the B.S.R.A. observed, that for power outputs of up to 15 watts per channel the valve could no longer compete with the transistor. At the Fair, transistor amplifiers in the hi-fi class were commonly offered with outputs of up to 110 watts, and although it is difficult to appreciate listening to this output in the average living room, it does indicate the advances in transistors. Most manufacturers were not content to state that the equipment was "fully transistorised" but plugged that they were silicon types. So it looks like the trend this year for amplifier enthusiasts is to acquire a "Silicon Solid Status".

The complexity of the units seems to grow each year. One can remember not so long ago being content with volume, treble and bass. Now one sees miniature Jodrell Bank-type front panels with Low-filter; High-filter; Equalisation; Input selector; Balance; Stereo reverse (should be interesting); Stereo left; Stereo right; Stereo left + right etc.

Stereo was very much in evidence and mostly solid state. The trend here was split right down the middle as regards units. Some were complete with amplifier, preamp and both speakers all in one package. Others had one or both speakers floating. Many speakers and indeed amplifiers were of the "bookshelf" type, usually in a matt wood. Listening to "Uranus" from the Planet Suite on stereo with large enclosures some 3ft. cube, and then on a couple of the small twelve inch bookshelf cabinets gave a vivid demonstration of the efficiency of the



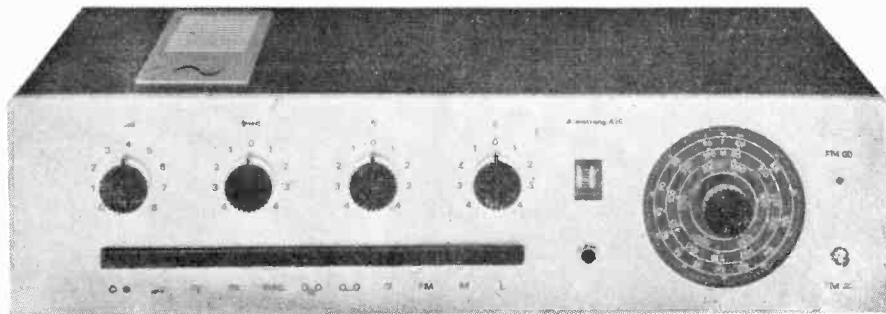
smaller units. They did lack the roundness in the bass, but the reproduction nevertheless was exceptionally good.

Prices varied, but on the whole were high, some very high. Perhaps the common-sense way in buying would be to say—if I'm satisfied with the performance of cheaper equipment then it's pointless to spend more, but if I want the ultimate in quality and my ears can appreciate the difference, then I will pay for quality.

All things considered there was nothing really startling at this year's Audio Fair. Most of the units on show are already displayed in the dealers' windows and have been for some time. Summing it all up: Transistors now outnumbered valves. Stereo is becoming commonplace and trends indicate that before long it could well be stereo only, since the units can receive and/or play mono too. Prices are high but then so is performance, and there are more knobs to twiddle. Bookshelf units are advancing with the advance in the frequency response of smaller speakers.

Perhaps next year we will have vest pocket stereo, but we wonder how they'll fit all those controls in!

The Armstrong 426 is an example of the growing complexity of audio units and the tendency towards "integration".



Tape Recorders

New trends this year in the tape recorder field were hard to find. The most noticeable was that more machines were making use of cassette loading. Also, we noticed fewer low-priced machines and more with comprehensive mixing and dubbing facilities. More are becoming available for vertical operation.

Philips, who pioneered the cassette-loading recorder market in the UK, released another battery-operated machine at the show—the EL 3302. Similar to its predecessors, it has almost double the audio output at 400mW, and an external loudspeaker socket. The price remains 27gns. Also from Philips come two mains-operated cassette-loading tape recorders—one stereo and one mono.

The range of Philips pre-recorded "Musicassettes" can be used on all of their cassette-loaded machines, and there are over 100 different mono/stereo Musicassettes available from the repertoires of EMI, Philips and Pye records.

Grundig's latest cassette-loading tape recorder, the C110, is also a mains-operated machine. Although it measures only $13\frac{3}{4} \times 9 \times 4\frac{1}{2}$ in., it has a two-watt push-pull amplifier and seven-inch elliptical speaker. Using the half-track recording system, it has a recording and play-back time (for DC90 tape) of approximately $1\frac{1}{2}$ hours. The technical specification gives a wow and flutter figure of better than $\pm 0.4\%$, a frequency range of 50c/s to 10kc/s, and a signal-to-noise ratio of better than 45dB. Grundig claim this machine to be virtually foolproof—click-in cassette loading, simple press-button controls, a green light to indicate the machine is switched on and a red warning light when the recording button is depressed. The price is 48gns.

Most of the four-track machines shown this year have comprehensive mixing facilities, permitting one to record on one channel while listening to the other. To permit this, three tape heads and independent and play-back amplifiers are necessary. An example is the Truvox R104 at 89gns. This machine, which has been on the market for some time now, has the facility aptly labelled *duo-play*.

The *Fidela* range of four-track tape desks and recorders from the Waltham Electronics Company of Geneva (handled in this country by Denham and Morley Ltd.) attracted a lot of attention for they were on show for the first time in this country. All of these are suitable for vertical or horizontal operation. The recorders have solid-state amplifiers and attractive specifications along with appropriate price tags—75 and 138gns. The tape decks are also expensive; Model 707 costs 119gns, but it comes complete with separate record and play-back amplifiers having a 30c/s to 22kc/s frequency response. The other deck, Model 780 at 145gns, also features adjustable bias for optimum performance with different types of tape.

Among the Telefunken exhibits were the Magnotophon 200 series of vertical and horizontal recorders. The 204E is a two-speed ($3\frac{1}{2}$ and $7\frac{1}{2}$ in.) stereo machine with a frequency range extending up to 18kc/s on the higher speed. This 106gn. machine has comprehensive mixing facilities.

Another semi-professional performance/stereo machine is the Tandberg Series 6x. This 'x' series is similar to earlier models, but incorporate an additional bias head, improved frequency response and

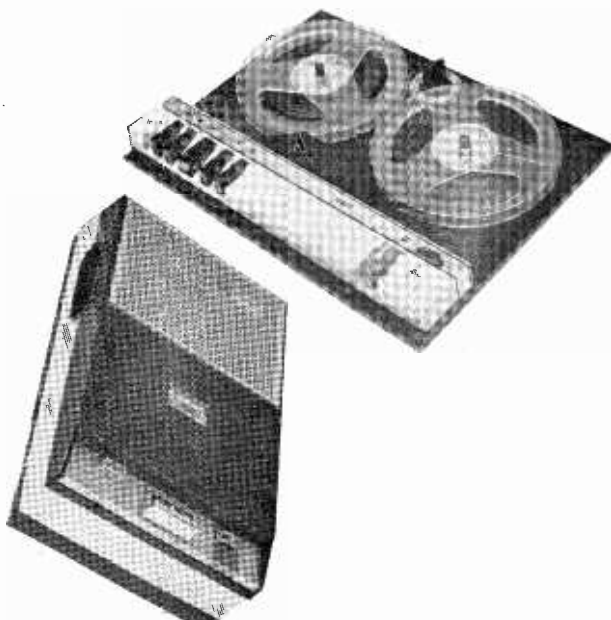


One of the Fidela vertical tape recorders shown for the first time at the Audio Fair.

signal-to-noise ratio—within 2dB from 20c/s to 25kc/s and a 62dB signal-to-noise figure on the fastest speed of $7\frac{1}{2}$ in./sec. Wow is less than 0.1% and crosstalk rejection is better than 60dB. Two and four-track recorders using this deck are offered at 115gns.

The newest model in the Uher range of professional recorders is the 1000 Report Pilot. With this machine, one can synchronise sound with film as well as reporting under professional conditions. Features of this £243 portable recorder include

Latest in the range of BSR popular tape decks—The TD20, available with a wide range of stereo or mono head arrangements.



One of the growing range of cassette tape recorders—the new Philips Model EL3302.

stroboscopic tape speed control and switchable equalisation. It has only one tape speed—7½in./sec.

BSR's latest three-speed tape deck, the TD20, introduced at the end of last year, was prominently displayed. It is available in both stereo and mono versions with two or four-track heads. The control linkage has been improved and only requires the lightest pressure to operate the direct-action keys. Wow and flutter is claimed to be better than 0.15% on 7½in./sec., 0.25% on 3½in./sec., and better than 0.35% on 1½in./sec. It will take up to seven-inch reels and there is provision for a third head.

Tape Recorder Developments Ltd., who announced their first tape deck just over a year ago had on show seven variations of their TRD 1 deck, and silicon semiconductor electronic units to complete a hi-fi system—with any of the deck variations. As an indication to the type of deck, the wow and flutter specification is as follows: 0.04% at 30in./sec.; 0.05% at 15in./sec.; 0.08% at 7½in./sec.; 0.13% at 3½in./sec.; 0.2% at 1½in./sec.; and 0.35% at ¾in./sec.

Tape Recorder Spares Limited had their usual wide range of pre-packed leads, plugs and accessories. Often it is not realised that this company deals with more than tape recorder accessories. In fact, they have a very wide range of connectors that could well solve many problems of the hi-fi and audio enthusiasts.

Microphones and Pickups

It is a very far cry from the carbon granules of yesteryear to the array of sophisticated microphones now available on the market; microphones of range and diversity to meet all requirements and depths of pocket.

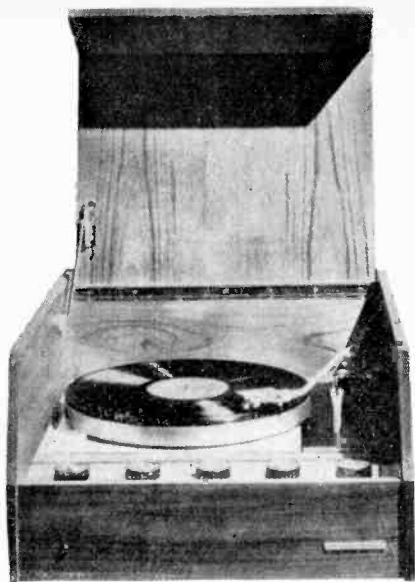
One of the new developments noted at the Fair was a dynamic unit by AKG which combines two moving coil capsules, one covering high frequencies, one covering low frequencies. Philips also



A trend in speaker enclosures—the Celestion Ditton 3-element 15-watt system for bookshelf mounting.

had a unit with two moving coil units; this was a stereo type (Model EL179) in which the two m.c. units are detachable.

Another interesting model was the Sennheiser unit which combines the directional properties of the gun microphone and the high performance of a condenser (or should we say capacitor?) micro-



Parmeko stereo record reproducer incorporating the latest in pickups—the Miniconic transistor cartridge.

phone. It is in fact, a transistorised r.f. condenser type.

It is impossible in this space to detail the many mentionable microphones on show, but those which attracted our attention included the new series of subminiature ribbon units by Lustraphone, the new Unisphere models by Shure which are based on the Unidyne dynamic cardioid type, the three new dynamic models from M.B. Mikrofonbau and the latest high-quality cardioid microphone from STC—who also showed for the first time the 4119 hyper-cardioid ribbon microphone.

Pickups, cartridges and gramophone decks, as to be expected, showed a general tendency to higher efficiency and slicker presentation. The most unusual exhibit was the new semiconductor stereo pickup introduced by Miniconic.

Insensitive to hum fields and turntable noise, the pickup is claimed to have a power output 40dB greater than a magnetic cartridge, 20dB greater than a ceramic cartridge. It functions by modulating the flow of d.c. provided by the amplifier power supply through a semiconductor strain gauge element (the resistance of which varies as the stylus is flexed) to produce signal current variations. In other words, energy is provided by an external source and not, as conventionally, by the record groove. The makers claim a frequency response of an octave below and two octaves above audible range, reduced record wear and chatter, a cleaner signal with increased dynamic range. The first British stereo equipment to incorporate this revolutionary pickup is the System 22 system marketed by Parmeko.

Also new at the Fair was the range of moving magnet stereo cartridges by Audio Technica, the new Studio 1000 range of amplifiers, tuners and speaker units by Braun and the *ffss* Mark 4 heads and cartridges by Decca. Focus of interest on the Garrard stand was their new Model 50 automatic turntable unit which incorporates pause and cue control, tubular pickup arm and calibrated force adjustment. ■

repairing radio sets

PART 3

GORDON J. KING

Having heard from H. W. Hellyer (last month) on the use and choice of tools and service equipment we now continue with fault symptoms in the "electronics" of the animal and thence to their diagnosis.

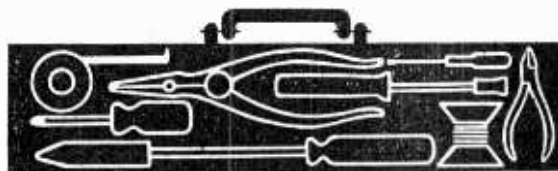
Part 1 investigated the first two or three stages of a typical valved receiver. These stages collectively are often referred to as front ends, being composed of r.f. amplifier (if the set has one), mixer and local oscillator. Modern a.m./f.m. sets have two front-ends, one for medium-frequency (and possible short-wave) a.m. and another for v.h.f./f.m.

FRONT-END NORMAL

Assuming that first tests failed to reveal any conclusive defect in the front-end, we can conclude that the mixer, or that section of the frequency changer, is delivering off-the-air signals converted to i.f. as they are tuned in by the set's dial. Something, then, is preventing these signals from reaching the detector and later stages. That is, assuming the symptom is the easy one of "no signals" or "set dead".

The best plan under these circumstances is to apply a modulated signal at the set's i.f. to the input of the first i.f. amplifier. A straightforward valved set usually has a single i.f. amplifier stage, a typical circuit being shown in Fig. 3—1.

Here the control (first) grid of the i.f. amplifier valve receives an i.f. signal from the secondary winding of the first i.f. transformer, whose primary



is loaded into the anode circuit of the mixer or frequency-changer valve. It should be understood that the nature of this testing for a "dead set" starts at the aerial input, works through to the frequency-changer, checks the local oscillator (as in Part 1) and then goes on to the i.f. stages, commencing at the input of the first i.f. amplifier valve (Fig. 3—1).

Assume that we have a signal generator and tune it to the set's i.f. (recent models 470kc/s, earlier models 465kc/s), then switch on the audio modulation and apply the signal to the control grid of the first i.f. valve. Signal continuity from this grid to the loudspeaker should give a modulated tone output. If there is no response the next move is to check the i.f. stage up to the detector input. If discontinuity remains, then the trouble is either in the detector or audio stages (to be considered in Part 5).

Useful first-action tests are (i) check that the i.f. valve heater is alight (change valve and/or check heater supply circuit if not) (ii) check the valve envelope for temperature with a hand (a "cold" valve—with heater alight—could indicate lack of anode and screen grid current) and (iii) try tapping the valve with the set running to establish the possible presence of internal inter-electrode shorts or open-circuits.

BASIC D.C. TEST

If these tests give no clues to the fault, a more scientific approach will be necessary. A good test for valve emission is to measure the voltage across the cathode resistor (see Test 1). A valve normally operating will yield about 2.2 volts d.c. across this resistor. A test voltage appears because the sum of the anode and screen-grid current passes through the cathode resistor, and this develops a voltage drop across it of magnitude depending (a) on the value of the resistor and (b) on the current value.

It is easy to find the cathode current (in mA) by dividing the voltage measured (in volts) by the value of resistance in kilohms (thousands of ohms). For example, 4 volts measured across 500Ω (0.5kΩ) signifies a current of 8mA.

If this first basic or "key" test indicates cathode current, we are sure that: (i) the valve has emission, (ii) its heater is aglow, (iii) the valve has both anode and screen grid voltage and (iv) the general d.c. conditions of the stage are reasonable—if not normal. A more exacting indication on the d.c. conditions can be obtained from a knowledge of the anode and screen grid (i.e., cathode) current of the valve in the circuit. Such operating parameters are

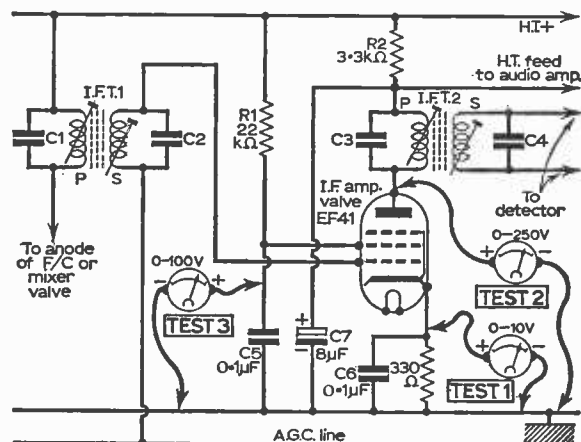


Fig. 3—1: Typical a.m.-only i.f. stage, showing three prime tests.

usually given in the service sheet, manual, or valve data book.

Abnormally low cathode current could mean (a) low emission valve, (b) low screen grid voltage, (c) low anode voltage or (d) reduced heater current. (This is often overlooked.)

To establish (a), **Tests 2 and 3** (see Fig. 3—1) would be made, and if the anode and screen grid voltages are reasonable (refer to service sheet, if possible), check the valve either by substitution (often the best way) or with a valvetester. Typical values are *anode 225 volts* and *screen grid 100 volts*.

So far we have established that the i.f. signal cannot be passed through the set from the control grid of the i.f. amplifier valve and, assuming Tests 1, 2 and 3 to be positive, that the d.c. conditions of the stage are reasonable.

There is a remote chance that the valve has some internal short or open-circuit which is failing to affect the d.c. conditions yet preventing the passage of signal. A sharp tap on the envelope of the valve with a screwdriver handle may prove something here; but valve substitution is much more conclusive a test in a case like this.

Some enthusiasts may not possess a signal generator or other equipment, yet may wish to try their hands at radio repairs. Where possible, therefore, suggestions based on instrument-less testing will be included. One instrument, however, is indispensable and that is a good quality multirange testmeter with a d.c. sensitivity not less than 10,000 ohms/volt (bearing in mind that low voltage and current readings may have to be made in transistor equipment).

Signal continuity in the i.f. stage can sometimes be proved by connecting an aerial to the control grid. This should pick up random signals in the i.f. band and reproduce them in the loudspeaker. Another dodge is connecting the contact points of a low-voltage electric buzzer between chassis and the control grid via a 100pF capacitor. The impulsive "signal" produced by the working buzzer contains many harmonic components well into the i.f. band, and signal continuity is revealed by a harsh buzz in the speaker. This, of course, also proves the detector and audio stages at the same time. Special transistor, pulse generating signal continuity test instruments are also available commercially, but there is nothing to beat a good modulated signal generator.

I.F. stage continuity can also be vaguely assessed by rubbing the tip of a screwdriver blade on the control grid pin of the i.f. valve while holding a finger in contact with the metal blade. Good response in the i.f. channel is then indicated by fairly loud crackles from the speaker when the test is performed.

DYNAMIC TROUBLE

We now assume that the d.c. conditions are normal, yet the signal fails to pass through the stage. This is often called "dynamic trouble", signal rather than d.c. A prime factor here is misalignment of the i.f. transformers. These are best checked—and aligned—by a modulated signal generator, as explained in Part 1 (April issue).

It will be recalled that the signal is applied to the signal grid of the frequency-changer valve (at fairly high level if the circuits are well out of

alignment) and then the *second* and first i.f. transformers adjusted—secondary and then primary—aiming for maximum output at the detector or audio stage.

ALIGNING THE I.F.'s WITHOUT INSTRUMENTS

It is possible to align the i.f.'s. without a signal generator, assuming that the front-end circuits are in alignment. The technique is first to bring the i.f. windings to exactly the same frequency, irrespective of the *actual* frequency. This can be done by "clicking" the screwdriver blade on the frequency-changer signal grid or by the use of a buzzer (as already explained) or other pulse-type harmonic generator and adjusting the i.f. trimmers or cores, one after the other, until maximum output is attained. The circuits will all be tuned to the *same* frequency, not necessarily the *correct* one.

Next, apply an aerial signal with the set tuned to the longwave Light Programme. Since the i.f.'s. will most likely not be tuned to their correct frequency, the Light Programme will come in well off tune and possibly weakly, so full volume setting must be used.

