31. LEOP.

PRACTICAL WIRELESS

DECEMBER 1965

2/-

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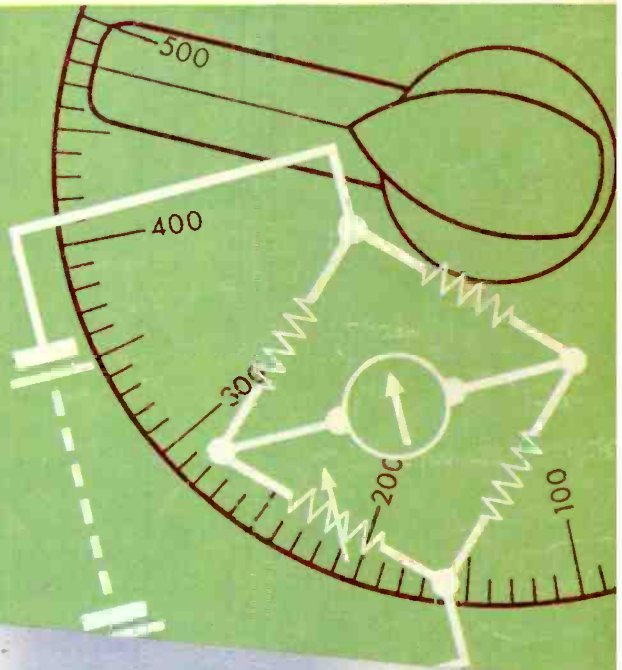
24-PAGE POCKET GUIDE

AERIAL DATA

- HALFWAVE AERIALS
- MULTIBAND AERIALS
- TRANSMISSION LINE DATA
- LONG WIRES
- AERIALS FOR TV



21-RANGE LCR BRIDGE

Tubes

HIGHEST QUALITY—
COMPARE OUR PRICES

Carr. & Ins. 12/6

		GUARANTEE 6 Months	12 Months	NEW TYPES
MOST MULLARD	12in.	£2. 0.0	£3. 0.0	MW 31/74 £3.15.0
MAZDA COSSOR,	14in.	£2.10.0	£3.10.0	
EMITRON, EMI- SCOPE, BRIMAR,	15-17in.	£3. 5.0	£4. 5.0	MW 36/24 £4.15.0
FERRANTI TYPES	19in.	£3. 5.0	£4. 5.0	
PROCESSED IN OUR OWN	21in.	£3.15.0	£5.15.0	CRM 172 MW 43/64 £6.0.0
FACTORY	23in.	£3.15.0	£5.15.0	

SATISFACTION GUARANTEED

Autochangers, etc.

LATEST GARRARD

All Factory Fresh. All with cartridge. **SRP10** Mono (Single) Player, £4.19.0. **SP25** Semi-Transcription (Single), £11.19.0. **AUTOSLIM** Standard Auto, £5.19.0. **AT6** Auto (Limited Number), £8.19.0. **AT5** Slimline—similar to AT6, £7.15.0. **Model 1,000**—Compact low-priced record changer, automatically playing up to 10 records, £6.19.0. **Model 2,000**—Automatic record changer with large turntable, playing up to 8 records, £7.19.0. **Model 3,000**—Designed for use with high-compliance cartridges; low-mass arm gives exceptionally low record wear, £10.10.0. **AT60**—Automatic or manual operation, has precision arm-bias compensator and heavy turntable, £11.19.0. **A70**—For the critical user—offers automatic playing, with pusher-platform, and many other features, £19.19.0. **LAB80**—An outstanding automatic transcription turntable for professional reproduction, £25. **301**—Transcription Heavy Table, £22. **401**—Transcription turntable with heavy 12in. turntable, machine-cut strobe, neon lamp and speed control, £29.19.0. **Model 50**—Automatic record changer with large turntable, weight-counterbalanced arm and plug-in pick-up head, £9.10.0.

B.S.R.

GU7—Single Deck Complete, £4.5.0. **UA14** or **U25**—Auto Changer, £5.15.0.

PRICES SLASHED

LZ87 TAPE RECORDERS. Famous make, latest Silver/Grey finish, 4 inputs, 2-speed 3¾ x 7½in. Complete with microphone, footage counter, volume level indicator, tone control, spare spool. This machine takes 7in spools and is a full size Recorder, not a toy! Price normally £30.9.0. 5/- p.p. **£17.10.0**

TRANS/CEIVER TYPE RT33. The very latest Silver/Black finish. They gave a fantastic performance with reliability, long telescopic aerial, crystal controlled. Note a licence is required to transmit. They compare with much dearer models. 2/6 p.p. **£8.19.0**

MEMO CALL. Pocket sized battery operated tape recorder, complete with tape, earphone, built-in speaker Normally £12.10.0. A must for those who want to record telephone conversations, ideas, letters etc. whilst travelling or home 2/6 p.p. **£8.10.0**

TELEPHONE AMPLIFIER. "Desk Companion". A larger model complete with pen and holder etc. Fully portable and transistorised. A must for the desk leaving both hands free to deal with papers, etc., etc. 2/6 p.p. **£3.10.0**

25 WATT GUITAR SPEAKERS. Very heavy coned 12in. cast chassis. There is nothing to touch it for power handling and quality at the price. Plus 5/- p.p. **£4.19.0**

BINATONE 10-TRANSISTOR. All wave set, complete with telescopic aerial, earphone, leathercase, medium size, superb performance. Not to be confused with cheap sets, amazing value. **£10.19.0**

MULTI-METERS. TK.20.A. 8 Ranges AC/DC/Current/Resistance 0-100K, moving coil. **49/6**

EP.10.K. 10,000 OPV. High quality. 15 Ranges AC/DC/Current/Resistance. Accuracy ±3%. **£3.19.6**

EP.20.K. 20,000 OPV, more sensitive version of EP.10.K. **£4.19.6**

EP.30.K. 30,000 OPV, 18 Ranges, including Resistance to 10 Meg. **£6.19.6**

EP.50.K. Professional Quality, 22 Ranges, AC/DC/Volts/Current/Response/Decibels/Capacitance. **£9.19.6**

TEST EQUIPMENT. ITI-1 Transistorised Signal Injector, complete with Transistor Oscillator with Indicator Lamp, Detachable Test Probe and instructions. **35/-**

IDEAL FOR ANY RECORDER. PRICES SLASHED. GUARANTEED APPROX. ½ PRICE. WORLD FAMOUS MAKE BY ENORMOUS PURCHASE.