The i.f.'s. can then be tuned nearer to the correct frequency by adjusting the main tuning so that the Light Programme can still be heard yet may still be off tune although closer to the actual 1,500 metre mark on the dial. The i.f.'s. should again be peaked in turn for maximum signal output and the process repeated until the i.f.'s. can be peaked with the tuning spot-on the station setting on the main dial. The i.f.'s. should then be in fairly reasonable alignment.

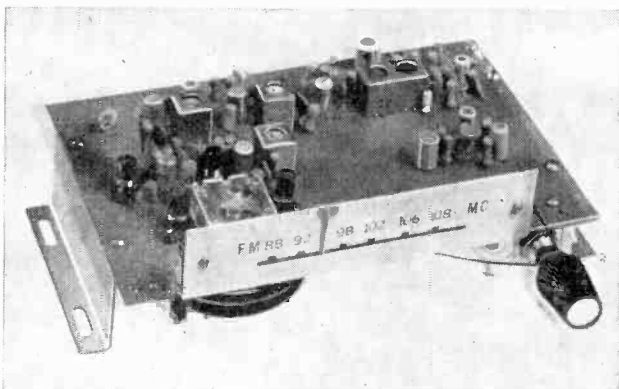
A dynamic fault can exist due to a short-circuit across one (or more) of the i.f. transformer windings. Note that an open-circuit, at least in the primary, would be brought to light by the d.c. testing earlier described. Typical trouble is a short across a trimmer (if used) or fixed parallel tuning capacitor (i.e., C1/2/3/4 in Fig. 3—1). A short can also occur across an internal tag panel, and such possibilities can only be examined by taking the screening can from the transformer. Incidentally, an open-circuit capacitor across a winding will be revealed during the alignment process by that particular tuned circuit failing to peak at the correct frequency.

If tuning is by a trimmer capacitor, the tendency towards maximum output will occur with the trimmer fully compressed (assuming that there is also a fixed trimmer), while if tuning is by dust-iron slug, the slug will be fully in the core and still not tuning the winding properly. Incorrect i.f.

★2 alignment aggravates adjacent channel interference effects, and these will be recognised from Symptom 2 on the record issued free with the April issue.

A fault typical of i.f. transformers is intermittency in the winding(s) or parallel capacitor. The primary winding (carrying h.t. current) is the one that often goes down in this way, but on some transformers leakage between primary and secondary is possible. Symptom 5 on the record typifies the noises

★5 that can be expected from this trouble. To see whether the fault is in the first or second i.f. transformer, the control grid of the i.f. valve



FMT.41 Transistorised FM Tuner

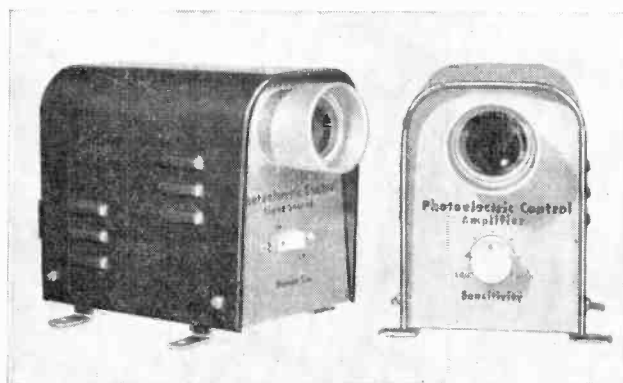
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repairing radio sets

can be shorted direct to chassis. If the symptom persists, it is definitely not in the first i.f. transformer or in the front-end sections.

It may be a good idea to short out the secondary of the second i.f. transformer at this juncture to prove the audio section. If the noise effects cease, then the second i.f. transformer is almost certainly responsible. If they persist, the audio stages should be investigated (dealt with in Part 5).

If intermittency in the primary winding is responsible, it is often possible to "see" this in terms of a flickering pointer when the voltmeter is connected as for Test 2.

I.F. INSTABILITY

Oscillation in an i.f. stage can be brought about by incorrect i.f. alignment. Some sets are sensitive when the windings are peaked, and if they are the ★1 amplifier could change into an oscillator and produce the effect of Symptom 1 on the record. This kind of set requires so-called stagger-tuning in which one winding is detuned relative to the other on each transformer, but not sufficiently to reduce the sensitivity or to encourage adjacent channel interference.

Instability can also result from a bad valve (old valves with sprayed-on gold-coloured conductive coating were troublesome in this respect, but there are very few of these about now!) and from an open-circuit screen grid capacitor (C5 in Fig. 3—1).

An open-circuit in the cathode bypass capacitor (C6 in Fig. 3—1) will usually result in reduced sensitivity rather than instability owing to negative feedback effects. A set with an electrolytic in position C7 in the circuit could also go low-gain due to its open-circuit.

Other troubles that occur in the i.f. stage are (a) noise (Symptom 5) due to badly seating valves and/or dirty valve pins and faulty sockets, (b) burning resistors due to a shorting bypass capacitor (i.e., R1 would overheat due to C5 shorting, or R2 due to C7 shorting), (c) overloading due to an a.g.c. fault (Symptom 4) to be considered later and (d) intermittent operation due to a badly soldered connection, bad valve and poor connection of valve pins with its holder sockets. Valve bad seating can often be brought to light by wriggling the valve in its holder while the set is running.

A.M./F.M. I.F. STAGE

All that has so far been said applies equally to the i.f. stage employed in a.m./f.m. sets. From Part 1 it will be recalled that sets of this mode employ two i.f. transformers in series, one tuned to 470kc/s for a.m. and the other to 10·7Mc/s for f.m.

An i.f. stage typical in this respect is shown in Fig. 3—2. This shows that the basic d.c. parts of the circuit are almost identical to those in Fig. 3—1. The valve is a more modern version since it has to provide reasonable gain at 10·7Mc/s as well as at 470kc/s, and the voltages to be expected on a valve of this kind are shown on the diagram. Alignment of the a.m. transformers is performed first, and

these then present the correct impedance to the much higher frequency f.m. transformers, allowing their subsequent alignment.

The control grid of the valve is fed from the secondary windings of the first set of i.f. transformers (which are also in series with each other), and in some sets there is a switch to short out the primary of the first f.m. transformer when the set is set to a.m. working.

It may be remembered from Part I that on f.m. the a.m. mixer section of this kind of set works as an additional i.f. amplifier with the local oscillator section switched off. This gives another f.m. trace located in the v.h.f. tu-

Dynamic testing through this dual-type of i.f. amplifier follows the practices already described and the fact that the circuit is normally responsive to two widely differing i.f. signals means that failure of one channel only cannot be caused by a valve fault or incorrect d.c. conditions. The reason is often related to misalignment of the affected channel or trouble in the appropriate i.f. transformer section.

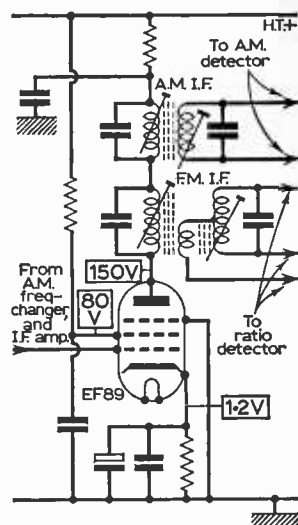


Fig. 3-2: This kind of i.f. stage is found in a.m. /f.m. receivers.

DETECTOR AND A.G.C.

Now let us look at the detectors, starting with a.m. circuits. A detector a.g.c. circuit in common use is shown in Fig. 3—3. This employs a double diode-triode valve, but only the two diodes interest us at this time; the triode is used in the audio stages and will be considered in Part 5.

The detector is nothing more complex than a diode connected in series with the secondary winding of the second i.f. transformer, along with its

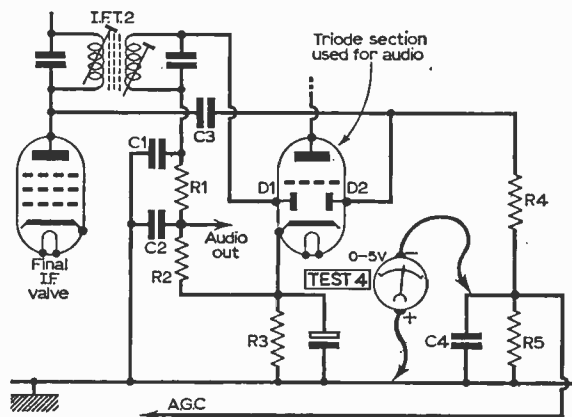


Fig. 3—3: An a.m. detector and a.g.c. circuit, showing a test for a.g.c.

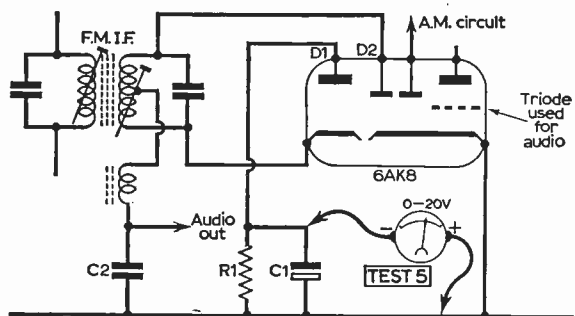
The detector diode is D1 and its load is R1 and R2 in series, with the bottom end returned to valve cathode instead of chassis. This is to avoid biasing the diode by the voltage dropped across the cathode resistor R3 when the triode is passing current. The audio signal thus appears across R1 and R2, and it is tapped-off at their junction. C1 and C2 are i.f. filter capacitors, taking away the residual i.f. signal, leaving only the audio component.

On the a.g.c. line therefore, is a negative potential (with respect to chassis) which is used as extra grid bias for the i.f. amplifier and frequency-changer (mixer section) valves. As the mutual-conductance (and hence stage gain) is determined by the amount of grid bias—the greater the bias the less the gain—the overall amplification of the signal circuits is automatically regulated by the strength of the signal. Rapid fading is also combated by the time-constant on the a.g.c. line.

One fault which can develop in the detector/a.g.c. stages, and cause bad overloading, is open-circuit of **★4 C3**. This effect is clearly illustrated in Symptom 4 of the record and, apart from distortion due to "envelope distortion", intermodulation troubles can occur on strong signals giving a background whistle accompaniment.

In some sets the a.g.c. voltage is transferred to the control grids through very high (order of megohms) resistors, so even a highly sensitive meter would give very little reading at these points. A valve voltmeter or equivalent transistor instrument would, however, be suitable.

The detector itself rarely develops faults except perhaps when an i.f. filter capacitor goes open-



circuit. This can aggravate instability and introduce whistles. Since the diodes are working at very low power they rarely fail, even though the triode may go low emission.

In a.m./f.m. sets, the detector valve is usually a triode (for audio) with *three* diodes, one with its own cathode and two using the common triode cathode. One of the diodes common to the triode cathode is used as an a.m. detector, which is often arranged to provide a.g.c. as well, while the other diode, in conjunction with that with its own cathode, is used in a ratio-detector for f.m., as shown in Fig. 3—4.

A good test for this kind of detector is to measure the voltage across the d.c. load, as shown by **Test 5** in the circuit. With a correctly working circuit, up to 20 volts will be measured across the load when the f.m. set is tuned to a strong transmission.

If R1 goes high in value the effect is a sort of "overhang" on the f.m. tuning, it being difficult to establish quickly the correct tuning point.

To be continued

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dual function SIGNAL GENERATOR



H. WEBSTER

NEXT to the multi-range testmeter probably one of the most useful items of equipment in the amateur workshop is a generator of signals covering a wide frequency spectrum. While such an instrument can be quite complex and costly, for most amateur requirements a simple, stable, modulated oscillator is sufficient for most purposes. With the aid of such an oscillator, alignment of receivers is easily carried out and the degree of uncertainty associated with trial and error methods eliminated. Apart from this prime function the signal generator is an invaluable aid to fault tracing in receivers.

The basic requirements of an oscillator suitable for alignment purposes are as follows. It should be stable and not require recalibration at frequent intervals. Changes in supply voltage should not have an adverse effect on the oscillator frequency. Radiation of energy other than by the output socket should be reduced to a minimum. Finally, the output of the oscillator should be controllable. Although none of these desirable features is easy to obtain and

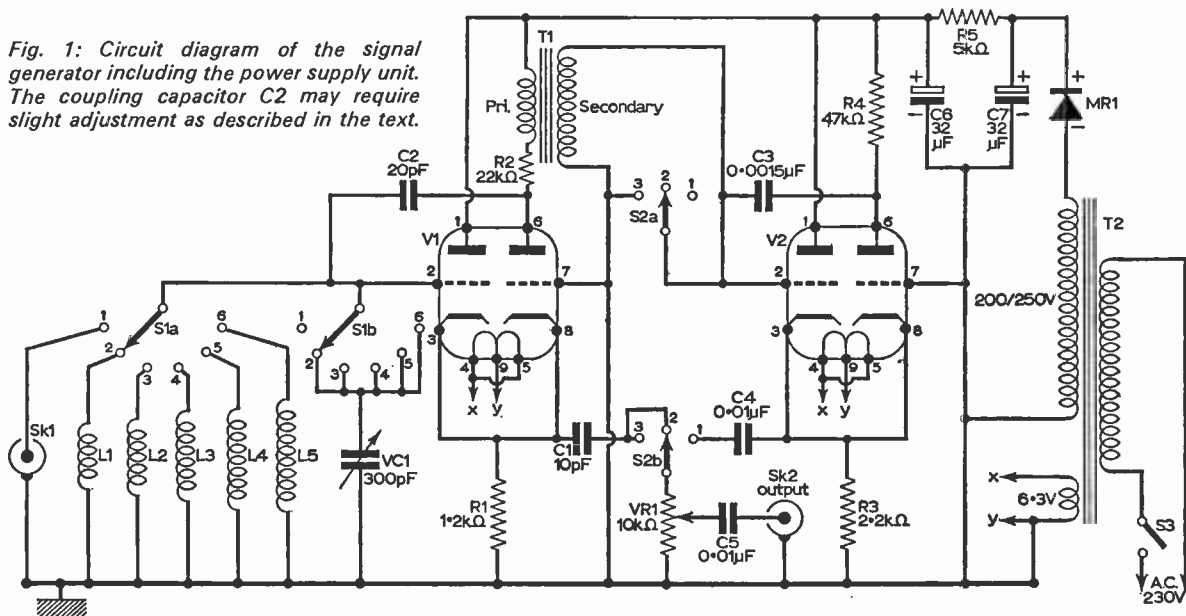
is reflected in the relatively high cost of commercial instruments, nevertheless, by careful attention to screening and suitable choice of oscillator, it is possible to construct a generator which approaches these ideals.

The signal generator described in this article has been designed with these features in mind. As well as performing all the usual functions of the normal oscillator, a further valuable feature enables the experimenter to extend the scope of the instrument to inductance and capacitance testing. This aspect of the design will be dealt with briefly in the latter part of the article.

CIRCUIT DESCRIPTION

An examination of the circuit given in Fig. 1 will show that both the radio and audio frequency oscillators are of the "two terminal" type. In each case a double triode is employed, one section being used as a cathode follower and the other as a grounded grid amplifier. Energy in the correct phase is fed

Fig. 1: Circuit diagram of the signal generator including the power supply unit. The coupling capacitor C2 may require slight adjustment as described in the text.



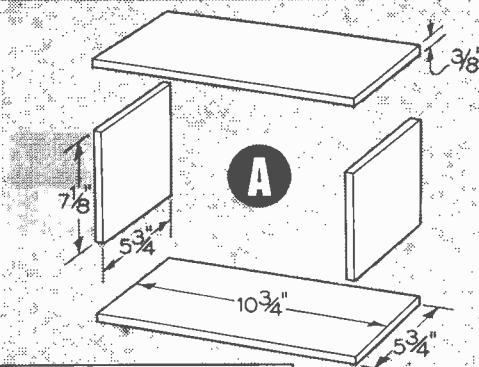
Dual function signal generator.
Figure 2

A: Dimensions for a suitable cabinet.

B: Chassis drilling details.

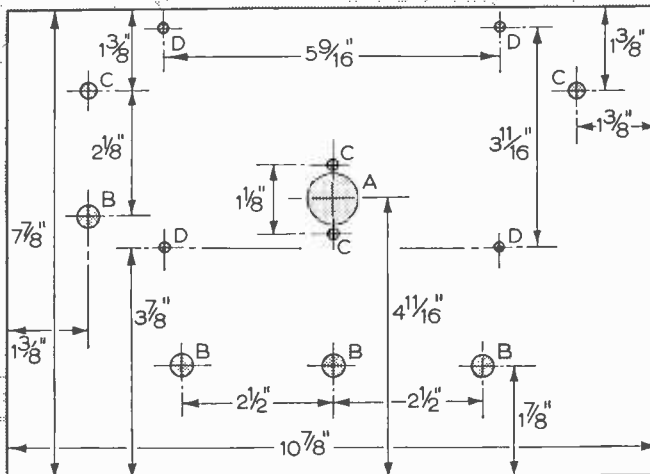
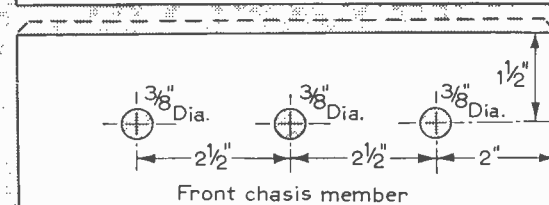
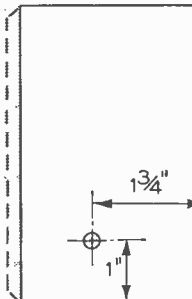
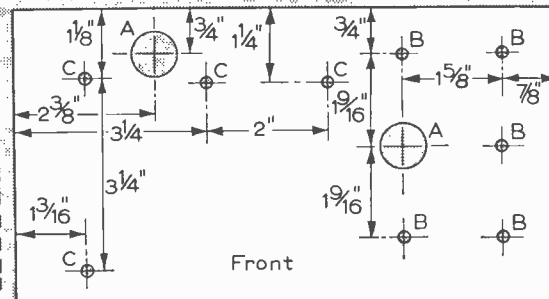
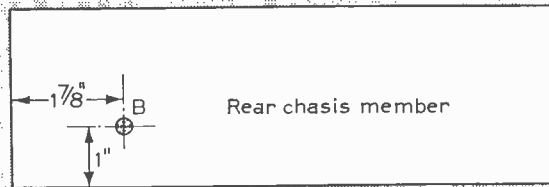
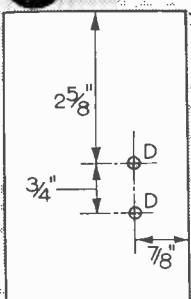
C: Cardboard template for mounting coils.

D: Front panel drilling details.

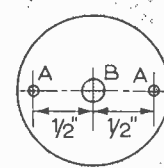


Holes A $\frac{3}{4}$ " diameter
Holes B $\frac{1}{4}$ " diameter
Holes C 4 BA clearance
Holes D 6 BA clearance

B



Holes A $\frac{1}{8}$ " diameter
Holes B $\frac{1}{4}$ " diameter
Template $\frac{3}{8}$ " diameter



C

D

Hole A $\frac{7}{8}$ " diameter
Holes B $\frac{3}{8}$ " diameter
Holes C 4 BA clearance
Holes D 6 BA clearance

back from the second section of each triode into the grid circuit in such a way that continuous oscillation is maintained. The coupling capacitor, C2, between the anode of the section triode section of V1 and the grid of V1 is rather critical. Since valve and component tolerances vary somewhat, it may be found that some experiment is necessary to achieve optimum results. Generally a value between 10 and 50pF will be adequate. An indication that the value is too high will be shown by violent squegging.

Anode modulation of V1 is achieved by connecting the h.t. supply to V1 in series with the primary of the audio transformer T1. The audio component developed in the secondary of T1 is inductively transferred to the primary winding of the transformer. An audio signal for amplifier testing is taken from the cathode of V2. Selection of the desired signal, whether r.f., modulated r.f. or a.f. is by means of switch S2.