★ TAPE ★

We offer you fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. Not substandard in any way. Try one for yourself. They are truly worth a few more coppers than acetate, substandard, jointed or cheap imports. Try one and prove it for yourself!

Standard Play			Double Play		
3"	150ft.	2/3	3"	300ft.	4/-
4"	300ft.	4/6	4"	600ft.	8/-
5"	600ft.	7/6	5"	1200ft.	15/-
5¾"	900ft.	10/6	5¾"	180ft.	19/6
7"	1200ft.	13/6	7"	2400ft.	27/-
Long Play			**Triple Play**		
3"	225ft.	2/9	4"	900ft.	13/-
4"	450ft.	5/6	5"	1800ft.	25/-
5"	900ft.	10/6	5¾"	2400ft.	34/-
5¾"	1200ft.	13/-	7"	3600ft.	44/-
7"	1800ft.	18/6	**Quadruple Play**		
			3"	600ft.	8/-

Postage 1/- or Post Free less 5% on three reels. Quantity and Trade enquiries invited.

AM/FM RADIOS

Latest wonderfully styled, guaranteed top make, 10-transistor with full long and medium waves. Size 9¾ x 6 3/16 x 12 13/16in. Magnificent reproduction. A pleasure to look at. "An aristocrat in its class". 12 months guarantee against faulty manufacture. Genuine retail price £28.7.6. Unrepeatable. **17 Gns.**

QUALITY PORTABLE TAPE RECORDER

Fabulous quality and reproduction of music. 6 transistor, 1⅞in. and 3¾in. speeds. Output 500mW into high quality speaker. Ingenious single control knob. Fast forward and rewind. Battery level and record level meter. Fast load. Precision capstan drive with dynamic earpiece monitor recording. Radio recording leads. Outside speaker facilities. The most outstanding portable in the country. Size 8 13/16 x 3⅞ x 6⅞in. Genuine normal price of 35 gns. Unrepeatable. 12 month guarantee All spares available. With tape, tape reel, mike, etc. **19Gns.**

VALUE IN VALVES

GUARANTEED 3 MONTHS BY RETURN OF POST

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days. ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 6d., 2-11 1/-, Free over 12.

OZ4	4/6	6K8GT	8/3	14S7	14/6	EBC41	6/3	EZ41	5/9	R19	9/6
1A7GT	9/6	6K25	8/6	19AQ5	7/9	EBC81	5/9	EZ80	5/9	SP41	2/3
1C5GT	7/6	6L1	9/6	20D1	8/9	EBF80	7/6	EZ81	6/-	SP61	2/-
1H5GT	8/9	6L6	7/6	20F2	9/6	EBF89	7/9	FC4	8/-	T41	6/9
1N5GT	8/9	6L6G	6/6	20L1	16/-	EBL21	9/9	GZ32	7/6	TDD4	7/-
1S4	7/6	6L18	7/9	20P1	9/6	EBL31	19/6	HVR2	9/-	U14	7/6
2D21	5/6	6L19	12/6	20P3	11/-	EC52	4/9	KT33C	3/9	U18	7/6
3A4	4/-	6LD20	7/9	20P4	17/-	ECC32	4/-	KT36	14/-	U22	6/9
3A5	6/-	6P25	8/6	25A6G	8/-	ECC34	9/-	KT44	6/-	U24	12/6
3D6	4/-	6P28	9/9	25L6GT	7/9	ECC40	6/9	KT45	8/6	U25	8/3
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5U4G	4/-	6SA7	5/9	30FL1	9/6	ECC83	5/9	KT66	12/-	U50	4/6
5Y3G	4/6	6SG7	4/9	30L15	8/9	ECC84	7/6	KT76	8/6	U107	12/6
5Y3GT	4/-	6SK7	5/-	30P4	9/6	ECC85	6/-	KT88	17/6	U191	9/-
5Z4	9/-	6SL7GT	5/6	30P12	7/-	ECC88	9/6	KTW61	5/9	U281	8/6
5Z4G	7/-	6SN7GT	4/6	30PL1	9/3	ECF80	6/-	KTW63	5/-	U282	15/-
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6/30L2	9/-	6U4GT	8/-	35L6GT	8/-	ECH21	11/6	MU14	7/-	U329	8/6
6A8G	7/9	6V6G	4/6	35W4	6/-	ECH35	7/6	N37	10/6	U801	19/-
6A7G	7/6	6V6GT	6/-	35Z4GT	5/6	ECH42	8/6	N78	13/-	UABC80	7/-
6AK5	4/3	6X4	4/6	50L6GT	8/6	ECH81	7/-	N108	13/-	UAF42	7/9
6AQ7	5/-	6X5G	5/-	80	5/-	ECH83	6/3	PC86	10/-	UB41	6/6
6AT6	5/-	6X5GT	5/6	185BT	19/6	ECL80	6/6	PC97	7/6	UBC41	7/6
6AU6	7/-	7B6	9/-	185BTA	19/6	ECL82	8/-	PCC84	6/6	UBC81	6/-
6AV6	6/-	7B7	5/6	807(A)	5/-	ECL83	10/6	PCC85	6/6	UBF80	7/9
6BA6	5/6	7C5	7/3	807E	4/9	ECL86	10/3	PCC88	11/9	UBF89	7/6
6BE6	5/6	7C6	7/6	813	49/-	EF36	3/-	PCC89	8/6	UBL21	9/6
6BG6G	15/-	7H7	5/-	866A	12/6	EF39	4/6	PCC189	13/6	UCC85	7/3
6BH6	5/-	7S7	8/9	954	3/6	EF40	11/-	PCF80	6/9	UCF80	8/6
6BJ6	5/-	7Y4	4/6	955	2/3	EF41	8/-	PCF82	6/-	UCH21	9/3
6BR7	8/6	10C1	9/-	956	2/-	EF54	3/3	PCF84	12/-	UCH42	7/3
6BW6	6/9	10C2	14/6	9001	3/6	EF80	3/6	PCF86	7/6	UCH81	7/9
6BW7	5/-	10F1	4/9	9002	4/9	EF85	6/-	PCL82	7/9	UCL82	8/-
6C4	2/3	10LD11	14/6	9003	5/6	EF86	7/6	PCL83	9/-	UCL83	10/-
6C5	5/6	10P13	8/6	ATP4	2/6	EF89	6/9	PCL84	7/3	UF41	6/6
6C6	5/6	10P14	9/6	AZ31	6/-	EF91	3/-	PCL85	7/6	UF42	4/9
6C9	11/-	12AH7	7/-	B36	4/6	EF92	3/-	PCL86	10/6	UF80	6/3
6CD6G	17/-	12AH8	9/-	CBL31	19/-	EF183	9/9	PEN25	3/9	UF85	7/6
6D6	3/-	12AT6	6/6	CL33	9/-	EF184	9/6	PEN45	8/6	UF89	5/9
6F1	4/9	12AT7	4/9	CY31	7/6	EL32	3/9	PEN46	4/6	UL41	7/6
6F6G	3/6	12AU6	9/-	DAF91	4/6	EL33	6/6	PL33	8/6	UL44	14/-
6F13	4/3	12AU7	4/9	DAF96	7/3	EL34	11/6	PL36	9/6	UL46	8/3
6F14	9/6	12AV6	6/3	DF91	3/-	EL35	6/-	PL38	17/6	UL84	7/-
6F15	9/6	12AX7	6/-	DF92	3/-	EL38	12/6	PL81	7/9	UR1C	7/6
6F23	6/6	12BA6	7/-	DF96	7/3	EL41	8/-	PL82	6/6	UM80	9/6
6J5G	3/-	12BE6	6/6	DK91	5/6	EL42	7/9	PL83	6/6	UU6	8/9
6J5GT	4/3	12BH7	8/9	DK92	7/-	EL84	6/6	PL84	7/6	UU8	11/-
6J6	2/6	12E1	17/6	DK96	7/3	EM34	8/6	PY31	8/-		
6J7G	4/9	12J7GT	8/-	DL92	5/-	EM80	7/9	PY32	10/-	UY21	9/6
6J7G7	7/6	12K7GT	4/-	DL94	6/6	EM81	6/9	PY80	6/6	UY41	6/-
6K8GT	6/-	12K8	9/9	DL96	7/3	EM84	8/9	PY81	5/9	UY85	5/-
6K7	5/9	12K8GT	9/6	EABC80	6/6	EM85	8/6	PY82	5/9	VR105	5/-
6K7G	1/-	12Q7GT	5/-	EAF42	3/3	EY51	7/6	PY83	5/9	VR150	7/9
6K7GT	4/6	12SA7	6/3	EB41	5/-	EY86	7/3	PY88	9/-		
6K8	8/6	12SK7	2/9	EB91	2/-	EY88	8/6	PY800	6/3	X66	7/9
6K8G	5/-	12SQ7	7/6	EBC33	4/9	EZ40	6/6	PZ30	9/6	Z66	8/6