The frequency span of the generator is from 200kc/s to 30Mc/s. This range is covered using five inductors, L1 to L5, taken from the Denco range of iron cored coils. The screening cans supplied with these coils have been retained since they help materially in reducing extraneous radiation. Power requirements for the unit are quite modest and any small transformer with an output of 200-250 volts

at 20mA and 6.3 volts at 1 ampere is adequate. The specified audio transformer in the modulating section has a primary rated at 8mA and if any other type of transformer is substituted it must have a similar rating.

Although in the interests of compactness, miniature type valves have been specified, there is no reason why older types such as the octal based 6SN7 or 6SL7 should not be used. These two valves function perfectly satisfactorily in this circuit without any alteration in component values. Naturally the use of the larger octal valve holders will necessitate some chassis dimensions changes.

CONSTRUCTIONAL DETAILS

The generator is built on a 9in. x 5in. universal chassis. Full drilling and mounting details are given in Fig. 2. The front panel drilling dimensions given in Fig. 2D are applicable to the specified Eddystone dial. A flexible coupler is used to connect the epicyclic drive mechanism to the variable capacitor. When fitting the drive to the capacitor spindle care must be exercised in the alignment of the spindle and drive mechanism since slight misalignment will mar the smoothness of the drive system. Although many generators, both amateur and commercial, use a direct drive system, the use of a slow motion drive

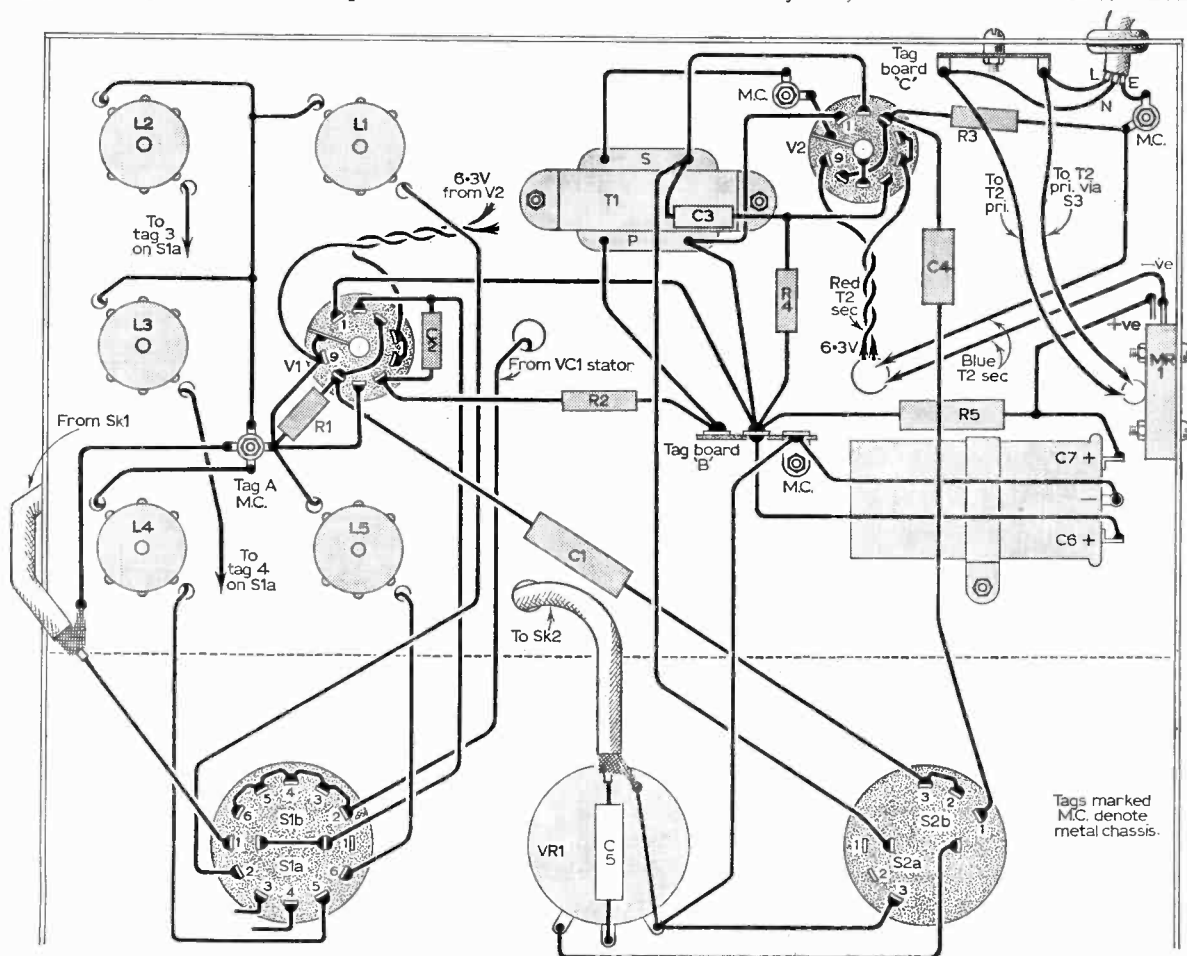


Fig. 3: Under chassis layout and wiring diagram. Note, tags marked MC are bolted directly to chassis.

enables more precise settings to be obtained.

The inductors, L1 to L5, together with the screening can lids are mounted ensuring that the holes in the chassis and can bases coincide. The cardboard template shown in Fig. 2C may be used to facilitate drilling of the chassis and can bases. Since the coil formers and associated plastic securing nuts are of polystyrene it is important that overtightening of the securing nuts is avoided.

When mounting the two valve holders, make sure that they are correctly orientated as shown in Figs. 3 and 4. The completely wired chassis is also shown in the same figures. On all coil ranges the primary windings are shorted out and connected via the earthy end of the grid coil to earth. It may be found on ranges 4 and 5 that the coils have wire ended terminations. If this is the case the grid wire must be insulated with a short length of sleeving before passing it through the chassis.

Wiring of the unit is straightforward although care must be exercised when soldering connections to the coil pins. Excessive and prolonged heating of the pins will lead to distortion of the polystyrene

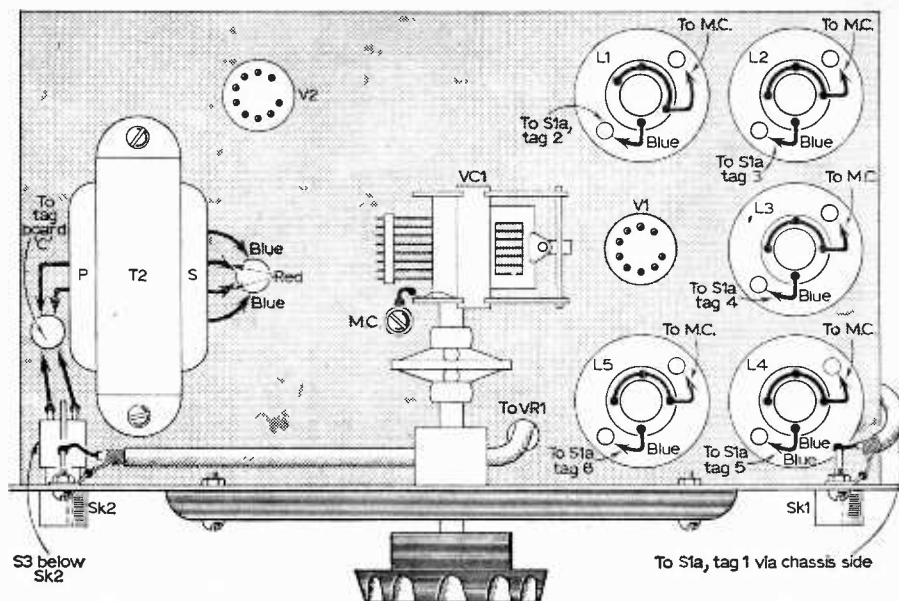


Fig. 4: Layout of components above chassis.

rear of the box is covered with a nominal 11in. x 8in. aluminium top plate taken from the universal chassis range. When covering the interior of the box with foil make sure sufficient overlap is allowed at the edges so that intimate contact between the front panel and back plate is obtained. This method of construction was adopted in the interests of cheapness, and a metal box would be preferable.

Calibration based on comparison with signals of known frequency has been given many times in PRACTICAL WIRELESS and although no attempt

TABLE 1

Range 1		Range 2		Range 3		Range 4		Range 5	
f kc/s	Dial	f Mc/s	Dial	f Mc/s	Dial	f Mc/s	Dial	f Mc/s	Dial
200	98	0.6	98	1.8	98	5.5	98	9	93
250	72	0.7	80	2.0	85	6.0	85	10	79
300	54	0.8	65	2.5	62	7.0	69	12	62
350	41	0.9	54	3.0	45	8.0	57	14	49
400	30	1.0	45	3.5	31	9.0	47	16	38
450	21	1.1	37	4.0	22	10.0	39	18	30
460	19	1.2	31	4.5	14	11.0	32	20	23
470	18	1.3	25	5.0	8	12.0	26	22	18
500	14	1.4	20	5.5	4	13.0	21	24	13
550	8	1.5	15	—	—	14.0	17	26	9
600	3	1.6	11	—	—	15.0	13	28	5
—	—	1.7	7	—	—	16.0	10	30	2
—	—	1.8	4	—	—	17.0	7	—	—

The table shows approximate dial readings against frequency. The coils should be adjusted as advised in the text in conjunction with Table 2.

formers. On completion of the wiring check the resistance between the h.t. line and chassis. A reading of approximately 500kΩ should be obtained. A much lower reading should be investigated and any obvious faults remedied.

The writer housed the instrument in a wooden box lined with aluminium foil. Constructional details are given in Fig. 2A and are self explanatory. The

will be made to give exhaustive details a brief description is given for the benefit of the newcomer.

The method requires a receiver, not necessarily accurately calibrated, covering a wide frequency range. After setting the receiver to a transmission of known frequency, the generator is adjusted to zero beat with the known frequency. By choosing an adequate number of frequencies for each band, a

graph may be drawn of frequency versus dial readings. Care must be exercised during this procedure since it is quite easy to confuse harmonics with the fundamental frequency. If a superhet receiver is used for calibration purposes, additional difficulties may arise, particularly on frequencies above approximately 10Mc/s. Simple superhets with an intermediate frequency of 450kc/s and without adequate selectivity prior to the mixer, will almost certainly suffer from second channel interference. As an example, consider a receiver of this type tuned to a known frequency of 15Mc/s. If, as is generally the case, the receiver oscillator is tuned to the higher frequency side of 15Mc/s, then in order to give an intermediate frequency of 450kc/s the receiver oscillator will be set at 15.45Mc/s. A little thought will show that a transmission on 15.90Mc/s

TABLE 2

Range	Frequency Range Mc/s	Core Turns
1	0.2—0.6	5½
2	0.6—1.8	6
3	1.8—5.5	12½
4	5.5—17.0	12
5	9.0—30.0	20

For approximate calibration the coil cores are unscrewed to their fullest extent and then screwed in. The number of revolutions is shown in the table.

will equally give rise to an i.f. of 450kc/s. In terms of the generator calibration this means that when the generator is tuned from the low frequency end a first response will be obtained at 15Mc/s. Further tuning of the generator will give a further response when the generator frequency is 15.9Mc/s. In general terms, for each receiver setting on the high frequency ranges, two generator responses will be evident, one when the generator is set to the actual frequency, and a second in which the generator is set to this frequency plus twice the i.f. of the receiver. Although all this may appear rather formidable, in practice the actual calibration of the higher frequency ranges is quite simple and provided the foregoing is borne in mind, no real difficulty should arise. In any case, a graphical check will reveal any errors.

APPROXIMATE CALIBRATION

For those constructors who feel hesitant about this procedure and have no receiver covering the whole gamut of frequencies the following approximate calibration will enable them to make a start. The iron cores of each coil are gently unscrewed to their fullest extent. Do not apply undue force. The cores are then screwed back into the formers the number of complete turns shown in Table 2. The calibration chart shown in Table 1 is applicable to this procedure. If this method is adopted it is imperative that the specified coils are used and the wiring lay-out of Figs. 3 and 4 followed as closely as possible. It must be stressed that the foregoing method is of an approximate nature and is only intended as a preliminary aid to calibration and as a help to the constructor who has no suitable

★ components list

Resistors:

R1	1.2kΩ	R5	5kΩ 5 watt
R2	22kΩ	R6	400Ω
R3	2.2kΩ	R7	400Ω
R4	47kΩ	VR1	10kΩ carbon pot
All fixed resistors 1 watt except where otherwise specified			

Capacitors:

C1	10pF	C4	0.01μF	C7	32μF
C2	20pF	C5	0.01μF	C8	200pF
C3	0.0015μF	C6	32μF	C9	400pF

Variable Capacitor:

VC1 300pF Jackson E1

Valves:

V1 ECC82 V2 ECC82

Inductors:

Chassis mounting types

- L1 Denco Maxi Q Yellow Range 1
- L2 Denco Maxi Q Yellow Range 2
- L3 Denco Maxi Q Yellow Range 3
- L4 Denco Maxi Q Yellow Range 4
- L5 Denco Maxi Q Yellow Range 5

RFC: See text

- T1 Intervalve type 3:1 ratio
- Radiospares 8mA rating

Mains Transformer

T2 Osmabet 230v 45mA 6.3v 1A

Miscellaneous:

MR Metal rectifier contact cooled 250V 50mA
B9A Skirted valve holders (2), B9A screens (2), Coax sockets (4), 2P 6W switch S1a, b; 2P 3W switch S2a, b; SPST switch S3, Universal chassis 9 x 5 x 3, Home Radio Aluminium panel 10½ x 7½ (2), Dial—Eddystone 598 (Stratton), Flexible shaft coupler; knobs, sleeving, coaxial cable, etc.

reference standard. More accurate calibration may be carried out at a later stage. When the finalised calibration has been completed the five scales of the dial may be marked in with indian ink.

DUMMY AERIAL

A suitable dummy aerial for use in conjunction with the signal generator during receiver alignment is given in Figs. 5 and 6. This dummy aerial is satisfactory for frequencies between 150kc/s and 2Mc/s. For the higher frequencies up to 30Mc/s the simple form shown in Fig. 7 is recommended.

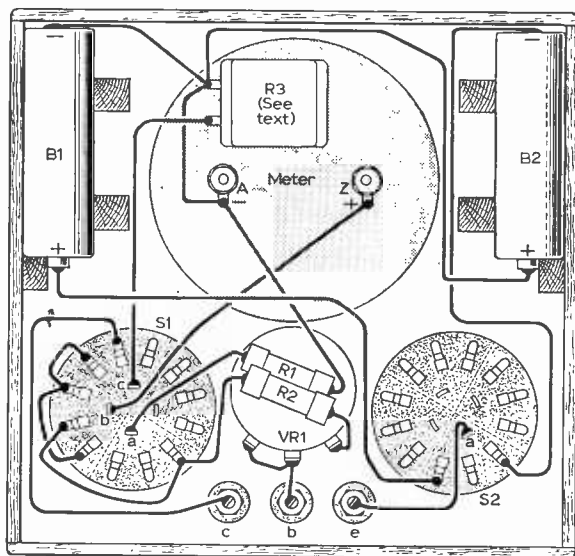
In each case the dummy aerial may be mounted inside a discarded tobacco tin as shown in Fig. 5. The 20μH choke used in the medium frequency version consists of 70 turns of 34 gauge enamelled wire close wound on a ½in. diameter former. The remaining details given in Fig. 5 are self explanatory.

A feature of the generator not generally available

—continued on page 142

Transistors are now readily available from various manufacturers' surplus units, and some of these are here enables some of the more useful transistor provide constructors with a very useful piece of

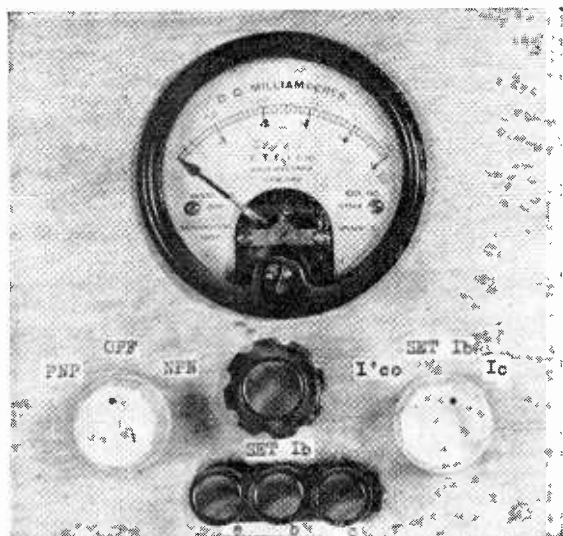
To enable the tester to be used for both n-p-n and p-n-p transistors, the circuit of Fig. 1 is modified slightly by the addition of Fig. 2. The meter is



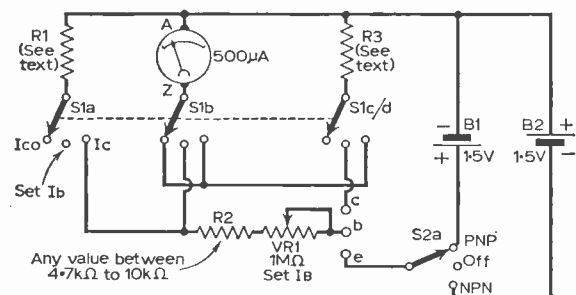
connected to points A and Z on Fig. 1 via the p-n-p/n-p-n switch S2. This enables both the meter and the supply to be reversed for testing n-p-n transistors (see Fig. 2).

Resistor R1 should be equal to the meter's d.c. resistance, ± 20 per cent will be satisfactory, while R3 the 10mA shunt resistor *must* be made very accurate. Its precise value will depend on the meter used and its value may be calculated as follows:

$$R = \frac{\text{Meter's f.s.d.}}{\text{f.s.d. required} - \text{Meter's f.s.d.}} \times \text{Meter's resistance.}$$



Having now discussed what it does and how much it will cost, let us turn to the question of how it works. Basically, a measured d.c. current is fed into the base of the transistor under test, and then the collector current is measured. The resistance of VR1 controls the base current, while R2 performs the function of preventing this current from



Scale 0-10

PNP

NPN

Off

To A

To Z

S2b

S2c

Accurate meter on 10mA range

Small pre-set (adjust till both meters have same reading)

150Ω

1.5V

Fig. 2 (left): Modification for testing *n-p-n* transistors.
Fig. 3 (right): Calibration of the unit.

ISTOR TESTER

BY G.A. BOBKER

sources quite cheaply. Others are obtainable in unmarked. The simple but efficient unit described has characteristics to be measured and it will thus stand its gear at low cost. Construction is uncritical.

Example: Supposing we are using a meter having a f.s.d. of $500\mu\text{A}$ and a resistance of 250Ω . In order to give a f.s.d. of 10mA it would require a shunt resistor whose value will be:

$$R = \frac{500}{10,000 - 500} \times 250$$

This equation gives the value of R_3 as approximately 13.1Ω , therefore a preset potentiometer of some 25Ω will be ideal. To calibrate accurately, the meter is placed in series with another meter of known accuracy as shown in Fig. 3. As the shunt has to be very accurate it is switched in the tester by two of the switch contacts wired in parallel, S_{1c} and S_{1d} . This has the advantage of reducing the contact resistance of the switch.

As the leakage current of some a.f. output transistors can be as high as $450\mu\text{A}$, if a more sensitive meter is used then S_{1c}/S_{1d} should be arranged to switch in a $500\mu\text{A}$ shunt in the "I_{co}" position. The switch S_1 should be the normal 4-pole 3-way type. If fancy switches, or switches to hand are used, difficulty might be experienced if they are not of the "Break-before-make" type.

Construction

The cabinet was made from plywood fixed together with glue and panel pins, the finished case being covered with "Fablon" or "Contact". The final size of the case will be determined by the size of the meter used. The clips to hold the batteries were made from strips of brass pilfered from a defunct cycle-lamp battery, and these were fixed to the cabinet with Araldite. This is very easily achieved and is far superior to soldering wires direct to the battery cases.