CONNECTING WIRE

P.V.C. Bright Colours. Five 25ft. coils only. **4/-**

CO-AX, low loss, 6d. yd., 25 yards 11/6; 50 yds. 22/-; 100 yds. 42/6. Co-ax Plugs, 1/3. Wall outlet boxes 3/6

MAINS TRANSFORMERS

Excellent Quality Guaranteed Upright mounting 250-0-250v. 60mA, 6.3v., 3A (80mA 12/6) Ditto semi-shrouded, **9/6**

SPECIAL C.R.T. OFFER

Due to huge Bulk Special Purchase we are offering CRM141 and MW 36/24 Tubes at the unrepeatable price of 39/-. P.P. 12/6. The above are guaranteed for 6 months.

★ BULK BARGAINS ★

12 POTS. Popular values. 5K. to 2 Meg. Unused, mixed pre-set, long sp., switch, etc. **4/6**

CONDENSERS, 25 mixed Electrolytics Many popular sizes. List Value £5. Our price **10/-**

100 RESISTORS 6/6
Excellent. Sizes ⅛-3 watt.

100 CONDENSERS 9/6
Miniature Ceramic and Silver Mica Condensers, 3pF to 5,000pF. LIST VALUE OVER £5.

25 TAG STRIPS 4/-
2, 4, 6, 8-way etc. Unused.

100 HI STABS 9/6
1% to 5%, 100Ω to 5 mΩ.

TRANSISTORS

GUARANTEED TOP QUALITY

Huge reduction, Red Spot standard LF type now only **1/6**
White Spot R.F. **2/-**

Mullard Matched Output Kits OC81D and 2-OC81 **12/6**
R.F. Kits OC44, OC45 (2) 3 transistors. **12/6**

AF114	8/-	OC44	5/6
AF115	7/6	OC45	5/6
AF116	7/6	OC72	5/6
AF117	7/-	OC81	5/6
AF127	9/6	OC81D	5/6
OC26	12/6	OC82	6/-
OC36	14/-	OC170	8/6
		OC171	8/6

GERMANIUM DIODES

General Purpose miniature detector A.V.C. etc. or 6/6 doz. **8d.**

Gold Bonded highest quality Individually tested. 9/6 doz. **1/-**

SILICON RECTIFIERS

Guaranteed performance. Top Makes. Tested 250v. working. 100mA (3 for 9/6) **3/9** 250mA (3 for 19/6) **7/6**

LOUDSPEAKERS. 3Ω Top Makes. 6½in. **7/6** 5in. 7 x 4in. **8/6**

Post: 2lbs. 2/-, 4lbs., 2/6, 7 lbs., 3/6, 15lbs. 4/-, etc. (C.O.D. extra). ALL VALVES LESS 5% AND POST FREE IN DOZENS.

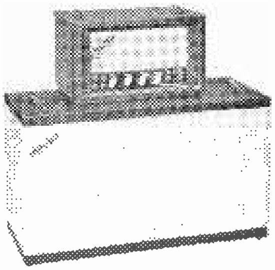
TECHNICAL TRADING CO.

Retail Only, Hi-Fi Demonstrations. 72 East Street, Southampton Tel. 25851
11/12 North Road, Brighton, Tel. 67999
ALL MAIL ORDER AND RETAIL SHOP
350/352 FRATTON RD., PORTSMOUTH Tel. 22034

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

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT

For lead, rhythm, bass guitar and all other musical instruments
For vocalists, gram, radio, tape and general public address



★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.

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

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

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

Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at more than three times the cost. **49 Gns.** Or deposit £7.16.0 and 12 monthly payments of 81/6 Total of 54 Gns. Carr. 25/-

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

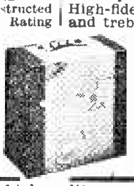
TRANSISTORISED SOUND MIXER

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

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

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

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



High-fidelity push-pull output. Separate bass and treble "Cut" and "Boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Loudspeaker is a heavy duty flux 12in 20 watt model with cast chassis. Cabinet is covered in contrasting shades of Rexine/Vynair. Size approx. 18 x 18 x 8in. Only **19 Gns.** Carr. 10/-. OR DEPOSIT 3 Gns. and 12 monthly payments of 31/6 (Total 21 Gns.) Send S.A.E. for leaflet.

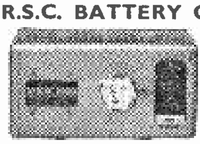
R.S.C. G5 AMPLIFIER

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

R.S.C. BATTERY CHARGING EQUIPMENT

Guaranteed 12 months

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



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

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

BATTERY CHARGER KITS

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

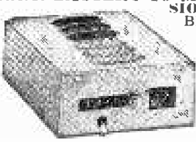
6v. or 12v. 1 amp.	22/9
As above with ammeter	28/9
6v. or 12v. 2 amps.	25/9
6v. or 12v. 2 amps. inclusive of ammeter	35/9
6 v. or 12 v. 4 amps with Ammeter and variable charge rate selector	52/9

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

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

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

R.S.C. BATTERY TO MAINS CONVERSION UNITS. Type BMI. An all-dry battery eliminator. Size 5½ x 4¼x2in. approx. Completely replaces batteries supply 1.4v and 90v where A.C. mains 200-250v. 50 c/s is available. Suitable for all battery portable receivers requiring 1.4 v. and 90v. Complete kit with diagram 39/9 or ready for use 46/9



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

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

HI-FI 12 WATT AMPLIFIERS

BRAND NEW EX-GUITAR AMPLIFIERS **8 Gns.** Carr 5/6 Manufacturers' discontinued Model Push-pull output. Latest high efficiency valves Dual separately controlled inputs for 'Mike' and gram. Separate Bass and Treble Controls. High Sensitivity. Output for 3 or 15 ohms speaker. Guaranteed tested and in perfect working order.

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

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

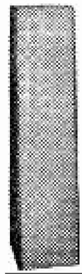
TRANSISTOR SALE Mullard OC71 2/11, OC45 3/11, OC44 3/11, OC72 2/11, OC81 2/11, OC171 8/9, AF117 6/9. Ediswan XA101 3/9. XA112 3/9, XC101A 3/9. Postage 6d. for up to 3 transistors.

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

R.S.C. (MANCHESTER) LTD.

Addresses Page 643

R.S.C. COLUMN SPEAKERS

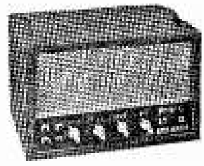


Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. Normally supplied for 15 ohm matching but can be supplied for 100v. line for 35/- extra.

Type C58. 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. **12½ Gns.** Carr. 10/-. Or deposit £2 and 9 monthly payments of 27/9 (Total £14.9.9).

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

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



A Four Input, two volume control Hi-Fi unit with separate Bass and Treble 'Cut' and 'Boost' controls. Designed for vocal or instrumental groups. For Bass Lead or Rhythm Guitar. Mullard or Brimar latest type valves. Housed in strong Rexine covered cabinet with twin carrying handles. Attractive black and gold perspex fascia plate. For 200-250v. A.C. mains. Output for 3 or 15 ohm speakers. Carr. 12/6. Send S.A.E. for leaflet. **17 GNS.** or Deposit £3 and 9 monthly payments of 37/-. (Total £19.13).

HEAVY DUTY CHARGER KIT

6/12 v. 6 amps., variable output

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

SELENIUM RECTIFIERS F.W. (BRIDGED)

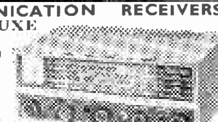
6/12v. 1a. 3/11 6/12v. 3a. 9/9 6/12v. 6a. 15/3
6/12v. 2a. 6/11 6/12v. 4a. 12/3 6/12v. 10a. 26/9
6/12v. 15a. 35/9

COMPLETE POWER PACK KIT

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

COMMUNICATION RECEIVERS

RX 60 DE LUXE 4 BAND



220/240v. 50/60 c.p.s. A.C. mains operation. Frequencies covered 1600 Kc/s to 30 Mc/s continuous. Incorporates 5in. speaker. Slide rule tuning dial 'S' meter. Internal ferrite aerial for medium wave. Telescopic whip aerial 58in. 10 section for short waves. Fitted sockets for optional outdoor aerial. Headphones external speaker socket. Other features are electrical bandspread tuning. Noise limiter. A.V.C., B.F.O., stand by switch. Size approx. 12½ x 5¾ x 8¼in. Handsome crackle finished metal cabinet. Brand new with full instructions manual. Usual guarantee. Carr. 10/-. **19 Gns.**

12in 25 WATT HEAVY DUTY LOUDSPEAKERS

Famous make. Normal price approx. £12. **£6.19.9** Limited number. Fully guaranteed. Carr. 10/-.

LINEAR TREMOLO PRE-AMP UNIT

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

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

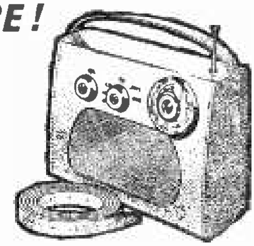
Why NOT BUILD ONE OF OUR PORTABLE TRANSISTOR RADIOS...

BACKED BY OUR SUPER AFTER SALES SERVICE

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

FIRST FOR QUALITY, PERFORMANCE & PRICE!

NEW ROAMER SEVEN Mk IV



7 WAVEBAND PORTABLE OR CAR RADIO

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

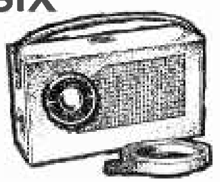
FULLY TUNABLE ON ALL WAVEBANDS ● **9 stages—7 transistors and 2 diodes**

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

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

MELODY SIX

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



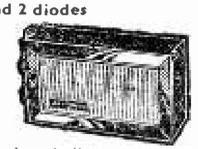
● **8 stages—6 transistors and 2 diodes**

Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¾ x 3½ x 1½in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

Parts Price List and easy build plans 2/- (Free with kit) Total cost of all parts now only **£3.9.6** P. & P. 3/6

POCKET FIVE

● **7 stages—5 transistors and 2 diodes**



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

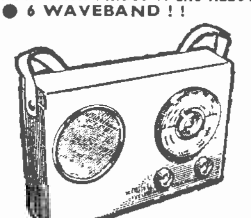
Parts Price List and easy build plans 1/6. (FREE with kit)