The terminals used in the prototype were of the spring loaded variety and were obtained from surplus equipment. Alternative terminals can be

★ components list

Resistors:

R1 see text
R2 $4.7\text{k}\Omega$ – $10\text{k}\Omega$ see text
R3 $1\text{M}\Omega$ potentiometer
R4 see text

Switches:

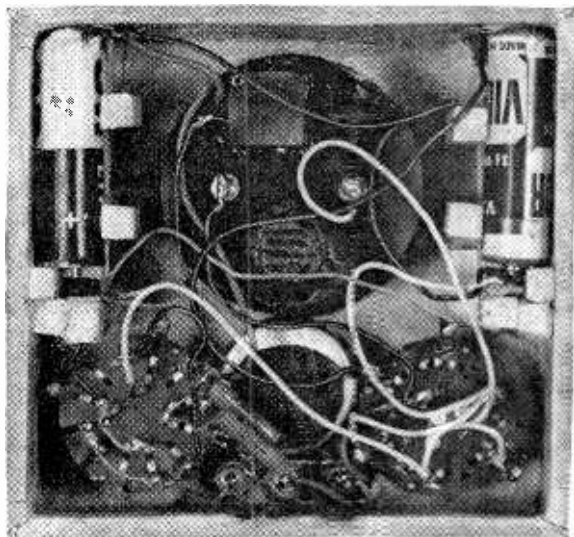
S1 4 pole 3 way
S2 3 pole 2 way

Meter:

$500\mu\text{A}$ f.s.d.

Miscellaneous:

Terminals, Batteries—2 penlight 1.5V, Materials for case, solder, wire etc.



made either from bolts or from three crocodile clips as shown in Fig. 5. Constructors may use their ingenuity as to terminals but whichever type is used they must provide good positive action holding the wires tightly. They should also be kept clean.

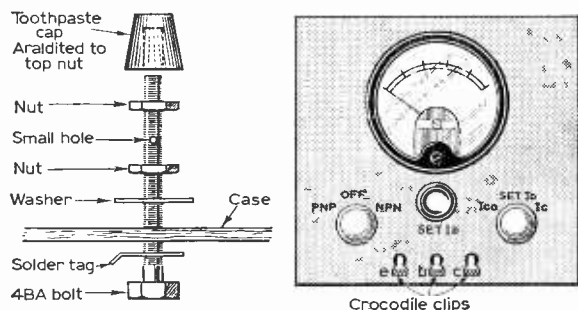


Fig. 5: Suggested approach to the problem of making suitable terminals, these may be modified bolts, or made from crocodile clips.

Using the tester

Set the p-n-p/n-p-n switch to the appropriate position and turn the function switch to the off position. (1) Connect the transistor to the terminals, switch to "I_{co}" and note the reading. (2) Switch to "I_b" and adjust "Set I_b" to give $20\mu\text{A}$ reading. (3) Switch to "I_c" and note the reading. Repeat (2) and (3) but this time using $I_b = 40\mu\text{A}$. The d.c. gain is simply I_c divided by I_b . The small signal or a.c. gain is obtained from the readings noted in steps (2) and (3);

$$\text{A.C. gain} = \frac{\text{Change in } I_c \text{ in } \mu\text{A}}{\text{Change in } I_b \text{ in } \mu\text{A}}$$

Example: If $20\mu\text{A}$ gave 1.2mA , and $40\mu\text{A}$ gave 2.6mA then gain = $\frac{2600 - 1200}{40 - 20} = \frac{1400}{20} = 70$

If the meter scale is marked at the $20\mu\text{A}$ and $40\mu\text{A}$ positions then steps (2) and (3) are made very simple.

Let's Keep the Pirates

You have published many letters and articles in your pages against Pirate radio stations. One of the more recent letters dealt with the shortage of medium-wave channels. Has anyone ever looked to see how many channels are allocated to this country and how efficiently they are being used? It seems to me that using nine channels for the Home Service alone, is not doing things efficiently. Surely by using synchronised transmitters on one channel, we could release eight channels at once for other services. Any regional variations, few and short-lived as they are, could be accommodated on v.h.f.

The public has proved the demand for what the Pirates are providing. Why not let them provide it from land-based stations using channels already allocated to the UK?

R. E. Tinson.

Wilford,
Nottingham.

Comments from New Zealand

This is a somewhat belated reply to H. C. Pryse who wrote in the December issue of PRACTICAL WIRELESS, concerning his inability to obtain spares for his H.E.30 receiver. The Lafayette brand name is only one of many names used on this receiver which is made by the Trio Corporation, 6—5 Ichome Shibuya, Shibuya-KU, Tokyo, Japan, to which he may care to write.

Many amplifiers and receivers which are sold in the USA with American names on them are made in Japan and as to Mr. Pryse's inability to receive a reply from the Lafayette Co. I am in full sympathy with him. I find there are quite a few British firms including advertisers in PRACTICAL WIRELESS who do not answer my letters when I request information or catalogues. I get the impression that British firms are not interested in overseas orders!

S. Burrage.

Auckland,
New Zealand.

Ease of Pronunciation

There has been a certain amount of controversy over the last few months on the subject of changing cycles to Hertz. I personally do not care one way or the other since it is just as easy to write MHz as it is to write Mc/s.

The point that seems to be overlooked is the pronunciation of the new term. For example, Mc/s and kc/s are usually pronounced "Megs and and Kay-ceeds". The new terms MHz and kHz will now, I suppose, be pronounced "Megger hurts and Killer hurts."

V. E. Green.
Redditch,
Worcestershire.

NEWS AND..

EDDYSTONE RADIO FOR "EDDYSTONE" LIGHTHOUSE



The Eddystone Lighthouse has been presented with a transistorised receiver by Eddystone Radio Limited. This new receiver type EB35 will provide the lighthouse keepers with high quality reception on all the broadcasting frequencies in the long, medium, short and f.m. wave bands.

The receiver was presented at the lighthouse by Mr. A. C. Edwards, Director of Eddystone Radio Limited, and accepted, on behalf of Trinity House, by Principal Keeper Emerson. Mr. Edwards is seen here with Principal Keeper Emerson (centre) on the afterdeck of the Trinity House vessel *Stella* as the receiver was being delivered to the lighthouse. The Eddystone lighthouse and Smeaton's Stump can be seen in the background.

"CONTACT" FOR THE SWL

We have recently received a copy of "Contact", the monthly journal of the World Communication Club of Great Britain. It gives useful information for the SWL and contains articles of a nature that would also appeal to Hams.

The aims of the Club are: to interest more people in the international aspect of radio; to provide fellowship to all interested; to encourage and help DXers in their hobby and to learn more about the world we live in through the medium of short wave radio.

If anyone would like further information and details of membership of the Club, contact Mr. S. Green, 26 Tolhouse Street, Great Yarmouth, Norfolk.

ST. DUNSTAN'S CALLING

On Saturday, 8th April, a new callsign was heard on the amateur bands, GB3STD. This was the temporary callsign allocated to St. Dunstan's Holiday Home and Training Centre for men and women blinded on war service, when they held a weekend reunion of war-blinded radio Hams at their centre at Ovingdean near Brighton. The station was equipped with the very latest in amateur radio equipment. They had as their host, Lord Fraser of Lonsdale, St. Dunstan's Chairman who, despite his blindness, was one of the pioneers of amateur radio.

...COMMENT

HELP FOR WEATHER WATCHERS

A high-frequency communication system is to be supplied by The Marconi Company for the East African Meteorological Department. The system will use remotely controlled, self-tuning transmitters, and has been ordered through the World Meteorological Organisation in Geneva. It forms part of a general programme to improve and speed-up the transfer of weather information throughout the world for the World Weather Watch, an international study aimed at increasing the understanding of the fundamentals of meteorology.

The equipment will be installed at Nairobi in Kenya, at the Central Terminal for the clearance of meteorological information from Africa to the Northern Hemisphere. It will provide a greatly improved service from there to Offenbach, near Frankfurt, headquarters of the West German Meteorological Service which will disseminate the information received to the main meteorological telecommunications trunk circuit which runs through Offenbach. The transmission will also be received at Cairo where the information will be relayed to the Moscow World Weather Centre.

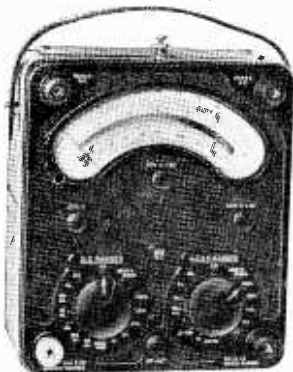
Two of the self-tuning transmitters will be installed at one of the East African Meteorological Depts. transmitting stations at Embakasi, just outside Nairobi.

SWEDISH DEALERS VISIT ENGLAND

The first of two parties of Swedish TV and radio dealers recently arrived in London. The visit has been arranged by Luxor Industri Aktiebolag, the largest Swedish-owned radio and TV manufacturer, and the Swedish Radio Dealers' Association. In all, 500 dealers from all over Sweden visited Britain for a combined educational and recreational trip.

Colour TV is expected to start in Sweden in 1970, and during the two visits the Swedish dealers studied British TV and had talks with the BBC and the ITA. They also met representatives of the Radio and Television Retailers' Association.

IMPROVEMENTS FROM AVO



An improved version of its panclimatic Avometer is announced by Avo (MI Group). The new model, which has been granted Ministry of Defence approval (to specification DEF-155), is designated Avo multirange test set no. 1. It will replace the previous models 8SX, 9SX and 40SX which for some years have been extensively used in the Armed Services.

The new version, like its predecessors, is specially designed for use in conditions of extreme temperature or high humidity.

The Avo multirange test set no. 1 retains design features of earlier Avometers, including mechanical cut-out, movement reverse button and interlocked range switching. The five-inch scale has markings for both voltage and current measurements, with a separate scale for resistance measurements. Additional overload protection is provided by a fuse connected in series with the ohms range.

The instrument is supplied with an ever-ready carrying case, a pair of rubber-covered test leads, two spring clips and a pair of test prods.

Dah Di Dah Dit Dah Dah Di Dah

I think it ought to be publicised that the Postmaster-General will do all he can to assist in making alternative arrangements for the place and time for sitting the GPO Radio Amateurs' Morse Test for those who, because of their location, have a long way to travel to any of the officially designated centres.

From my own home in Workington, the nearest designated centres are Whitely Bay and Glasgow, 220 and 270 mile journeys respectively. Alternative arrangements were however made to take the test at Ambleside, 40 miles away, with the further suggestion that it could be taken in Workington but only at very short notice.

All readers working for the Morse Test, living in places remote from named Test centres should write to the GPO Radio Services Headquarters, where I have no doubt they will be given courteous consideration, and some easier-reached centre arranged.

A. G. Thorburn, G3WBT. Workington, Cumberland.

Useful Lists

I would like to congratulate Mr. H. W. Hellyer on his Repairing Radio Sets article in the May issue of PRACTICAL WIRELESS. The lists of Test Gear and Bench Aids that he gives on pages 38 and 39 are an invaluable aid and certainly save hunting through lots of old issues of the three "Practicals" for the article that you know is there but for the life of you, just cannot find! Many thanks H.W.H.

P. Keeling. Woodford Bridge, Essex.

Oh Henry!

I read with interest Henry's remarks on page 27 of the May issue of PRACTICAL WIRELESS regarding Retail Price Maintenance. I do not know how Henry can possibly say servicing will suffer because dealers may have to bring prices down to compete with the "big boys".

It is a fairly common fact that from manufacturer to consumer, the price of a product is nearly doubled. Part of this is taken by the wholesaler—about 10%—so where does the rest go? Why, to the retailer who cannot cut his prices to the man in the street because it will affect his servicing organisation. Already most servicing facilities are rather shoddy, so what have we got to lose?

A. Read. Walthamstow, London, E.17.

VIBRATO & TREMOLO UNITS

by A. J. Bassett

LET us begin with a definition. "Tremolo" is a sound effect caused by rhythmic variations in the amplitude of a musical note or notes.

Another, radically different, effect is often confused with tremolo. This is "vibrato" i.e. rhythmic variations in the pitch of a musical note. Various amplitude-modulation devices now on the market are wrongly described as "vibrato" units. This is a gross inexactitude for a true vibrato effect can be achieved only by *frequency modulation* of the note.

Acoustic vibrato units are based upon the well-known "Doppler" effect; a note emitted at frequency "n" c/s by a moving object will have an apparent frequency "f" c/s when received by a moving or stationary auditor (e.g. listener or microphone).

The difference between "n" and "f" is the apparent shift in note frequency. This shift depends upon the velocity and direction of movement of both source and auditor. Similarly an apparent frequency-shift can be produced when a note from a stationary source is reflected from a moving object and the reflected sound waves received by a stationary auditor.

Thus arising from the "Doppler" effect we have three main acoustic means to an apparent change in pitch of a musical note radiated at a fixed frequency:

- (1) Moving source of sound
- (2) Moving auditor
- (3) Moving reflector of sound waves.

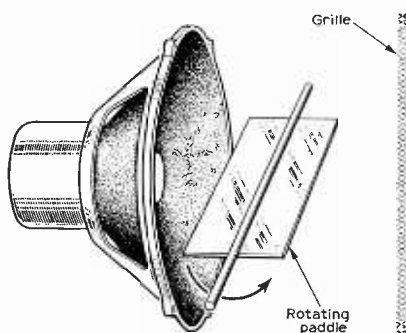
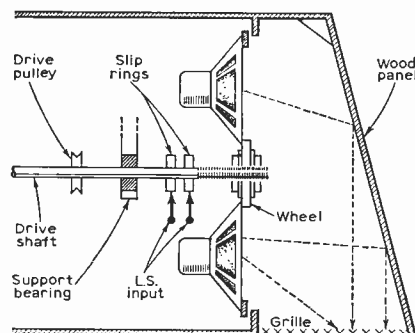


Fig. 1 (left): Rotating paddle method. The paddle may be polished or felt covered (see text).

Fig. 2 (right): Rotating loud-speaker device producing vibrato and tremolo effect.



The "loudspeaker paddle" method is shown in Fig. 1 where a wooden or metal paddle is rotated in front of the loudspeaker, producing a cyclic change in both pitch and amplitude. To enhance the tremolo effect, the paddle should be smooth and polished, thus promoting reflection of sound waves. If only vibrato is required, the paddle may be covered with felt.

There is no reason why several units should not function simultaneously at different speeds. Thus several loudspeakers may be fitted with paddles

in a single installation and the paddles run at different speeds to produce an exhilarating "chorus" effect.

Best speed of rotation is in the region 100 to 300 r.p.m. for average use. The effect is best applied to the high and middle response speakers, large brass speakers being left alone.

Four main output loudspeakers are mounted in a "pitch" circle on a plywood wheel, which acts as a baffle. The wheel is driven silently round at about 80 r.p.m. Slip rings with multiple phosphor bronze brushes are used to make connections to the loudspeakers. Sound waves are guided outwards by means of a stout wooden panel as shown in Fig. 2. Destructive interference between waves of opposing phase contributes toward a tremolo effect, in addition to the vibrato effect which is the main feature of this device.

Echo Device

Here a real echo chamber is used. Once again, both vibrato and tremolo are produced, with the addition of echo and reverberation. In Fig. 3 a corner mounted loudspeaker (L) operating at a low level produces a complex pattern of direct and reflected sound-waves in the chamber. The sound is picked up by a rotating high-quality directional microphone (M). Because of the varying path-

lengths of the reflected and direct waves, a phase-shift effect emerges, which is sampled at various, angles by the microphone to produce a more or less intense vibrato effect. Tremolo is produced because some of the sound waves are stronger at different angles.

The degree of echo produced by such a chamber may be undesirable for certain types of music. This echo is determined by the length (S) of the chamber, which could be only 4ft. for minimum echo, though a length of 12ft. might be acceptable in

other instances. This is a subjective matter, and much depends upon the size and character of the main room or hall.

The chamber itself may be constructed in an unused passage or cellar from which extraneous noise is excluded. The walls are best constructed of concrete, brick, stone or heavy galvanised iron. The microphone is driven at about 300 r.p.m. from a silent-running electric motor using plastic or

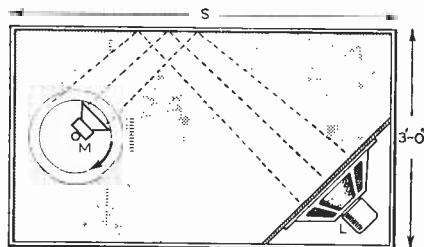


Fig. 3 (left): Echo chamber containing loudspeaker and microphone—only the microphone rotates.

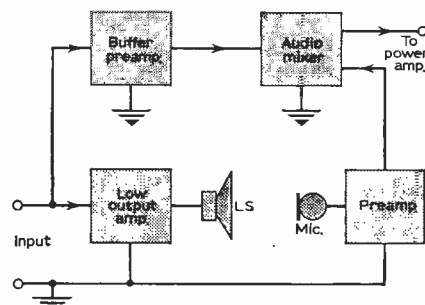
Fig. 4 (right): Block schematic of complete system when using an echo chamber

rubberised gears. Its output passes to slip rings on its drive spindle where multiple phosphor-bronze brushes are used for smooth, electrically silent contact. Fig. 4 shows the block diagram of a circuit suitable for use with the echo chamber.

Electronic Units

In these days of fierce commercial competition, and the consequent production of cheap goods, discrimination suffers, and there is a general tendency to accept substitutes which can never really satisfy the enthusiast. Amongst the many items which fall victim to this trend, we find an important accessory to modern music; the "electronic vibrato unit". This unfortunate device has suffered to such a degree that there are very few genuine electronic vibrato units on the market, and none of the many "constructors' circuits" which the author has seen will give a genuine vibrato effect. The majority of vibrato units do in fact operate as amplitude-modulation devices. Some of these a.m. devices operate by means of screen-grid modulation of a pentode. A typical circuit is shown in

Fig. 5. V1, a double-triode valve (ECC83) and its associated network form a low-frequency Wien-bridge oscillator, whose output is fed to the screen-grid of V2 via C3 and depth control VR4. The gain of V2 varies in sympathy with the changes in the voltage on its screen-grid, thus providing amplitude-modulation of the audio signal. VR5 is a gain control, which may be adjusted until the



mean gain of the unit approximates unity. The output may contain, in addition to the input frequencies, traces of the tremolo frequency, but these are small and are usually not objectionable. This unit could not possibly produce frequency-modulation of any note it might receive from the pre-amp. A different approach is clearly needed.

We will now discuss a unit which does not rely upon acoustics; can be built fairly small, and which will produce a true vibrato effect; the basis of operation is a phase shift ladder network, whose theoretical diagram is shown in Fig. 6 together with associated amplifier circuits.

To each stage of the ladder is connected a capacitor plate P1, P2, - - - P6, these plates being arranged in a ring in the order given. Above this ring is placed a ring of thin sheet dielectric (e.g. perspex) pressed flat against the plates. A sliding pick-up plate P7 is arranged to run round on the dielectric, thus providing capacitive pickup of the audio signal, from each of the plates in the ring, in turn.

Because the phase of the signal is different at each stage of the ladder network, the output waveform derived from P7 is alternatively "compressed" and "expanded" with regard to the time axis. If the device is correctly adjusted by extra pads or dielectric where need be, amplitude-modulation is rendered negligible. The result is a frequency-modulated output derived from a constant frequency input.

Fig. 7 shows a rough sketch of a printed circuit board, showing arrangement of the capacitor plates P1—P6. It will be noticed that plates P2—P5 are split into different positions in the ring as shown. This aids in the production of a smooth output. An electric motor (not shown) drives the wiper plate P7 (not shown) over these plates to pick up the signal via the dielectric. Signal pickup from P7 is effected by a phosphor-bronze sliding contact. Speed of rotation of P7 is adjusted to about 300 r.p.m. for average use. The ladder network components shown are on the other side of the board. The paired capacitor plates are connected together by wires. The size of the printed circuit, etc., may be left to individual choice, but a pitch circle of 4 to 6 in. should be adequate for plates P1—P6, the

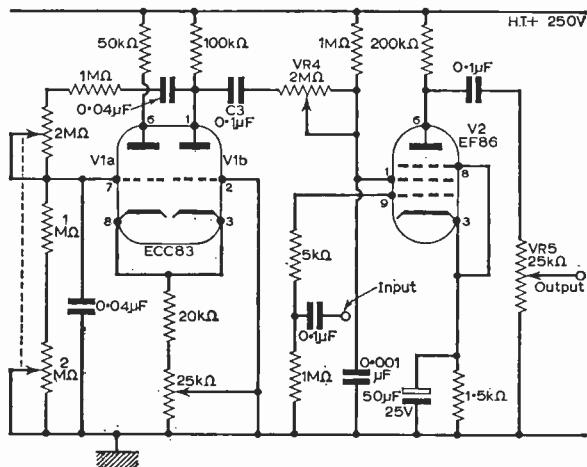


Fig. 5: Tremolo unit suitable for electric guitar or electronic organ.