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

NEW ROAMER SIX

NOW WITH PHILCO MICRO-ALLOY R.F. TRANSISTORS

● **6 WAVEBAND ! !**



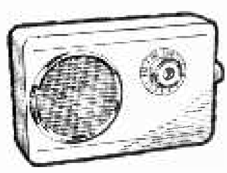
● **8 stages—6 transistors and 2 diodes**

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

★ **EXTRA BAND FOR EASIER TUNING OF LUX, ETC.**

Parts Price List and easy build plans 2/- (FREE with kit) Total cost of all parts now only **£3.19.6** P. & P. 3/6

New TRANSONA FIVE



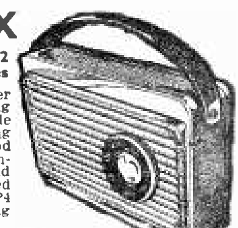
"*Home, Light, A.F.N. Lux. all at good volume*". G.P. Durham.

● **7 stages—5 transistors and 2 diodes**

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

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

TRANSONA SIX



● **8 stages—6 transistors and 2 diodes**

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

Total cost of all parts now only **59/6** P. & P. 3/6.

Parts Price List and easy build plans 1/6 (FREE with kit)

SUPER SEVEN

● **9 stages—7 transistors and 2 diodes**

Covers Medium and Long Waves and Trawler Band. The ideal radio for home, car or can be fitted with carrying strap for outdoor use. Completely portable—has built-in Ferrite rod aerial for wonderful reception. Special circuit incorporating 2 R.F. Stages, push-pull output. 3in. speaker (will drive large speaker). Size 7¼ x 5¼ x 1½in. (Uses 9v battery, available anywhere.)

Total cost of all parts now only **£3.19.6** P. & P. 3/6 *Parts Price List and easy build plans 2/-. (FREE with kit)*

RADIO EXCHANGE CO

61, HIGH STREET, BEDFORD

Telephone: Bedford 52367

Callers side entrance Barratts Shoe Shop open 9-5 p.m. Sats 10-12.30 p.m.

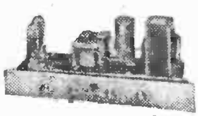
ALSO SEE FACING PAGE FOR OTHER ITEMS

STERN-CLYNE

HIGH FIDELITY EQUIPMENT

(1) Mullard "10 Plus 10" Stereo Amplifier
A High Fidelity design providing up to 10 watts (per channel).
KIT OF PARTS £20.0.0.
Built and tested £24.0.0 (C. & I. 7/6).
We can also supply the Main Amplifier for operation with our Dual Channel Pre-amplifier.
KIT OF PARTS £27.0.0.
Built and tested £34.0.0 (C. & I. 10/6).

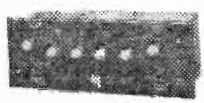
(2) Mullard Dual Channel Pre-Amplifier
A four-valve design for both Stereophonic and Monophonic operation.
KIT OF PARTS £12.10.0.
Built and tested £15.0.0 (C. & I. 5/-).



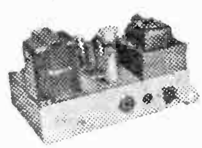
(3) The "Twin Three" Stereo Amplifier
Based on a recent design by Mullard Ltd. it is ideally suited for use in Portable Record Players.
Built and tested £9.0.0 (C. & I. 7/6).
To construct a Stereo Portable Record Player, we offer:
Assembled Amplifier with two 8 x 5in. Loudspeakers and Portable Case for £16.10.0 (C. & I. 10/-).

Fully descriptive leaflets available on any of the above items.
Instruction Books and Detailed Price Lists are supplied Free with Kits of Parts but may be purchased separately if required.
Items 1, 2 and 14, 3/- each; 6 and 13, 3/6 each; 7, 8, 9, 10, 2/- each; 11, 2/6 each; 12, 5/-. All Post Free.

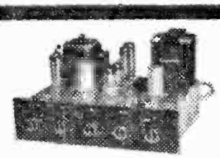
(5) Tudor AM/FM Tuner
Self-powered VHF/FM long and medium waves. FM 87.5-108.5 Mc/s AM.MW 522-1,630 Kc/s. LW 145-270 Kc/s. Multiplex output.
Built and tested 24 Gns. (P. & P. 7/6).



(6) Mullard 3-Valve Pre-Amplifier Tone Control
Designed mainly for the Stern Mullard range of Monophonic Power Amplifiers.
KIT OF PARTS £10.0.0.
Built and tested £13.13.0 (C. & I. 5/-).

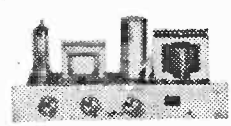


(8) Mullard "5-10" Main Amplifier
For use with Mullard 2- or 3-valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained.
KIT OF PARTS £10.0.0.
Built and tested £13.10.0 (C. & I. 6/6).
Above incorporating Partridge Output Transformer £1.6.0. extra.

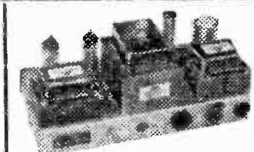


(9) Mullard "5-10RC" Amplifier
The popular "5-10" complete incorporating Passive Control Unit providing up to 10 watts high quality reproduction with an input of 600mV.
KIT OF PARTS £12.0.0.
Built and tested £16.0.0 (C. & I. 7/6).
With Partridge Output Transformer £1.6.0 extra.

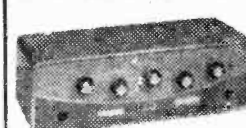
(10) Mullard "3-3RC"
A high quality Amplifier developed from the very popular 3-watt Mullard "3-3" design.
KIT OF PARTS £8.8.0.
Built and tested £11.10.0 (C. & I. 6/6).



(11) The "Mono-Gram"
A small Amplifier of genuine high quality performance producing up to 3 watts undistorted output.
KIT OF PARTS £4.10.0.
Built and tested £6.0.0 (C. & I. 3/6).

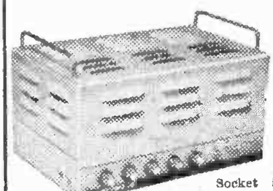


(16) JL10 Power Amplifier
Incorporates the latest diode/pentode ECL86 valves in push-pull. Partridge ultra linear output transformer. Partridge mains transformer and smoothing choke. 10 watts power output, surplus.
Built and tested £12.12.0 (C. & I. 7/6).