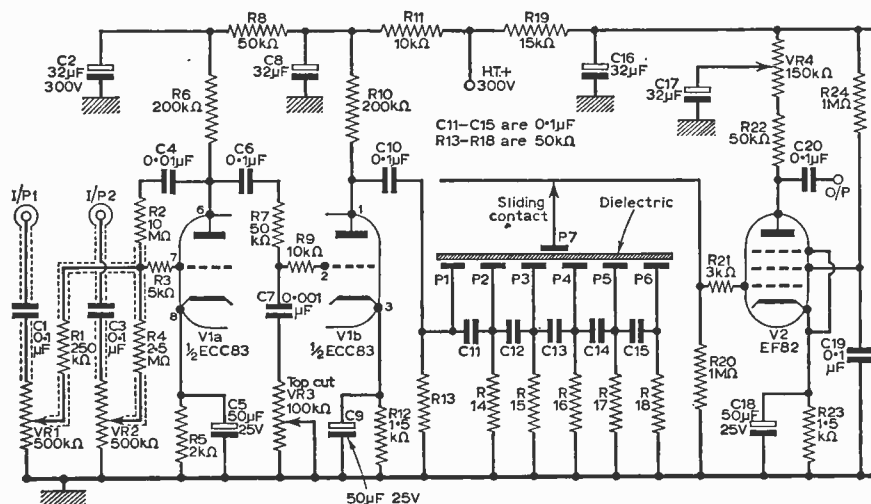


Fig 6: Phase-shift ladder network and associated amplifier—producing true vibrato effect. The component values in the ladder network may be varied (see text).

larger plates producing a better quality. The wiper plate P7 may be big enough to just cover one of these plates, or possibly a little shorter. This may be determined by subjective listening, or by the use of an oscilloscope to obtain good output waveform.

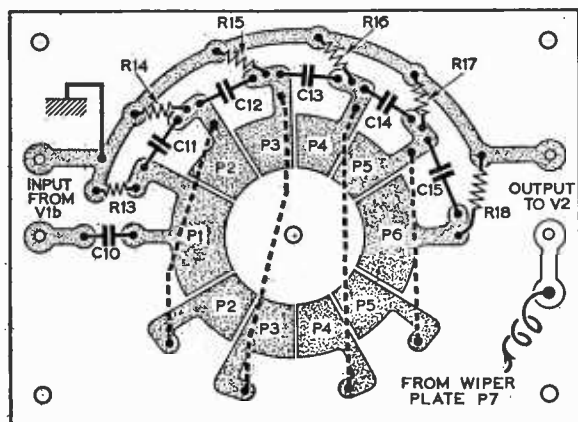


Fig. 7: Suggested layout of printed circuit board showing arrangement of the capacitor plates P1-P6.

Almost any small electric motor may be used provided the power is adequate to drive P7 against the small friction involved; however, a synchronous or regulated type is to be preferred. The motor should be geared down by non-metallic gears to avoid hum pick-up. Several modellers' motors are

available with suitable plastic multi-speed gear-boxes, and these should be tested in the shop to ensure that they are reasonably silent-running.

The whole unit should be well shielded against external capacitive pick-up; special care being taken to shield the motor leads (use shielded twin cable), and the valves in separate compartments to avoid audio feedback.

V1 of Fig. 6 forms a preamplifier with high and low sensitivity inputs, and volume controls VR1, VR2. The top-cut tone control VR3 operates in conjunction with low-pass filter network R7, C7, R9. This is necessary to compensate for bass attenuation in the phase-shift network. The output from V1b is fed to the ladder network, and having passed to P7, is amplified by V2. VR4 is a gain control, which cuts down the voltage gain of V2, and will help combat any tendency to a.f. oscillation in this high-gain circuit. Output from V2 is fed to the main amplifier through C20.

The values of C11-C15 and R13-R18 may be varied to suit individual taste and the type of instrument to be used. Thus for bass instruments, a higher value of capacitor may be preferred.

With regard to the mechanical section of this unit, the constructor is not bound to use a printed circuit at all; thus the capacitor plates may be assembled in the form of a cylinder, inside which is a film of dielectric round which runs plate P7. In fact the whole design is quite flexible, and with care the constructor may build a vibrato and/or tremolo unit more suited to his purpose than many on the markets of today.

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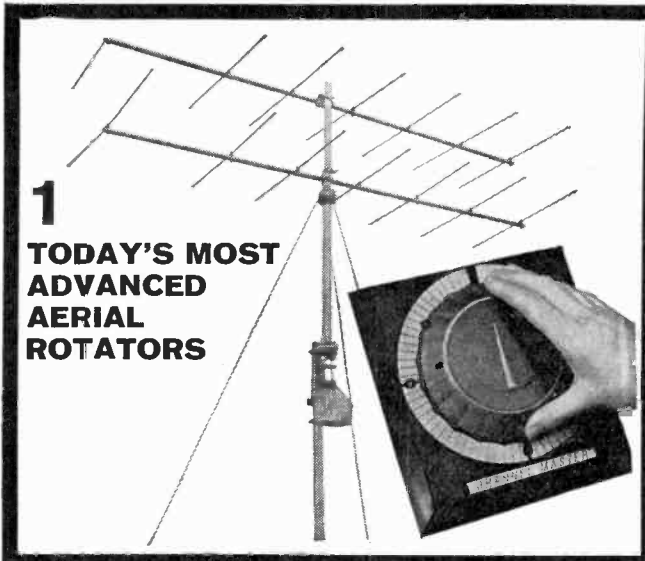
Timed to finish around the time the colour service starts on BBC-2, a compact basic course in colour TV starts in the June issue. Make sure you get the full series by ordering your copies now!

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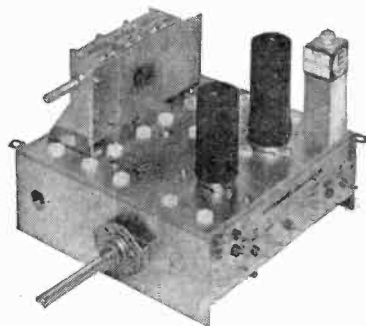
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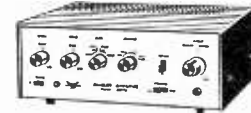
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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

ALBANIA: *Radio Tirana* (Rue Ismail Quemal, Tirana) European English schedule is 0630-0700 6,157 plus possibly 7,120; 1500-1530 1,214 (some reports say 7,265/1,277); 2000-2030 7,265; 2200-2230 7,265 (plus 1,310 in some reports). Non European English TX believed to be 0200-0300 9,715/7,265 and 0400-0430 7,265/9,390/1,310.

Radio Shkodra (Drejtoria e Radio Shkodres Shkoder) may just be heard at 1700-1930 on 8,217.

Andorra: *Radio Andorra* (c/o 82 Chelsea Manor Street, London, S.W.3) has been testing on 719 at 1800-0100 with a view to starting an external service beamed to the U.K.

Bulgaria: *Radio Sofia* (4 Boulevard Dragan Tsankov, Sofia) reported with new frequencies 11,930/11,955 for African English TX at 2105-2130.

France: O.R.T.F. (Maison de l'O.R.T.F., 116 Avenue du President Kennedy, Paris 16) has English 0515-0530 9,500/11,960; 1100-1115 17,850/21,650; 1300-1330 15,245/17,740/21,580; 1915-1930 15,245/9,700.

Germany: *Deutsche Welle* (Brueckerstrasse 1, Postfach 344, 5 Köln) has made following changes in English TX: 1550-1620 11,765/15,435; 1100-1115 11,930/15,275/17,875; 1900-1910 11,925/15,380.

Westdeutschen Rundfunk Wallrafplatz 5, Köln) is to increase the power of its 1,586 TX to 800kW.

Radio Free Europe (1 Englisches Garten, Munchen) shows the new frequencies of 7,215 and 21,575 in its latest schedule.

Great Britain: BBC (CEXB, Bush House, London, W.C.2) using 25,750 for 1200-1300 Chinese TX.

Holland: *Radio Nederland* (P.O. Box 222, Hilversum) using 25,610 for some programmes. The 1600-1720 Sunday Happy Station session has been reported on 17,765/11,730 A special QSL is to be issued from April 28 to October 7 to commemorate the Canadian Expo 67 exhibition. A new picture series will then follow.

Hungary: *Radio Budapest* (Brody Sandor—S.U. 5—7, Budapest VIII) now uses 3,995/6,234/7,100/7,220/9,833 for the 2200-2230 English session.

Italy: R.A.I. (Viale Mazzini 14, Rome) has completely revised schedule. English is now aired as follows: 2135-2155 9,710/7,275/6,050; 0100-0120 11,810/9,575; 2200-2255 11,905/9,540/6,095; 0350-0410 17,770/15,310/11,905; 0425-0504 7,275/6,050; 2025-2045 9,575/7,235/6,130.

Monaco: *Trans World Radio* (Rue de la Poste 5, P.O. Box 141, Monte Carlo) has English 0630-0730; 7,295; 0730-0815 9,655/7,295. 0815-1000 Sunday, 1200-1245, 1430-1530 9,655. Frequencies are subject to confirmation.

Poland: *Radio Warsaw* (Warsaw). Revised European English schedule is: 1830-1857, 2130-2155 9,525/7,125;

1930-2000 9,525/7,285/7,125/1,502; 2030-2100 9,675/9,540; 2230-2300 9,540/7,285/1,502; 2303-2330 818.

Rumania: *Radio Bucharest* has new English transmission at 1200-1230 on 11,920/15,250 and 1300-1330 11,920/15,250/15,318. The 1500-1530 is now on 11,885/11,920/15,250.

Spain: *Radio Nacional de Espana* (General Yague 1, Madrid) has a new Hungarian TX at 1300 on 9,760.

Sweden: *Gothenburg Radio* (Omsala) reported testing at 0700, 1223 and 1715 on 11,820. Does anyone know anything about this station?

Radio Sweden (Box 955, Stockholm 1) now has English: 0900-0930 9,625/21,585; 1100-1130 9,625/15,240; 2015-2045 9,625/11,705; 1900-1930 11,705/17,840; 1230-1300 15,240/21,690; 2245-2315 9,620/11,705; 1400-1430 21,585/17,840; 0515-1545 17,840; 1600-1630 17,840/15,240; 0200-0230, 0030-0100 11,805; 0330-0400 11,705; 2330-2400 1,178.

Switzerland: *Swiss Broadcasting Corporation* CH 3000, Bern 16). The summer English schedule is: 0130-0315 6,120/9,535/11,715; 0515-0700 9,695/11,715; 0700-0900 (not Sundays) 6,135/9,535; 0700-0900 9,590/11,775/17,890; 0915-1030 15,305/21,520/17,830; 1115-1300 9,665/11,865; 1315-1500 15,235/17,775/21,520; 1515-1700 15,305/17,830/21,540; 1900-2045 9,665/11,865. Available transmitter powers are now 25/100/150/250 kW.

U.S.S.R.: *Radio Moscow* (Moscow) now broadcasts 24 hours a day in Chinese to China.

Radio Kiev (Ukrainiske Radio, Radio Centre, ul Khreshchatik 24, Kiev, Ukrainian SSR) has English to Europe Mondays, Thursdays and Saturdays at 1900-1930 6,020/6,040/9,640; 2230-2300 1,241. To North America on the same days 0030-0100 7,120/7,280/7,290/7,330/9,680; 0430-0500 7,250/7,290/7,330/9,600.

Yugoslavia: *Radio Belgrade* (70 Borisa Kidrica, Belgrade) has English 1530-1600 11,735/15,240/9,505; 1830-1900 6,100/7,200; 2200-2215 1,268/6100/7,200/9,505.

Clandestine: *Radiofonica Stamos i Foni*. This is a communist station with Greek programmes produced in East Germany and probably transmitted from Bulgaria. It can be heard 0510-0545 on 6,215 and 1730-1800 on 8,065.

Radio Portugal Libre transmits at 0700-0730 on 12,008; 1200-1230 11,510; 1900-1930 and 2115-2145 9,445.

Radio Espana Independiente transmits 0600-0700 6,950; 1300-1400 15,365; 1615-1800 9,430/10,130; 1800-2230 6,950/7,005/9,430.

Contributions came this month from Radio Sweden, R. J. Warner, A. E. Roxburgh, R. Severn, J. McDonald, J. W. Smith, D. S. Abbott, K. Proctor, W. E. Bartlett, D. Owen, J. Fitzgerald, and the Swiss Broadcasting Corporation.

WE will spend two minutes with heads reverently bowed in silence before pressing on. This token of mute sympathy is for the G3JDG receiver which passed peacefully away—just as ten metres was beginning to get interesting too. The mains “trany” has shorted itself out so it looks like I’m stuck with the t.r.f. until after Easter. Have you ever noticed how things always break down on a Sunday or a bank-holiday, when all the shops are shut? Prior to being struck “mains tranyles” however, things were going great guns and most bands appeared to be very busy. Ten metres has yielded VK stations at 5 and 7 on a.m. phone; fifteen has gone literally potty with signals at times and seems more consistently open these days; twenty has been, well twenty, lots of DX and quite good openings to the Pacific and Oceania. On seven megs lots of noise, commercials and DX too if you can stand the pace and have the skill to wrinkle them out. Eighty metres, well I didn’t do too well this month but others have sent in some very fine logs for 3.5 so it must be me. (More exciting confessions next month.)

LOW FREQUENCIES

Still very few people send logs for the l.f. bands. Everyone seems to stick h.f. where DX falls like ripe plums into the ears of anyone who cares to listen out. Some people are persistent however.

N. Henbry (Sussex), EA12, 20 metre dipole for 7mc/s, 7ft. vertical copper rod at 30ft. for all other bands. Norman really goes to town on the l.f. segments. On 80 s.s.b. he logged—FØAO/M, K1SLZ, K2DPA, K3UQU, K4SXT, K7UIT/9A1, KP4AST, TF3EA, TI2NA, VE1AHP, VE2BTS, VS9ALV, W1ZBT, W2ZPO, W3BMS, WA3DCG, W4SIB, 3A2MJC, 3AØAE, 3B1FG, 3C1UA, 3C2WM, 3C3FJZ/SU, 9H1AB. Up higher on 7Mc/s the log reads—CN8AW, CN8BV, GC8HT, K5OSH, PZ1CF, WB2CKS, W4OMW. It’s no good, I shall have to lay a long lead from Norman’s shack to my place to plug in a spare pair of phones.

L. Smith (Glasgow), 19 set (modified), 66ft. long wire went s.s.b’ing on forty and hooked—CN8AW, CN8BB, DJ4AX, DJ7QV, DL9ME, EP3AM, I1BAF, OE2EGL, PY6NW, UA3KBO, UB5KIW, YU3LB. Nearly all the reports this month were for the h.f. bands, so let’s turn the bandswitch to 20/15/10 and see what’s about.

HIGH FREQUENCIES

A. Darragh, QTH not stated so we’ll put him down as no fixed abode, GC1U, 100ft. long wire running N/S. On 20 s.s.b.—AC4AK, CE1FC, CE3TS, CP8OS, CT1BK, EP1BP, EP2BI, HI8LAL, HK4KL, HV3SJ, IS1KW, JA—1AEA, EZT, 4TRV, KC6BW, KH6BT, KL7BZ, KR5CUN, KR6UL, KS6BT, LU5AH, OX3LY, OX4AA, OY7S, PX1PA, TF3EA, TG2IA, TG8IA, TI2PAS, TU2DC, UA7JA, UA9FC, UF6KPA, UJ8KAA, UNICC, U5ARTEK, VK—2ID, 3AUP, 4KS, 5LT, 6KK, 7SS, W4EFB/P/KH6, XE1FFA, XF1KB, YS1AG, ZL—1AI, 3BE, 3QH, ZS—2PD, 3FT, 6AJL, 6RA, VU2BX, 3A—ØAE, 2BS, 2MJ, 2RJC, 3B—1GL, 3C—3BVE, 5SV, 6ALX, 7ZU, 8AD,

4U1SU, 4X4MO, 5A1TV, 5A5TV, 5H3TG, 6Y5MJ, 9G1ND, 9H1A, 9M2DX, 9X5PB.

S. Porter (Surrey), has an R1155 with a 20 metre dipole. He reckons the best time to listen is around sunrise, and from 1800 onwards. His log for twenty includes—EL3D, KA6BFU, KP4CSV, KP4AXC, VK2NI, VK2ID, VL9UC, XE1CE, YV5BSL, 3A2KO, 4X4BL, 5A5TV, 7XØAH, 9X5A.

D. Clark (Bucks), progressive s/het plus PR30, 60ft. NW/SE, 20 s.s.b.—IS1DMN, K1EPG, K2AGZ, K3FGO, K4LZU, K5ZSX/MM, KG6AQG, KL7EBK, KP4ID, KR6UL, OD5FA, OX4VT, SVØWII, TF3HS, VE1ACD, VE1AGH, VE3DJE, VK2AFD, VK3SX, W—1/2/3/4/5/9/Ø, WA8CH/MM, YN1JW, YV4AZ, ZE1AE, ZF1GC, ZL3UY, ZS1JM, 3A2CP, 5A1TG.

P. Baker (S. Wales), HE30, 120ft. l.w., heard these on 15 metres, mostly s.s.b. the rest a.m.—CN8FT, CR3KD, CR4BA, CR7BO, CR8AL, CT2AP, EA6BG, EA9EJ, EL6B, EP2RT, EP3AM, HC2SW, JA—1OYY, ITTL, 4AXW, 9JX, K6PIZ, KP4CQV, KV4CX, MP4—BBA, BGM, BGL, OA4TF, OD5BU, OX5AR, PY9AI, VE6QG/SU, SVØWL, TF2WKE, TI2RLJ, UA9DT, VE7PV, VK5HT, VS9ALV, WB2FBQ/MM, W6ITA, W7VSM, YS1TF, ZE6JL, ZL—3KA, 4JI, 4MZ, ZB1YR, 3C5HV, 3C6AJY, 4X4LL, 5A1TV, 5N2ABB, 7XØWW, 9G1EZ, 9H1X, 9U5BB.

J. Preece (Cheshire), PCR3, 60ft. l.w., 15 metres all a.m.—CN8CF, CO8RA, CR4EJ, CR6AU, CR7FM, EA9EJ, EP2RT, FG7XE, FM7WQ, HC2SW, HI8BGA, KG6AAY, LU5DZ, MP4BGL, OD5ET, PY1MGW, ST2SA, SV1DL, TF5TP, TJ8AC, VP6BW, WA5QQF, W6QBA, YV4ON, ZE6JE, 3C3GCO.

P. Knowles (Cheshire), CR45 plus PR30, 70ft. l.w., listened on ten metres a.m. for—CT1JW, EA3HL, K1ZFP, LA2XK, MP4BGM, UA3AWK, UB5EVW, VP7NP, W1DT, WB2QEH, ZS6RQ.

G. Taylor (Staffs), HE30, 135ft. l.w., ten metres a.m.—PJ3CL, VP6UN, XE1CT, 9Y4BS, on s.s.b.—CR7ER, DU1FH, EP2GI, FG7XL, HC1MF, JA2BVY, KV4EY, VK4TT, VP2MK, XW8AL, YV1EJ, ZE4JS, 5R8AS, 9L1TL.

P. Allsop (Derby), GC1U, 66ft. l.w. all a.m. on ten metres—K1ZKD, K2BJR, K3HTZ, KØQMU/P, VE3CKM, W1UHY, W2BFZ, W3DJW, W5WS, W9MZM, XE2CJ, ZC4MO.