(17) Double Feature Pre-Amplifier
Inputs for microphone, crystal or magnetic pick-ups, tuner unit, and in addition offers full facilities for tape recording and high fidelity replay. This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is requiredis a suitable tape deck.
Built and tested £18.18.0 (C. & I. 5/-).
Prices if both units purchased together:
Built and tested £30.0.0 (C. & I. 10/-).

VERITONE 30 AMPLIFIER

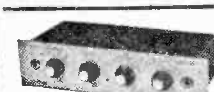


A general purpose amplifier of outstanding quality ideally suitable for Dance Bands, Clubs, Hotels, Factories. Indoor and outdoor Public Address requiring a powerful robust portable Amplifier which will provide high quality reproduction, distortion free. The Amplifier has two standard Jack Socket inputs, high gain and low gain with individual volume controls and with the master volume control the inputs may be mixed and balanced as required. Housed in a really robust steel case finished in smooth grey hammer finish with chrome handles and silver grey front panel with contrasting letters and knobs. Built-in Pre-amplifier and Control Unit. 30 watt Undistorted Output. Switched Output for 3 or 15 ohms Loudspeakers. Fully assembled and tested carriage and insurance 10/-. Ventilated Cover with chrome handles as illustrated. 35/- extra.

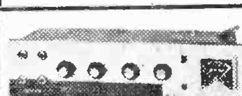
Price 18 Gns.

VERITONE 30

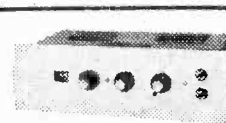
A small versatile 3-4 watts Gram Amplifier suitable for Crystal Pick-up or Radio Tuner, ideally suited for a small domestic installation. Output imp. 3 ohms, volume control, treble control, bass control and middle control. Valve line-up: EL84. EF86, EZ80.
Chassis size 8½ x 4 x 1¾in. Silver anodised finish. Attractive front panel silver grey finish with contrasting lettering and knobs. Size 8½ x 2¼in.
Fully assembled and tested 6 Gns. (C. & I. 5/-).



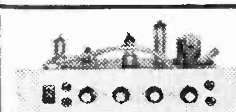
(7) MULLARD 2-VALVE PRE-AMPLIFIER
Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIERS but also perfectly suitable for other makes. Now with new design front panel.
KIT OF PARTS £6.6.0.
Built and tested £9.10.0 (C. & I. 5/-).



(12) Stereo Tape Pre-Amplifier Model STP-1
For use with current Truvox, Brenell or Collaro "Studio" ½- and ¼-track Stereo Decks. Now with new design front panel.
KIT OF PARTS £22.0.0.
Built and tested £28.0.0 (C. & I. 8/6).



(13) Mullard Type "C" Tape Pre-Amplifier
Suitable for most ½-track Mono Tape Decks. Now with new design front panel.
KIT OF PARTS £14.0.0.
Built and tested £19.10.0 (C. & I. 7/6.



(14) Mullard Tape Amplifier Model HF/TR3
Based on Mullard's type "A" design and suitable for most ½-track Mono Tape Decks. Now with new design front panel.
KIT OF PARTS £13.13.0.
Built and tested £19.0.0 (C. & I. 7/6).

STERN-CLYNE Appointed stockists for the New Veritone range of hi-fi equipment

TWO ENTIRELY NEW DESIGNS FOR THE MODERN-MINDED HI-FI ENTHUSIAST

THE VERITONE SATURN TRANSISTORISED FM TUNER

SPECIFICATION: Transistors: 1 x AF125, 1 x AF121, 4 x AF116. Diodes: 4 x OA79, 1 Variable Capacity Diode, Solid State Full Wave Bridge Rectifier, 1 OAZ212 Zener Diode. 4 I.F. Stages. Switchable A.F.C. Tuning Meter. **Facility for plug-in Multiplex Stereo Adaptor (available at a later date).** Tuning Range: 87.5-108.5 Mc/s. Stabilized Power Supply. Din Outlet Socket. Fully Variable Audio Output Attenuator. Supplied with or without Plastic Laminated Case (Teak). Sensitivity 4mV. for 30dB signal to noise ratio. Attractive Black and Silver Grey front panel with mirror strip top and bottom.

PRICE 25 GNS. *Carriage & Insurance 7/6*
Teak case optional extra.

THE VERITONE VEGA TRANSISTORISED STEREO AMPLIFIER

SPECIFICATION: Power response, with channels used simultaneously, 13 watt R.M.S. per channel, at 50 c/s and 10 Kc/s the above features are reduced by approximately 2 watts. Loudspeaker impedance 15 ohm. Frequency response on unequalised input, flat. ±1dB from 40 c/s to 20 Kc/s.—3dB at 20 c/s. Total harmonic distortion at 10 watts approximately 0.5%. Cross talk, —50dB at 1Kc ±5dB. Hum and noise—50/60dBs on Radio, Aux., Tape and Magnetic P.U.—50dBs on Ceramic P.U. ±3dB. Controls: Bass, Treble and Balance. Inputs for Radio, Tape, Aux, Magnetic P.U. and Ceramic P.U. Tape Output and Tape Monitor. Mains input 200-220-240 volts. Transistors per channel 5 x OC45, 2 x OC35 or OC29, 2 x ACY17, 1 x 2N696, 6 x Diodes per amp. Dimensions: 11 x $4\frac{1}{4}$ x $6\frac{5}{8}$in. Front Panel: Silver Grey with contrasting Black markings and knobs. Operation: 200/250 volts A.C. 50 c/s.

PRICE 39 GNS. *Carriage & Insurance 10/-*
Teak case optional extra.

NOW ON DEMONSTRATION AT ALL BRANCHES

STERN-CLYNE

SEE FOLLOWING PAGE FOR ADDRESSES

STERN-CLYNE

ELECTRONIC CENTRES THROUGHOUT GREAT BRITAIN

TR2 PORTABLE TAPE RECORDER. A truly first-class portable machine by famous manufacturer incorporating the renown BSR single speed 2-track Tape Deck. $3\frac{3}{4}$ i.p.s. Tape Counter. Record Level Indicator. Volume and On/Off Tone Control. 3 watts output. Inputs for recording from Microphone and Radio. Tape Monitor Socket. Extension Loudspeaker Socket. Attractive two-tone grey/cream rexine covered Portable Cabinet. Supplied complete with Microphone. Reel of Tape and Spare Spool. Carriage and Insurance 15/- extra. Credit Terms £2.18.0 deposit and 12 monthly payments of £1.9.4, total credit price £20.10.0.

Originally 23 Gns.

OUR PRICE **18 Gns.**

TR3 PORTABLE TAPE RECORDER. A high quality Portable Tape Recorder for the discerning enthusiast incorporating the latest BSR TD10 3-speed Tape Deck. $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s. 2-Track. Record interlock to prevent accidental erasure. Tape Counter. Record Level Indicator. 3-4 watt output. Volume and On/Off Tone Control. Inputs for recording from Microphone and Radio. Tape Monitor Socket. Extension Loudspeaker Socket. Attractive two-tone blue rexine covered Portable Cabinet with silver trimmings. Supplied complete with Microphone. Lead for recording from Radio or Record Player. Full Reel of Tape and Spare Spool. Carriage and Insurance 15/- extra. Credit Terms: £3.3.0, deposit and 12 monthly payments of £1.12.3. Total credit price £22.10.0

Originally 28 Gns.

OUR PRICE **20 Gns.**

FULLY AUTOMATIC TAPE SPLICER 34/6. P. & P. 1/6.

PLASTIC TAPE SPOOLS 3in., 1/3; 4in., 2/-; 5in., 2/-; $5\frac{3}{4}$in., 2/3; 7in., 2/6.

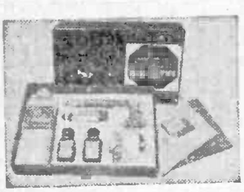
PLASTIC SPOOL CONTAINERS For spool sizes 5in., 1/6; $5\frac{3}{4}$in., 2/-; 7in., 2/3. Any single item plus 6d. P. & P. Orders over £1 post free.

We carry fully comprehensive stocks of Tape Recorders. Decks and Accessories at all Branches or order with confidence by mail.

AMERICAN RECORDING TAPE

5in.	600ft.	Std. Acetate ..	8/6
5in.	900ft.	LP Acetate ..	10/-
$5\frac{3}{4}$in.	1,200ft.	LP Acetate ..	12/6
$3\frac{1}{4}$in.	600ft.	DP Polyester ..	11/6
7in.	1,200ft.	Std. Polyester ..	12/6
5in.	1,200ft.	DP Polyester ..	15/-
7in.	1,800ft.	LP Polyester ..	20/-
$5\frac{3}{4}$in.	1,800ft.	DP Polyester ..	22/6
7in.	2,400ft.	DP Polyester ..	25/-

P. & P. 1/- per reel. 4 or more reels POST FREE.



ETCH YOUR OWN PRINTED CIRCUITS

A complete kit of parts to make your own printed circuit board to your own specification, high quality materials used to ensure perfect results. Price complete with all necessary chemicals and copper clad laminated board. 19/6. 2/3 packing and postage.

"the TRAVLER II"

★ MEDIUM AND LONG WAVES. ★12 VOLT POSITIVE EARTH. ★Push Button Wave Change. ★SIZE 7 x 2 x 7in.

$9\frac{1}{2}$ Gns. P. & P. 5/-

Ready built complete with 7 x 4in. speaker fitted to baffle fixing brackets, all nuts and bolts and fitting instructions.

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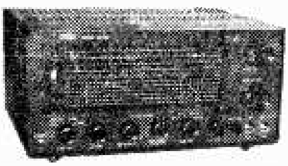

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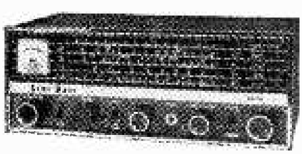

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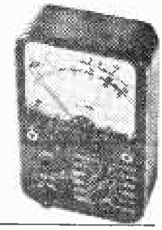

This outstanding meter was featured by *Practical Wireless* in the Jan. '64 issue. Lasky's are able to offer the complete kit of parts as specified by the designer.
RANGE SPECIFICATION: D.C. volts: 0-2.5-25-50-250-500 at 20,000 Ω/V A.C. volts: 0-2.5-50-250-500 at 1,000/ ΩV. D.C. current: 0-50μA. 0-2.5-50-250 mA. Resistance: 0-2,000 Ω. 0-200 Ω. 0-20M Ω. Basic movement: 40μA f.s.d. moving coil. Black plastic case, 3¾ x 5¾ x 1⅞in. Controls: 12 position range switch: separate slide switch for A.C. volts—D.C. ohms; ohms zero adjustment pot. meter; meter zero. Complete with all parts and full construction details. Data and circuit available separately, 2/6 refunded if all parts bought. Pair of Batteries, 2/5 extra. H.P. terms available.

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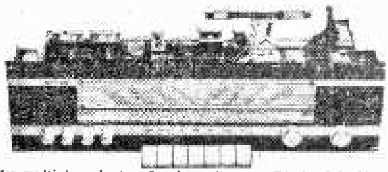

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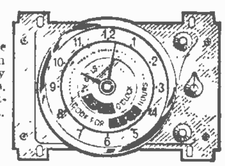

Type 3. A De Luxe electric clock, as illustrated, with combined sequence switching to give automatic switching of an electric appliance to switch on at any pre-set time up to 12 hours ahead and to switch off at any pre-set time up to 9½ hours later. Switch contacts are rated at 25 amps. 200/250 V., 50 c.p.s. and are therefore suitable for cookers and heating appliances as well as tape recorders, radios, lights, etc. Easy to set. 3in. dial. Overall size 5 x 3¾ x 2¼in.

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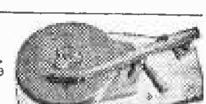

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PRACTICAL WIRELESS

DECEMBER 1965
VOL 41 NO 706

HAM OR SHAM?

AN interesting question is posed by a reader in News & Comment this month. It has been periodically raised before but there is no harm in examining the point again.

He asks, in effect—"What is an Amateur?" An innocent enough question, you may think, and one capable of simple reply, for surely it is only a matter of definition.

Briefly, our correspondent questions the right of an enthusiast to call himself an "amateur" when his shack is full of professionally-built equipment. Is he, perhaps, to borrow a term from another sphere, a "shamateur"?

It is undoubtedly true that the average amateur station today uses far more commercially built gear than hitherto, and many stations hardly boast a single piece of home constructed apparatus.

When commercially built transmitters were unavailable, everyone had to build their own. When commercial communications receivers were beyond the pocket of most amateurs, they made their own. When cheap and efficient test gear was hard to come by, amateurs "rolled their own".