P. Elliott (S. Africa), 5 valve s/het, 105ft. l.w. logged these on phone on 10—CE6EZ, HBØWEE, KR6BF, KV4CX, KV4EY, MP4BBA, OD5EC, PY2PA, SVØWFF, VE6ALA, WA6UEK, YA5RG, YV1PP, YV3FBP, 3C3FDZ/P/SU, 4Z4AO, 5N2ABA, 5R8AS, 9H1HR, 9M2LO, 9V1NY.

WHERE AND WHEN

Contests and rallies are on the increase now that the warmer months are coming. In May there’s quite a few and my diary reads—7th, Thanet Mobile Rally at Ramsgate; 7th, 2 metre portable contest; 20th—21st, 1296Mc/s contest; 27th—28th, 432 Mc/s contest; 29th, Redbourne Fair (Herts) listen on 160; June 3rd—4th, National Field Day. Deadline for this month is 20th. The deadline for all logs in future will be the 20th of each month.

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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
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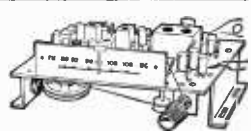
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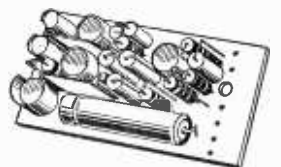
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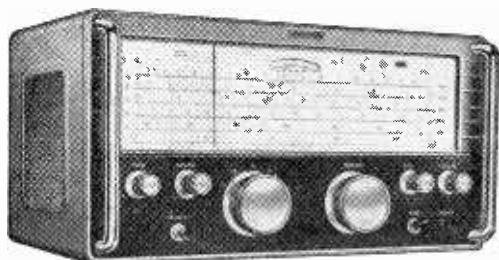
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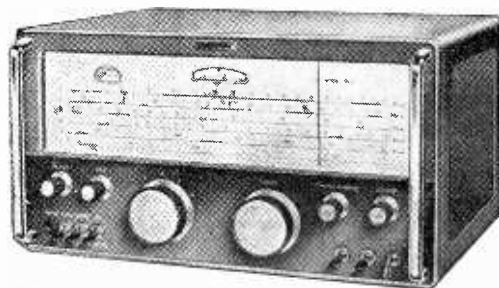


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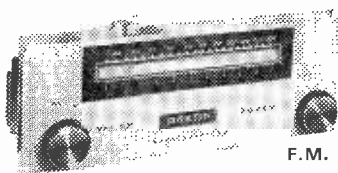
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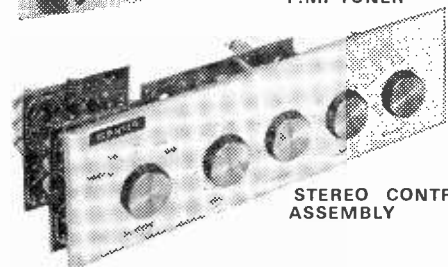
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commentary by HENRY

No. 34

Lead us
not . . .

THE price of newsprint is going up. Space must not be wasted. It is Henry's duty to utilise this column in a forthright, serious, progressive way. This was underlined by a letter on Page 821 of the March PRACTICAL WIRELESS. I.N.R.W. Newport accused the Editor of wasting space in comment; space that could have been better used for constructional articles. The sting of Mr. Newport's letter came in the tail. "*A far better policy would be to refuse advertised non-convertible 27 Mc/s walkie-talkie spreads unless boldly indicated as such.*"

The key-word is *boldly*. Our correspondent expects the advertisers to proclaim: "Buy it NOW—but use it NEVER." He may be right. It is scandalous that potentially illegal apparatus should be blatantly peddled for the innocent reader to be corrupted. What about those radio tuners for the front end of your hi-fi kit, feeding a tape recorder aren't they just a little naughty? Even the impeccable Mr. Molloy released the secret (Page 839, same issue) that the phone output of the R1155 was suitable to load a tape recorder. Shame on him!

We must draw the Editor's attention to another article that appeared in the same issue. A top-band transceiver is described by T. Simon.

Here the felony is compounded by an attractive cover picture

that even includes communications in foreign languages, aye, whisper it, from behind the Iron Curtain. What a gift to some potential George Blake.

The article bristles with law-breaking possibilities. In the first place, for only £15, our innocent is tempted to transmit. Or is it simply that the Editor is fanning another controversy on ham-licences and the anachronistic need to learn the Morse Code?

Let us look a little deeper at the article. Near the bottom of column 1, Mr. Simon tells us that in his area "... there is a strong break-through from the BBC at Brookmans Park (908 kc/s 2nd harmonic)". Who knows what else may break through, even using a well-peaked tank circuit. We may find ourselves clandestinely eavesdropping on the police, fire service, ambulances, even taxis. In a south-coast town even the dust-carts have two-way radio.

Further on we see two stages of modulation defended with the statement "... the QSO can be conducted in a confidential whisper with the mike gain half-way up." We have roamed the amateur bands and heard a few of those confidential whispers, thank you. It's a good job Mrs. Whitehead is only bothered about professional TV. What a fine hunting ground the ham-bands would provide for someone with a prurient mind.

True, Mr. Simon cares about

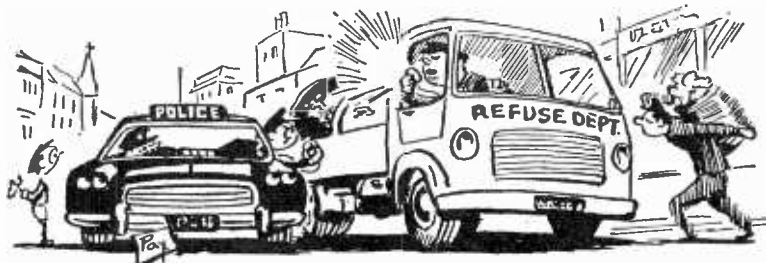
v.f.o. swishers and does his best to eliminate the beat note. He also uses frequency modulation the better to avoid t.v.i. Perhaps Mr. Newport would wonder darkly whether he has some ulterior motive — perhaps the family has demanded uninterrupted Coronation Street.

Yet the constructor still has to put 100pF across the mike to avoid BBC re-radiation. Tape recorder owners will recognise the phenomenon. Free radio programmes, lightly veiled in an innocent text. It's anarchy, that's what!

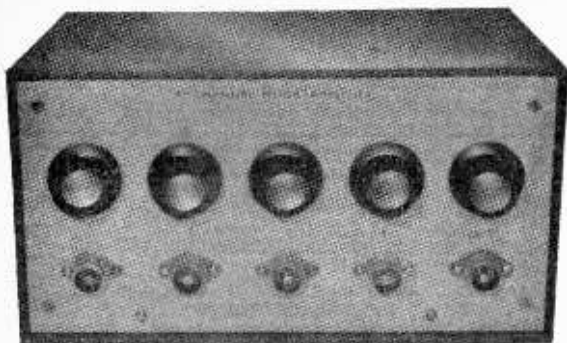
But Mr. N is more concerned with the advertisers. He worries about Swish not washing whiter than white noise. He forgets that we are conditioned to the blandishments of the adman and don't believe half of what we read, hear and see. Has he thought of the awful possibilities — the unsuspecting reader who buys and builds a kit that doesn't work, then offends the local litter-laws by throwing it out of the window? Or the student who chucks up his butcher's apron for a correspondence course and electrocutes himself with a 9V battery.

Somewhere a heart beats more strongly because Messrs. Super-Fi have advertised their home video tape link. What a prospect this conjures up! All your favourite programmes canned while you are out shopping, for a paltry ten quid an hour—or, as the advertisers say piously, much less when the demand steps up. To follow the argument through, we ought to ask for video tapers to apply for some kind of licence.

Henry stands aghast. The thought of such electronic sins being committed all round appalls him. Perhaps it is as well the price of newsprint is rising—there will be less room per issue for policy-bending letters.



The dust carts have two-way radios



4-CHANNEL

mixer/amplifier

F.L. THURSTON

A DESIRABLE item in any audio enthusiast's list of "accessories" is a good quality mixer, to enable a number of inputs to be added together to give a single, complex, output signal. This four-channel mixer contains a 500mW power amplifier and makes the device very versatile and suitable for use either on its own as a multi-input, general purpose, power amplifier, or as a fairly conventional mixer capable of driving a speaker or a low impedance feeder line. Semiconductors are used in this high gain unit, which features good stability and quality with low noise and low inter-channel interaction.

BASIC DESIGN PRINCIPLES

A conventional "mixer" consists of some kind of combining circuit, followed by an amplifier which compensates for any attenuation which takes place in the adding process. In the unit we are considering here, an additional power amplifier "block" is provided so that the simplified block diagram of our unit is as shown in Fig. 1a.

Dealing first with the "mixer" part of the unit, a passive adder type is used, and is shown in basic form in Fig. 1b. Here, only two channels are shown; each input is applied across a variable resistor and a proportion of the input signal is tapped off at the slider and applied to a series circuit comprising either R1/R3 or R2/R3. Thus, the two input currents flow in the common resistor, R3. The output voltage developed across this resistor is proportional to the sum of the input signals. R3 may be made common to as many input signals as are required.

When this basic "mixer" circuit is redrawn as in Fig. 1c, it can be seen to be nothing more than a couple of potential divider circuits. The approximate values of input impedance, input-to-output attenuation, and inter-channel interaction can be established at a glance. Note that "worst case" values are shown, with VR1 and VR2 set for maximum sensitivity and with input 2 open circuit. In this case, the input impedance to input 1 is approximately 55k Ω , and, if 1 volt is applied, the attenuation will be such that 55mV will appear at the output, and inter-channel interaction will be such that 25mV will appear across input 2. Input impedance will vary with the setting of VR1, and will be at maximum (100k Ω) when VR1 is set for minimum sensitivity. The attenuation factor between VR1 slider and the output will be virtually constant.

The most important factor, as far as quality is

concerned, is the inter-channel interaction factor, as this will cause distortion between the inputs if it is high. In practice, this factor will depend on the setting of VR2 and the source impedance of the signal connected to input 2. Typically, when 1 volt is applied to input 1 and zero input is applied across input 2, from a 1k Ω source, and both VR1 and VR2 are set for maximum sensitivity, only 0.22mV will appear across input 2 and interaction

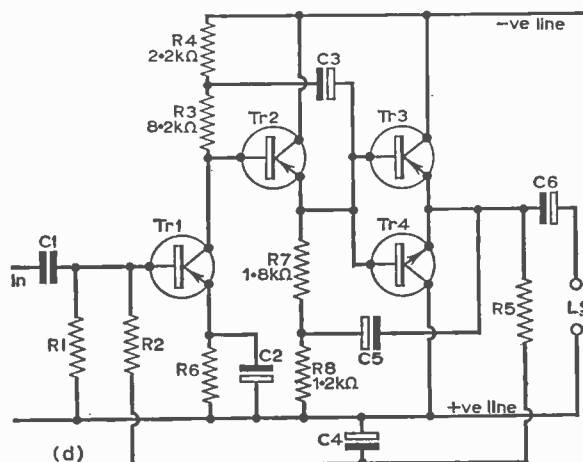
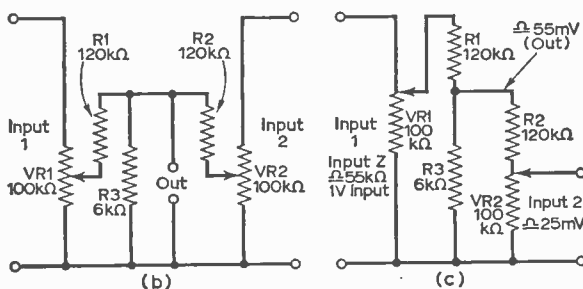
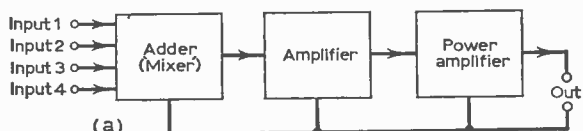


Fig. 1: 'a' block schematic of the mixer/amplifier; 'b' basic two-channel mixer; 'c' basic mixer re-drawn to show potential divider effect, with worst-case values; 'd' basic circuit of the amplifier section of the unit.

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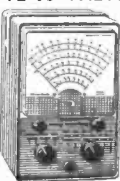
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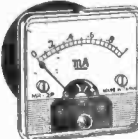
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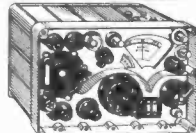
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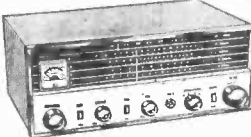
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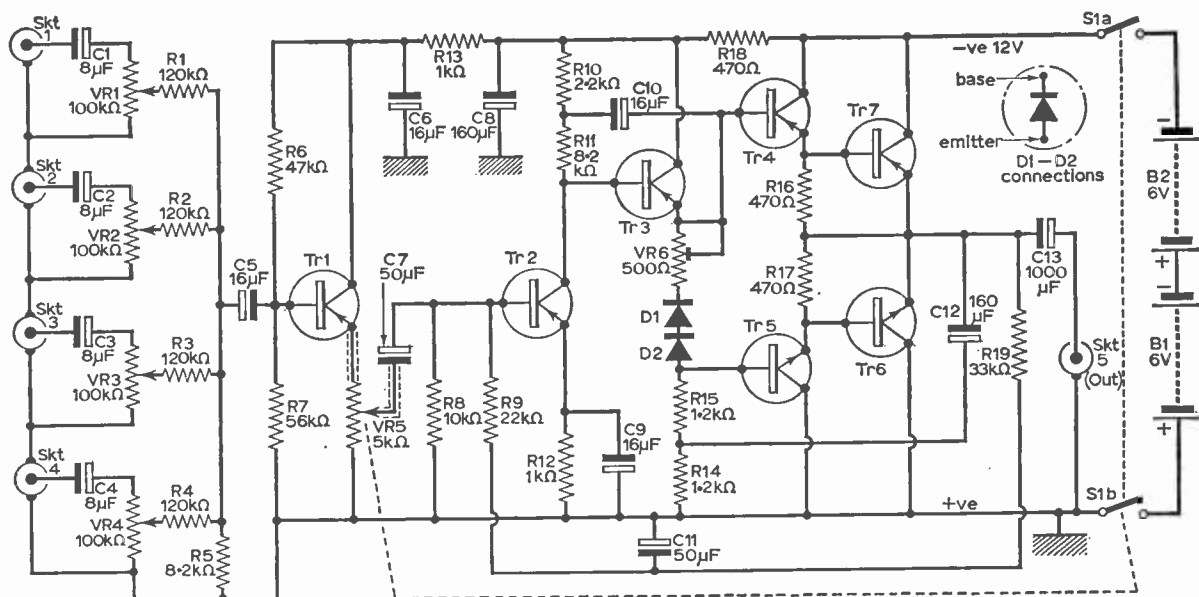


Fig. 2: Complete circuit of the four-channel mixer/amplifier. Note: the two diodes may be made from old p-n-p germanium transistors, see the inset in the top-right corner for connections.

will be negligible. The performance of this simple type of circuit can thus be seen to be "adequate", so the basic principles of the amplifier circuitry can now be considered.

The basic design requirements of the unit call for an amplifier with a very high degree of gain but with good stability and low distortion. Such an amplifier is, of necessity, rather complex; the basic principles of the amplifier are therefore best understood by first referring to the simplified circuit diagram shown in Fig. 1d. Here, the input signal (from the mixer) is connected via C1 to the base of Tr1, which is connected as a common emitter amplifier with its collector load split into two parts, R3 and R4. If the output from Tr1 collector

were fed in the normal way to a following amplifier stage, the input impedance of this second stage would be effectively in parallel with Tr1 collector load and would thus reduce its effective value and hence lower the gain of Tr1. In Fig. 1d this problem is overcome by using emitter follower Tr2 as a buffer between Tr1 collector and the following stages, the amplified output from this "pair" being taken from Tr2 emitter. Since Tr2 has a high input impedance, Tr1 can be given a very high value of collector load, with consequent high overall gain.

In practice, the maximum usable value of Tr1 collector load is dictated by the d.c. and temperature stabilisation requirements of the circuit, and, in this particular application, the maximum usable

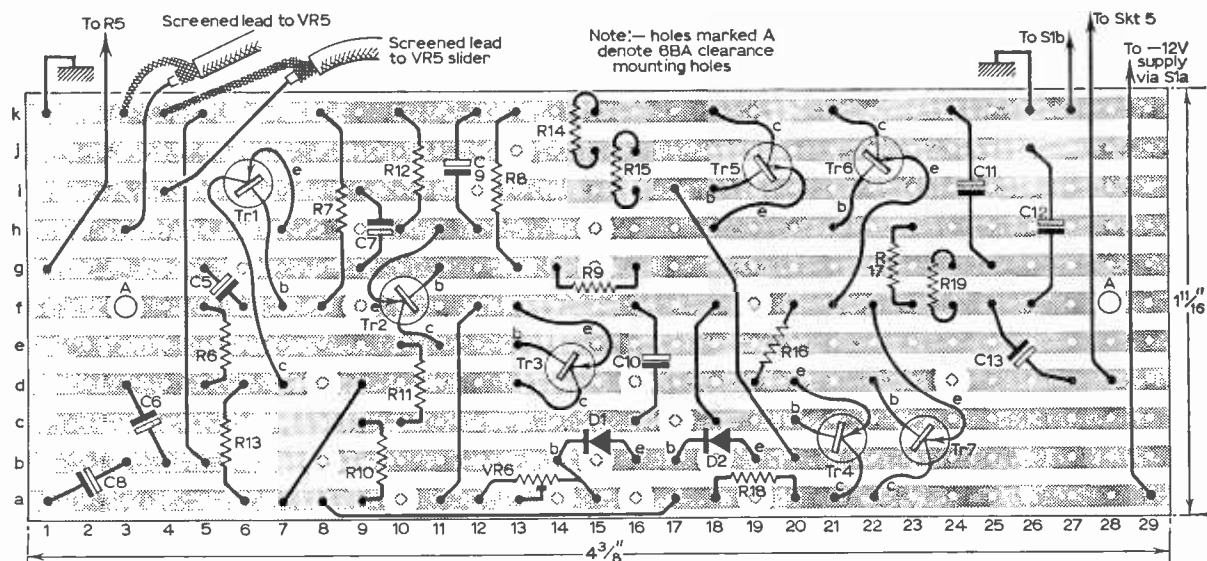
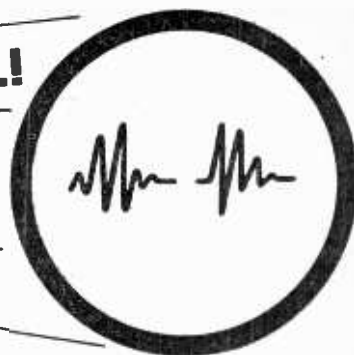


Fig. 3: Constructional data for the Veroboard panel. Care must be taken not to short the individual copper strips when soldering-in components.

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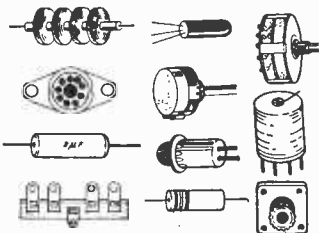
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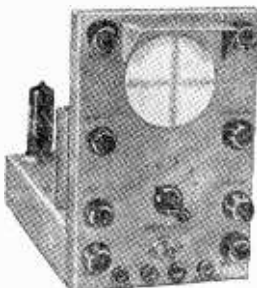
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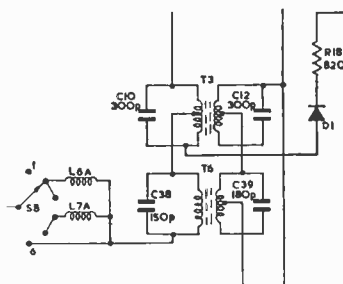
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184	4/9	12A17	4/9	DK96	6/6	EL41	8/8	PL36	9/9	UF41	8/8
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7C5	9/6	DF91	2/6	EF91	6/6	PCL85	8/6	UCF80	8/6	OC83	5/6
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tive, rather than regenerative, and very good circuit stability is thus obtained. Having cleared up the main details of the circuit, the final version of the completed unit can now be considered.

HOW THE CIRCUIT WORKS

The full circuit diagram of the completed unit is shown in Fig. 2. Here, the four inputs are applied to the variable resistors, VR1—VR4 via the coaxial sockets Sk1—Sk4 and the blocking capacitors C1—C4, and the input currents are added in R5 via R1—R4. If the output of the mixer, taken from across R5, were fed directly to the input of a common emitter amplifier the comparatively high input capacitance of the transistor would be effectively in parallel with R5 and would result in an increase in attenuation at the higher frequencies. This is overcome by feeding the output of the mixer to the base of emitter follower Tr1, which has a very low input capacitance.

The signal tapped off from the slider of VR5, the volume control, is fed, via C7, to the base of the common emitter amplifier, Tr2, which has its collector load, R10—R11, "Bootstrapped" from the emitter of Tr3 via C10. The amplified signal at the emitter of Tr3 is fed to the base of the p-n-p Darlington-connected emitter follower pair Tr4/Tr7 and to the base of the similarly connected n-p-n pair, Tr5/Tr6. Diodes D1 and D2, and VR6, in the emitter of Tr3, are used to apply a degree of temperature compensated base-bias to the output transistors and so minimise any cross-over distortion which might otherwise occur. The very low impedance output at the emitters of Tr6/Tr7 is fed to the output socket, Sk5, and thence on to the external speaker, via C13. Bootstrapping is applied from Tr6/Tr7 emitters to the R14—R15 emitter loads of Tr3 via C12. Overall d.c. negative feedback is achieved via R8, R9, R19; decoupled via C11.

A 12 volt battery supply is used, and an output power of well over 0.5 watt is available when feeding a 15Ω speaker.

CONSTRUCTION

For ease of construction, the major part of the circuitry is wired up on a small piece of Veroboard. Start construction by cutting the panel to size, as shown in Fig. 3a, and breaking the copper strips where indicated. Now drill the two small mounting holes, to clear 6BA screws, where shown, and cut back the copper around them to eliminate risk of short circuits when the panel is secured to the main chassis.

Now solder all components, shorting links, and leads in position on the panel as shown in Fig. 3b. Note that all components, other than R7 and R13, are mounted vertically. Insulated sleeving should be used where there is any danger of short circuits occurring. Before attempting to fit VR1 in place, reduce the width of the three mounting legs, with the aid of a small file, so that they fit easily in the holes in the Veroboard. Particular care should be taken to ensure that all electrolytic capacitors are connected with the polarities shown. Heat shunts should be used when soldering all semiconductors in place.

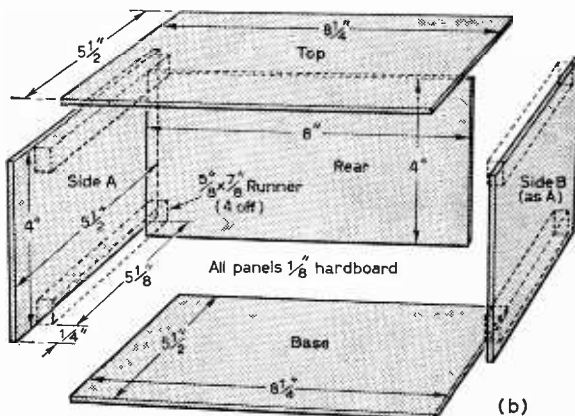
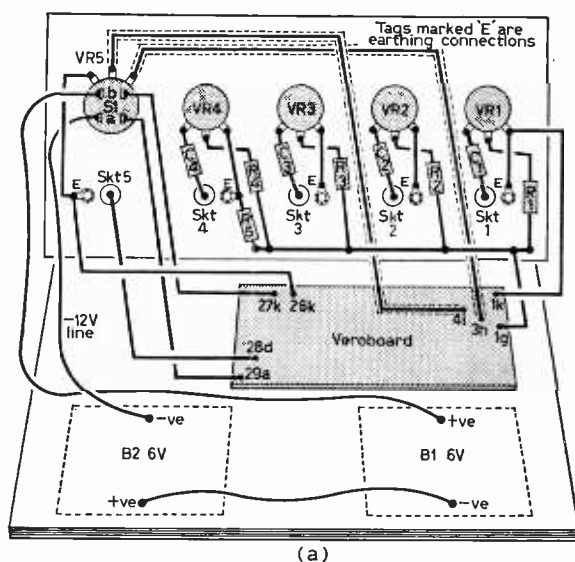


Fig. 5: 'a' shows the wiring details and 'b' cabinet details.

If preferred, D1 and D2 can be made from any scrap p-n-p germanium transistors, providing that the base-emitter junctions are intact, by cutting off the collector leads and soldering the resulting "diode" in place as shown.

When the assembly of the Veroboard panel is complete, double-check all wiring and make sure that no short circuits are occurring between the copper strips. If satisfactory, the circuit can now be given a functional check. Temporarily connect VR5 in place, set VR6 for minimum resistance, short the input to ground, and connect a 12 volt supply to the unit, taking care to monitor the supply current; the unit should draw about 8mA. Now connect a 15Ω speaker to the output, and check that there is no appreciable increase in mean current. If satisfactory, an input can be connected from a tuner, etc., and a functional check carried out; VR6 should be adjusted to give negligible cross-over distortion consistent with a low no-signal mean current, which should work out at about 10 to 12mA.

If the performance of the circuit is satisfactory, it should be run at fairly high volume for a few minutes, to make sure there is no tendency to thermal runaway. If there is any tendency to run-

away, the two output transistors (Tr6 and Tr7) should be fitted with heat sinks. Once these tests have been completed, the rest of the unit can be constructed.

Make up the main chassis, from light gauge aluminium, as shown in Fig. 4a, and cut and drill the front panel, from a medium gauge aluminium, as shown in Fig. 4b. If a battery supply is to be used, cut and drill and bend the two battery holders, from light gauge aluminium, as shown in Fig. 4c; the batteries are held in place by friction. Before assembling these components, carefully cover the outer face of the front panel with Fablon or a similar self-adhesive decorative plastic material; a material with a light wood-grained finish was used on the prototype. Cut away the surplus Fablon with a sharp knife. Now secure the five sockets, Sk1 to Sk5, and the five variable resistors, VR1 to VR5, in place on the front panel. Next, bolt the front panel to the main chassis, and wire up as shown in Fig. 5a. When wiring up is complete, secure the Veroboard panel to the main chassis by passing two 6BA screws through the Veroboard and the chassis, using the mounting holes provided, and interpose two small rubber grommets between the chassis and the panel to act as spacers/insulators.

The main construction can now be completed by bolting the two battery holders in place. The two batteries should now be fitted in place and the unit given a final and complete functional check. The cabinet can now be made up, as shown in Fig. 5b. This is an easy assembly to make, the sides, top, base, and rear being simply cut from hardboard and screwed or nailed to four short lengths of wood which hold the unit in a box shape. When the cabinet has been assembled, smooth off all rough spots with a file or sandpaper, and then cover the complete job with Fablon or a similar self-adhesive decorative plastic. Finally

★ components list

Resistors:

All $\frac{1}{2}$ watt, 10% carbon, except where otherwise stated.
 R1-R4 120k Ω , 5% hi-stab
 R5 8.2k Ω
 R6 47k Ω
 R7 56k Ω
 R8 10k Ω
 R9 22k Ω
 R10 2.2k Ω
 R11 8.2k Ω
 R12 1k Ω
 R13 1k Ω
 R14 1.2k Ω
 R15 1.2k Ω
 R16 470 Ω
 R17 470 Ω
 R18 470 Ω
 R19 33k Ω
 VR1-VR4 100k Ω variable
 VR5 5k Ω variable with built-in on/off switch (S1)
 RV6 500 Ω skeleton pre-set

Capacitors:

All sub-min. 15VW electrolytics
 C1 8 μ F
 C2 8 μ F
 C3 8 μ F
 C4 8 μ F
 C5 16 μ F
 C6 16 μ F
 C7 50 μ F
 C8 160 μ F
 C9 16 μ F
 C10 16 μ F
 C11 50 μ F
 C12 160 μ F
 C13 1000 μ F

Semiconductors:

Tr1 2G403 or NKT675
 Tr2 2G403 or NKT675
 Tr3 2G374 or NKT274
 Tr4 2G374 or NKT274
 Tr5 2N1304 or NKT713
 Tr6 2N1304 or 2N1306
 Tr7 2N1305 or 2N1307
 D1, D2 OA70
 (see text).

Miscellaneous:

Sk1-Sk5=Coaxial sockets. B1-B2=6 volt, type DT1 batteries. Veroboard, wire, sleeving, screened cable, nuts, screws, grommets, aluminium sheet, Fablon, etc. 15 ohm speaker.

secure the mixer/amplifier chassis in place with the aid of four small wood screws passed through the holes in the corners of the front panel, then mark the front panel with transfers or pressure sensitive lettering.

DUAL FUNCTION SIGNAL GENERATOR

—continued from page 119

in other types is the provision of an external socket to which the grid of the r.f. oscillator may be directly switched. Since the oscillator is of the two terminal type, oscillations may be set up in external coils without the use of tappings or separate feedback coils. What is perhaps more important is that

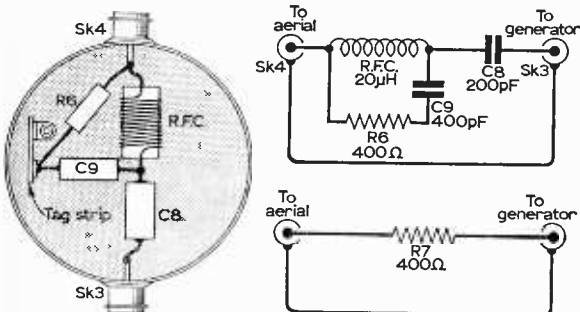


Fig. 5 (left): Layout of dummy aerial.

Fig. 6 (top right): Circuit of dummy aerial.

Fig. 7 (bottom right): Simplified dummy aerial.

oscillations may be set up in screened coils. Generally the presence of a screening can preclude the use of the more conventional grid dip oscillator technique. The author has found this facility to be of particular value when the resonance frequency of an unknown i.f. coil is required.

Let us suppose that an i.f. transformer in a receiver is suspect. The transformer is temporarily disconnected and one section connected via a short length of cable to the external socket of the generator. After switching the generator to this external coil, the signal emitted by the generator is picked up on a receiver. Let us assume that the i.f. transformer has a nominal resonant frequency of 470kc/s. A receiver set to the medium waveband will give a response in the neighbourhood of 940kc/s (319m), which is the second harmonic of 470kc/s. Although no account has been taken of the inevitable stray circuit capacitances, a response in this region is almost certain proof that at least one section of the transformer is functioning satisfactorily. The remaining section may be tested similarly. In the foregoing example it has of course been assumed that the i.f. transformer has its own built-in tuning capacitors. Further valuable uses to which the generator may be applied are coil matching and capacitor testing, details of which are given in the October 1964 issue of PRACTICAL WIRELESS.

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BH 15/1	EB91 3/1	EL86 7/8	N78 16/1
BD78 40/1	EB83 6/1	EL91 4/6	N78 16/1
BL63 10/1	EB84 1/6	EL95 6/1	N78 16/1
BM4 8/1	EB81 6/1	EL1360 20/1	N78 16/1
B85 20/1	EBF80 6/8	EM80 6/1	N78 16/1
B884 37/6	EBF85 7/6	EM81 6/1	N78 16/1
B2134 16/1	EBF89 6/8	EM84 6/1	N78 16/1
BT19 25/1	EBL31 20/1	EN31 10/1	N78 16/1
BT35 25/1	EC52 4/1	ESU74 30/1	N78 16/1
BT45 150/1	EC53 12/6	ESU208 6/1	N78 16/1
BT83 35/1	EC70 4/1	EY51 5/8	N78 16/1
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CC23 10/8	EC91 2/1	EY91 6/1	N78 16/1
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CV77 5/1	EC82 5/1	EZ41 6/8	N78 16/1
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CV103 4/1	EC84 5/8	EZ81 4/8	N78 16/1
CV4004 7/1	EC85 6/8	F1857 5/1	N78 16/1
CV4014 8/1	EC88 6/1	F1861 5/1	N78 16/1
CV4015 7/1	EC91 4/1	F1863 4/1	N78 16/1
CV4025 10/1	EC189 9/6	FW4/5006/8	N78 16/1
CV4049 6/1	ECF80 7/1	FW4/8008/8	N78 16/1
CV31 6/8	ECF82 7/1	G1/23602/8	N78 16/1
D1 1/8	EC142 9/1	G1/370/1	N78 16/1
D41 6/1	EC81 8/1	G1/81 20/1	N78 16/1
D61 6/1	EC83 7/6	G50/2G 5/1	N78 16/1
D77 3/3	EC180 6/1	G180/2M15/1	N78 16/1
DA30 12/6	EC182 6/1	G4 45/1	N78 16/1
DAP6 6/1	EC183 10/1	GTE175M	N78 16/1
DD41 4/1	EC186 9/1	P1384 5/1	N78 16/1
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DL810 8/1	EP85 4/6	K763 4/1	N78 16/1
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OC44, OC45, OC70, OC71, ACY22, OC81D 2/3 each
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Postage 1/-.

RADIO VALVE DATA, 8th edition. Compiled by "WW" 9/6. Postage 1/-.

WORLD RADIO TV HANDBOOK, 1967. 32/-.
Postage 1/-.

OUTLINE OF RADIO AND TELEVISION, by J. P. Hawker. 30/-.
Postage 2/-.

Inter GEC. TRANSISTOR MANUAL. 18/-.
Postage 2/-.

BASIC THEORY & APPLICATION OF TRANSISTORS. U.S. Dept Army. 10/-.
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new books

Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in heavy type should be quoted.

HOW TO LISTEN TO THE WORLD
Published by World Publications.
184 pages. 8½ x 5½in. Price 26s.

THIS is a new edition of a well established favourite. For those who have the previous edition there is little extra to be gained from purchasing this one. However, if you are a beginner and have had your appetite whetted by "PSE QSL" in the March PRACTICAL WIRELESS you will be helped considerably by this book.

Every aspect of DXing is covered both in theory and practice, and there are separate chapters on listening to various continents. For those with specialised interests there are chapters on learning languages by radio, listening to satellites and television DXing.

A good feature of the book is that every chapter is written by either a leading DXer or member of a short wave station's staff with the result that some good down-to-earth facts emerge. One slight disadvantage stems from this though in that inevitably there is a certain amount of overlap between chapters.

One disappointing feature is that the section How to write a report in Portuguese or Spanish is not in the latest edition. Even so a good buy for the beginner.—JMG.

HANDBOOK OF APPLIED MATHEMATICS
By E. E. Grazda, M. E. Jansson and W. R. Minrath.
Published by D. Van Nostrand Co. Ltd., 46 Victoria Street,
London, S.W.1. 1,119 pages. Size 7½ x 5½in. Price 80s.

THERE can be no doubt that the authors of this book have given value for money. In over a thousand pages they have covered a wide variety of fields. The problem is that if one recommends this book, to precisely whom can it fairly be offered. Starting with a general treatment of the various sections of mathematics the authors continue for the remaining 800-odd pages with the application of mathematics to various professions. For example, separate chapters are devoted to—Plumbing, Carpentry and Building, Brickwork, Print Shop, Accounting just to mention a few. For the layman it's a bit high up. The table headed "Coefficients of Transmission (U) of Pitched Roofs" might well prove too much for a layhandyman. On the other hand for the expert in a particular field, when he has read his chapter he will have another eight or nine hundred pages which are not applicable to his work.

As a person interested in mathematics as a whole, I found this book extremely interesting, and for those whose interests are parallel it would be a very useful addition to the bookshelf. Perhaps a better title would be "Applied Mathematician's Delight".—DLG.

NEWS FROM AROUND THE WORLD 1967
Published by O. Lund Johansen Ltd.
36 pages. 8½ x 6½in. Price 15s.

ONE of the fascinations of owning a short wave receiver is that when a new world trouble spot appears one can listen to the news from the spot. Alternatively you can hear the news from the various power centres and compare. To do this you need to know quickly when the country concerned has a news broadcast in a language you can understand and this is where this publication from the World Radio TV Handbook stable comes in with its listings of news broadcasts by both country and language.

For the DXer the book has a second use as an aid to the identification of stations. Whatever the language you can always tell the news broadcast. Reference to this book will show the stations transmitting news at the time concerned with the result that a process of elimination will enable the station to be identified.

One word of warning; although the times of news broadcasts are unlikely to vary greatly during the currency of this book the frequencies will. So don't pay too much attention to the frequency listings given.—JMG.

ABC's OF ELECTRONIC TEST EQUIPMENT
By Donald A. Smith. Published by Foulsham-Sams Technical Books. 96 pages. 8½ x 5½in. Hard covers. Price 16s.

IF you buy your instruments ready-made, a book on applications will appeal more than this slim volume. If you are a kit-building enthusiast, the information given by a reputable kit firm should be more than adequate for your needs. There is little here to augment it, despite a neat plug for Heathkit in the preface. To whom then, should this book appeal? Perhaps the best way to expound is to describe its contents and leave readers to judge.

Chapter 1, predictably, describes the meter movement. Chapter 2 explains the Volt-Ohm-Milliameter, and the following chapter the basic design of the valve voltmeter. There is no mention of the later types of transistor millivoltmeter or high impedance meters and it seems obvious that this book has not been revised since the original publication in 1963. Transistor testers receive a very perfunctory treatment and valve testers are hastily skated over.

Perhaps the greatest disappointment is Chapter 6, where a description of signal tracers does not include a single buildable circuit, nor any sensible details of the use of this very handy instrument. The chapter on oscilloscopes is longer, and more fundamental, but reveals very little practical circuitry and virtually no practical application.

new books—continued

Vital specifications are hardly mentioned at all.

Of all things to find in a purported instrument book, we find Battery Eliminators in Chapter 8. With modern regulated and transistorised power supply units, this chapter is something of an anachronism, just as the final chapter, on signal generators, has not reached the state of considering f.m. generators, wavemeters and other modern necessities.

The author is an electronics development engineer in instrumentation and his aim has been to give those intending to service electronic equipment a 'thorough understanding of test and measuring instruments'. It is a mystery why the publishers did not allow him the space to do so.—*HWH.*

Catalogue Received

G. W. Smith & Co. (Radio) Ltd., 3—34 Lisle Street, London, W.C.2 have just published their first comprehensive Catalogue of Electronic Components and Equipments. It contains over 150 fully illustrated pages and lists items ranging from relays to table lamps and communications receivers to zener diodes and amateur equipment.

The cost of the Catalogue is 5s. plus 1s. postage, but discount coupons included in the Catalogue enable the cost to be retrieved with purchases.

G. W. Smith carry the complete Lafayette range and are agents for Codar, Partridge Aerials, TW Electronics, Green, and Contactor Switchgear. They offer after-sales service and spares for all imported radio equipment shown in their Catalogue.

KEYING THE TEN-FIVE TX

—continued from page 103

"C.W." and apply power to the transmitter. After a suitable warming up period has elapsed rotate the Function switch to "Net" whereupon the stabiliser should glow. Check the current as monitored by the externally connected testmeter; this should be in the range of 15-20mA. Check that V1 is oscillating and that drive is available.

Connect a dummy load to the transmitter aerial socket (Sk3) and rotate the Function switch to "Transmit". Load up to approximately 8W. Check the current reading monitored by the external meter and compare it with the earlier reading; if the two readings differ adjust the value of R9 slightly in an attempt to make them equal each other. In the prototype this necessitated making $R9 = 4.7k\Omega$.

Later, the external meter may be removed and pin 7 of the OA2 tube returned direct to chassis. The meter should then be set to read 0-250V d.c. when a reading taken from between the R4/Ry junction and chassis should be 150V at both the "Net" and "Transmit" positions of the transmitter Function switch.

When these tests have been satisfactorily carried out the dummy load may be replaced with the station aerial and after adjusting the transmitter in the usual way a call may be put out in either c.w. or phone modes. It will then be found that the 10W maximum input available under phone conditions can be increased to approximately 15W of c.w. on "80" metres. ■

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A popular ex-WD heterodyne wavemeter still obtainable at around £3. How it works, how it may be used and how to modify it for working from a 6V a.c. source or direct from a.c. mains.

AUDIO -A.G.C. UNIT

How to construct a simple printed circuit in-line add-on unit to give automatic gain control facilities to existing P.A. systems, tape recorders, etc. Performance figures given.

Plus another article in The Repairing Radio Sets series and other constructional features.

PRACTICAL WIRELESS

July issue—on sale June 9th

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NEW BARGAINS

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PRE-SET 100K. by Welwyn with intrinsic bakelite knob. 1/- each. 9/- per dozen.
100K POT-METER. Miniature type with double pole switch and standard 1 in. spindle, by Morganite. 2/- each. 18/- per dozen.

25K POT-METER. Standard size with double pole switch by Egan with full length 1 in. spindle 3/- each. 35/- per dozen.

BLANKETSTAT GLASS. Enclosed, normally closed circuit with open should blanket overheats. 4/8 ea.
THERMAL RELAY. Can be used to delay the supply of HT while heaters warm up, or will enable 15 amp. loads to be controlled by miniature switches or relays. Regular list price over £2 price 7/6 each.

SIEMENS HIGH SPEED RELAY. Twin 1000 ohm coils. Platinum points changeover contacts—Ex equipment. 8/6 each.

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Sub-Miniature Silicon Diodes. General purpose type with gold-plated leads, 1/- each, 10/- per dozen.

MINIATURE WAFER SWITCHES

	2	3	4	6	12
1 pole	3/6	3/6	3/6	3/6	3/6
2 pole	3/6	3/6	3/6	3/6	3/6
3 pole	3/6	3/6	3/6		
4 pole	3/6	3/6			

Any 12 switches ordered together 40/-.

SEMI-CONDUCTOR BARGAINS

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	5/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
AC171	8/6	OA79	2/8	OC81	5/-
ACV18	5/8	OA81	2/8	OC81D	5/-
ACV19	6/8	OA85	2/8	OC82	5/-
ACV20	5/8	OA90	2/8	OC83	5/-
ACV21	6/-	OA91	2/8	OC84	6/-
ACV22	4/6	OA200	3/3	OC139	8/8
AF114	7/-	OA202	4/3	OC140	12/6
AF115	6/8	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	15/-	OC200	9/-
AF118	10/-	OC26	7/8	OC201	12/6
AF139	12/6	OC28	15/-	OC202	13/6
AF186	17/6	OC29	17/6	OC203	12/6
AF212	15/-	OC38	12/6	OC171	5/-
AS221	15/-	OC36	15/-	OR1P12	8/6
BC107	14/6	OC42	6/8	ORP60	5/-
BY100	4/6	OC44	4/-	SB078	8/6
BY213	7/6	OC45	8/6	SB305	8/6
MAT100	7/9	OC70	4/-	SB251	10/-

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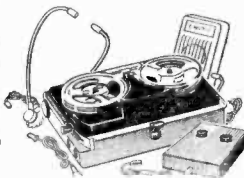
750mA.	100v.	1/3	1 Amp.	100v.	3/-
	200v.	1/8		200v.	4/-
	400v.	3/8		400v.	6/-
8A	100v.	3/6			
	200v.	5/-	10 Amp.	100v.	9/8
	400v.	7/8		200v.	12/6
	600v.	9/8		400v.	14/6

Sub-miniature glass encased—only approx 1 in. long wire ended.

750mA.	60v.	1/8	100v.	2/8
	200v.	4/8		

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NOUGHTS AND CROSSES MACHINE. This machine, described in Sept. '65, is impossible to beat and will provide endless fun at home and considerable attraction (and profit) at charity do's and fete, etc. It employs 19 switches and 9 bulbs and these and the other components necessary to make this are available. Price £4.10.0, post and insurance 3/6.

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DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to max. Full power at all speeds by fingertip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 2/6 post and insurance.

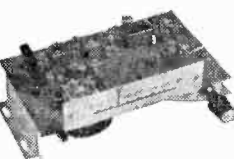
TWO NEW KITS

Multi-purpose Audio Switch, 5 transistors and all other components to make this ingenious unit described in last month's issue—only 48/6d. plus 2/9d. post and ins.

Analog Computer, all parts including centre zero galvanometer, perspex cursors, 8 in. dials, to make the unit described in last month's issue. Available at 39/6d., plus 2/9d. post and ins.

THIS MONTH'S SNIP

An assortment of radio panel bulbs, all made by the famous Philips company. Their cost if bought retail would exceed 30/-. Offered as a parcel for 10/- post free. Parcel comprises 12 x 6-3V. 3A; 6 x 12V. 1A, 6 x 24V. 0.5A; 6 x 12V. 6A, 6 x 6-3V. 1A. All M.E.S. cap.



F.M. TUNER

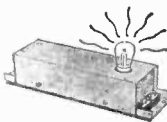
of exceptional quality, giving really fantastic results with virtually no noise. Suitable for mains or battery operation. 6 transistors—three IF stages—double tuned discriminator. Complete, new, and built up all ready to work on chassis. Size 6 x 4 x 2 in. with tuning scale and slow motion drive. A £12.12.0 tuner for only £8.10.0.

SOLID STATE IGNITION

Big things are claimed of Electronic Ignition systems and if you would like to try for yourself a circuit was described in "Practical Electronics" (Sept., 1966). This requires a silicon controlled rectifier, four transistors and other components available as a kit. Price £6.15.0, post free.

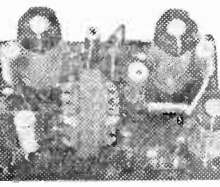
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For removing smells and generally improving oppressive atmosphere. In neat hammer finish box. Uses Philips ozone lamp and mains unit. Lamp easily replaceable. Only 39/8 plus 6/6 carr. and ins.

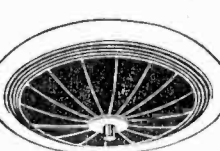


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4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed-back loops—sensitivity 5 m.v. Price 19/6. Post and insurance 2/6. Speakers 3 in. 12/6, 5 in. 13/6, 6 x 4 in. 14/6.



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Brings sunshine into your home. 150 watts of light but uses only 40 w. Beautiful fittings with glass, non-plastic centre, fluorescent tube and choke control. Made by Philips. Regular price £4.15.0. Special budget price 66/6, plus 8/6 c. and ins. Please state colour of glass centre, white, pink, blue, red, black, yellow or cream. Also whether plug into lamp holder or ceiling mounting model. 80 watt model (normal start), 99/8. 10/- carr. & ins.

MAIN TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500 mA (class B working). Takes the place of any of the following batteries: P11, P13, P14, P16, P17, P19, and others. Kit comprises: main transformer rectifier, smoothing and load resistor, 5,000 and 600 mfd. condensers. Zener diode and instructions. Real snip at only 14/6, plus 3/6 postage.

9 VOLT PRECISION MOTOR

Intended for driving battery operated tape recorders and record players. Laminated, 8 Pole armature with Brush Gear and rapid start switch. Normally 25/- Our Price 7/6, plus post and insurance 1/6.



SIMPLE RECEIVER FOR LOW VOLTAGE. A TRF transistor set powered from the Sun or a 1 1/2 v. cell. Suitable for children or others who forget to switch off. 4 N.F.N. silicon transistor biplate and all other components necessary to build this circuit described in "Wireless World," Oct., are available as a kit. Price 19/6, plus 2/6 post and ins.

PHOTO-ELECTRIC KIT

All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit. Laminated Boards and chemicals, Latching relay, Infra-red sensitive Photocell and Hood, 2 Transistors, cond., Terminal block, Plastic case. Essential data, circuits and P.C. chassis plans of 10 photo-electric devices including auto-car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warning tone electronic alarm—projector lamp stabiliser, etc.; etc. Only 39/6, plus 2/- post and insurance.

HI-FI SPEAKER BARGAIN

12 in. High fidelity loudspeaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 29/6. With built-in tweeter 35/-, plus 3/8 post and insurance.



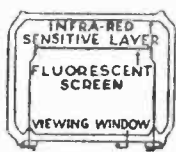
Multi Purpose Neon Test Unit Robust, useful and instructive—tests insulation—capacity—continuity—resistor—voltage controls—also acts as signal injector and L.T. fault finder—kit comprises neon indicator—4-way water switch—ebonite tubes—resistors—condensers—terminals, etc. with diagram only 9/6, plus 2/- post and insurance.



PF3 Eliminator—play your pocket radio from the mainline Save £2. Complete component kit comprises 4 rectifiers—main dropper resistances, smoothing condenser and instructions. Only 8/6, plus 1/- post.

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Famous war-time "cat's eye" used for seeing in the dark this is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the Infra-red strike it. A golden opportunity for some interesting experiments. 7/6 each, post 2/-. Data will be supplied with kit, if requested.



HALF PRICE OFFER

G.E.C. 13A Switched Sockets

Suitable for ring mains, etc. like the modern fused plug surface or sunk (flush) mounting type 4/9 each. 54/- ds.



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Fully transistorised for operating a 20-watt fluorescent tube or other 20-watt mains device. Size 6 in. long by 1 1/2 in. 23.10.0. Post and insurance 3/-.

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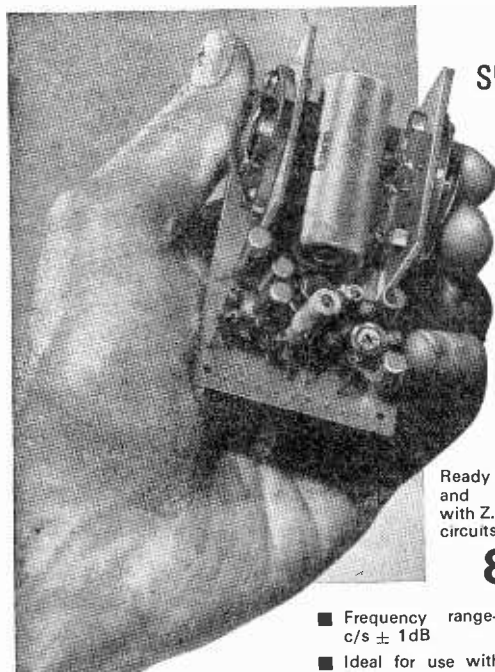


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Ready built, tested and guaranteed, with Z.12 manual of circuits

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- Size 3 x 1½ x 1½in.
- Class B ultralinear output
- Input sensitivity—2mV into 2K ohms

- Frequency range—15–50,000 c/s ± 1dB
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compact, powerful

SINCLAIR Z.12

COMBINED 12 WATT HI-FI AMPLIFIER AND PRE-AMP

12 WATTS R.M.S. OUTPUT CONTINUOUS SINE WAVE (24 W. PEAK)

15 WATTS MUSIC POWER (30 WATTS PEAK)

The embodiment of power, efficiency and reliability, there has never been an amplifier to touch the Z.12 for adaptability and compactness. Nothing could be better than this fine amplifier for use with space-saving plinth-mounted motor and pick-up assemblies. Equally, the light weight of the Z.12 makes it the ideal guitar amplifier, particularly since it operates efficiently on any power supply between 6 and 20 V.D.C. The pre-amp of this 8-transistor masterpiece will accept the outputs of pick-up, radio and microphone, etc. Full details for matching, control and selector switching circuits are in the manual supplied with each unit. The Z.12 is now in use all over the world and is the accepted standard for all hi-fi needs.

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"I must compliment you on your after-sales service. It is a pleasure to buy a product today and get the help that I have received."

E.E.W., Maidstone.

"I find the results after exhaustive tests very satisfactory. I consider that the performance is slightly superior to my valve equipment particularly as regards the reproduction of very low frequencies."

H.A. (Consulting Engineer), London, N6.

SINCLAIR MICRO-FM

7 Transistor combined FM tuner-receiver

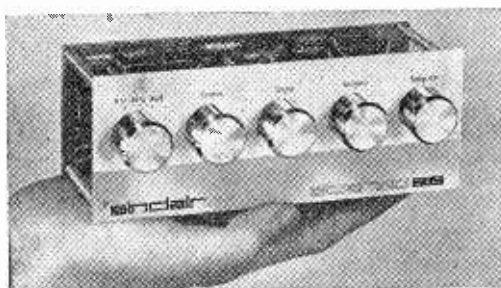


Needs no aligning when built

This unique, superbly engineered FM superhet is the only set in the world which can be used both as an FM tuner and an independent FM pocket receiver just whenever you wish. Problems of alignment have been completely eliminated making the Micro-FM ready for use the moment you have built it. The pulse counting discriminator ensures best possible audio quality; sensitivity is such that the telescopic aerial included with the kit assures good reception in all but the very poorest reception areas. The Sinclair Micro-FM will give you all you want from a high quality FM unit. The case is elegantly styled in brushed and polished aluminium with spun aluminium slow motion tuning dial. SIZE—less than 3 x 1½ x ¾in.

7 Transistors, 2 diodes. Low I.F. obviates use of relatively large components and eliminates need for alignment after building. Set operates from a self-contained standard 9v. battery. A guaranteed Sinclair design. Complete kit inc. aerial, case earpiece and instructions

£5.19.6



SINCLAIR STEREO 25

PRE-AMP AND CONTROL UNIT

FOR USE WITH TWO Z.12s OR OTHER STEREO AMP

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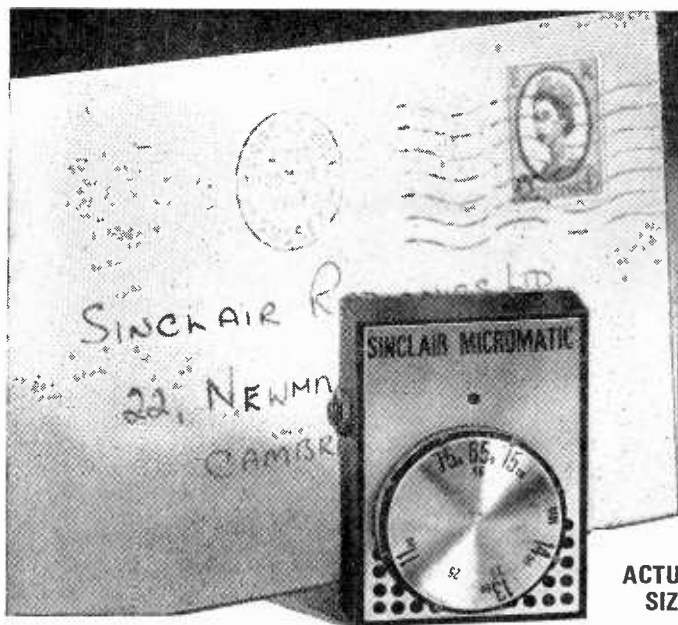
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His biggest surprise was when 2CY, Canberra (10Kw) identified itself. Australia is more than 1,200 miles away! I tested the receiver within half a mile of 2YA and 2ZB (just north of Wellington). Selectivity remained perfect. Neither station swamped the other and the customary nul was evident when the ferrite aerial was end on to the transmitters.

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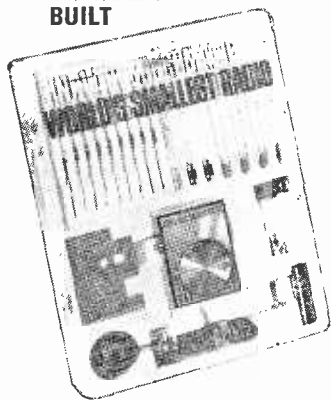
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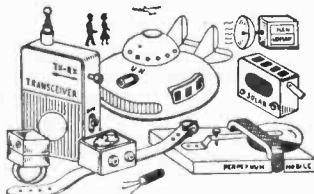
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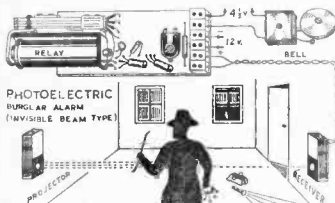
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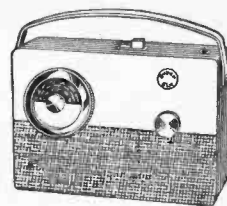
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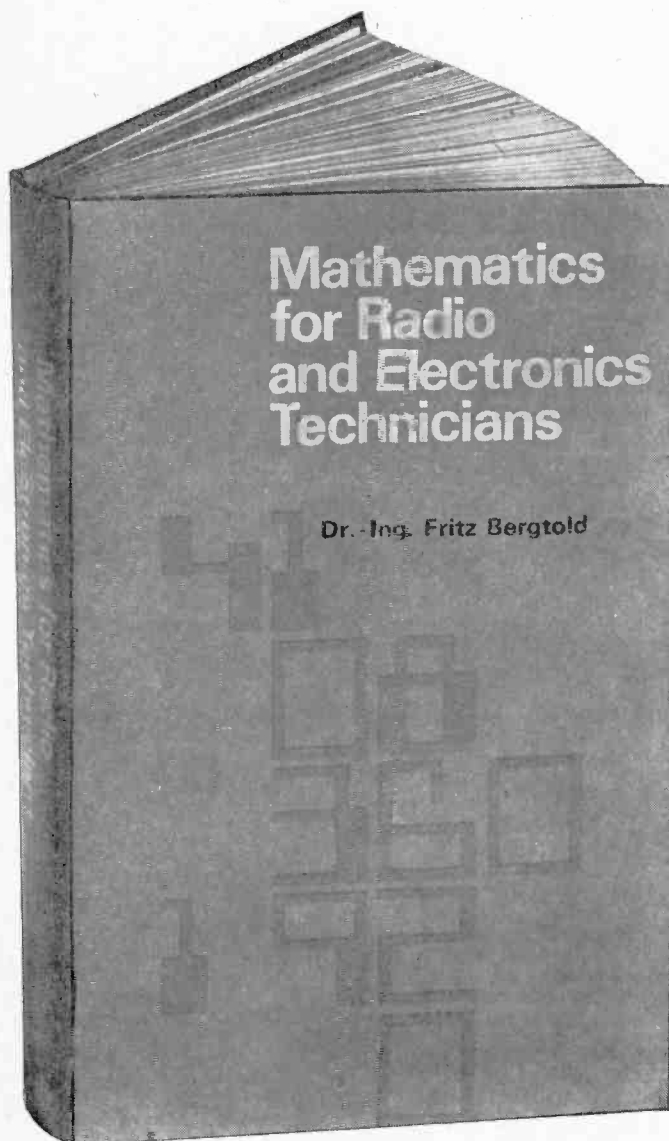
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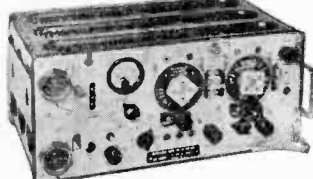
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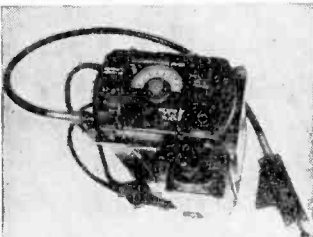
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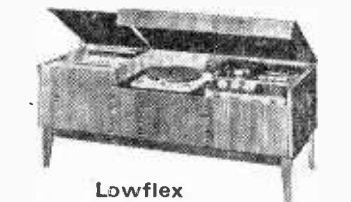
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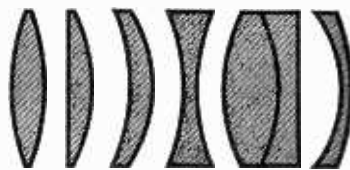
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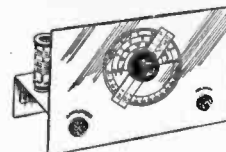
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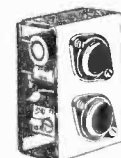
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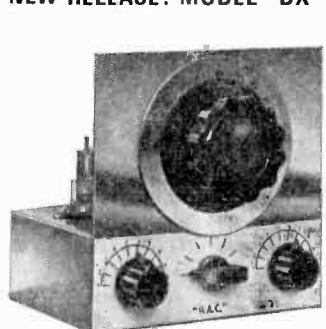
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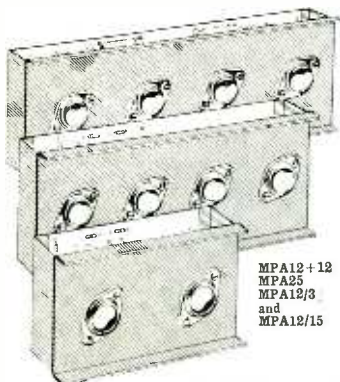
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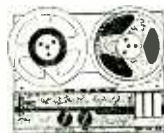
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