Today, good receivers are within reach of virtually every amateur. Today, transmitters of a wide variety are available to anyone able to buy them; auxiliary equipment, for all needs, is plentiful. In fact, today the radio amateur can equip his entire station and go on the air without even having to reach for his soldering iron—assuming he knows what a soldering iron is for!

A common defence is lack of time to build up one's own equipment. Yet today most people have far more leisure hours than they had in the days when at least some of the station had to be home designed and constructed.

Ironically, these "shamateurs" would rear in alarm at the thought of a Citizens Band for novices. Yet are they no better than mere operators themselves?

CONTENTS

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

The JANUARY ISSUE WILL BE PUBLISHED ON DECEMBER 9th

Competent Constructors

WHEN I first read R. A. Packer's letter in the October issue of PRACTICAL WIRELESS, I felt rather annoyed. On reflection. I found it more amusing than annoying for it expressed most admirably, the carping opinions and criticisms of people who, lacking ability and initiative try to degenerate the efforts of more industrious souls.

The Editors of P.W., P.TV., P. Electronics and Radio Constructor have done me the honour of accepting and publishing my *poor misguided* efforts. I cannot however recall any article or articles credited to Mr Packer. Perhaps he writes under a pseudonym? If so, I would be most interested to discover which one.

I would conclude by, very humbly, offering Mr. Packer a word of advice. If you *must* set yourself up as a judge of other people's work let us, by all means, have a sample of *your work* so that YOU in turn can be judged.

H. T. Kitchen.

Nuneaton,
Warwickshire.

Electronic Developments

I MUST disagree with R. A. Packer's remarks on the future developments in electronics (October issue). If he seriously believes that the encapsulated transistor will be obsolete by 1975, what does he think will replace it? Sub-miniature etched circuitry and slices of semiconductor are hardly practicable for the amateur constructor.

In ten years, Mr Packer will either have bought himself a million-pound semiconductor processing and etching plant, or given up, while the poor "incompetents" of today are *still* enjoying themselves with their "obsolete" valves and transistors.

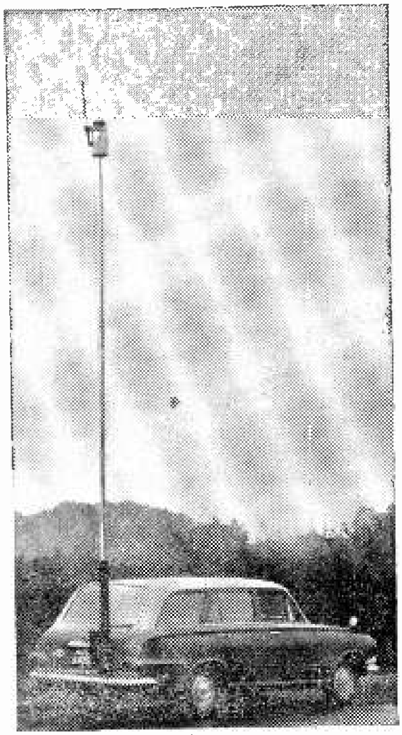
Miniaturization is all right for the equipment manufacturer where it may reduce labour and production costs, but why should the amateur constructor follow suit? Transistor equipment is quite small enough for my needs.

I. M. Hutchings.

Rugby,
Warwickshire.

NEWS AND..

ELECTRICALLY OPERATED TELESCOPIC MAST



★

A. N. Clark (Engineers) Ltd., of Binstead, Isle of Wight, have recently added to their range of Telescopic Masts a new series called "Super E". The unique feature of these latest designs is that they are arranged to be powered from a 12V supply which most conveniently takes the form of a vehicle battery. They are thus eminently suitable for mobile applications such as radio telephones, etc. The heights available range from 16-40ft. From operating the neat dashboard mounted switch, the time taken for the 25ft. mast to extend is under 20 seconds. A similar time suffices for retraction. By means of a simple electrical connection it is arranged that the mast cannot remain extended if the ignition switch is turned on.

★

CARRIER FREQUENCY IMPROVEMENT

In 1945 the BBC inaugurated high-precision frequency control of its 200kc/s transmission of the Light Programme from Droitwich. The long-term frequency stability, which was then within 1 part 10^{7}, was considerably improved in January 1963 and since then has been maintained within 5 parts in 10^{9}.

A further improvement has now been made in the frequency control of the Droitwich 200kc/s transmission resulting in a long-term stability which is now within $\pm$5 parts in 10^{10}. Due to the use of automatic frequency correction the excursion from nominal does not usually exceed 1 part in 10^{10}.

With the recent increase in broadcasting hours of the Light Programme, the Droitwich 200kc/s transmission is now available for 21 hours daily from 0400 to 0100 G.M.T

"WHICH?" REPORTS ON RADIOS

The September issue of "*Which?*" reports on 24 v.h.f. radios ranging in price from £18 to £42. The panel of experts tested the radios for sound quality, freedom from interference, ability to receive weak signals and ease of tuning.

The two most outstanding radios were among the most expensive: "*Which?*" names them, and the cheapest radio with the next best sound quality, as Best Buys.

..COMMENT

NEW AVO VALVE DATA MANUAL

Avo (MI Group) has just published the 17th edition of its Valve Data Manual.

This reference book, an essential for the servicing engineer, gives data on more than 8,000 valves in one volume otherwise available only by holding individual literature from every valve manufacturer.

Among the sections of the book are details of commercial equivalents of Service valves and Service equivalents of commercial valves; valve equivalents; test data for receiving and small transmitting valves (giving electrode connections and basing details); test data for tuning indicators, high voltage rectifiers and Russian valves.

The Manual also gives special data on all valve testers made by Avo since 1937.

The new Avo Valve Data Manual is available from the Spares Department, Avo Limited, 92-96 Vauxhall Bridge Road, London, S.W.1, and costs £1 15s. (post free).

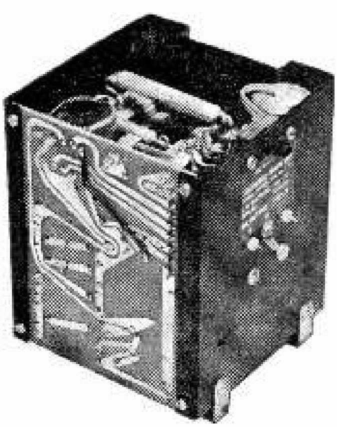
LONDON HI-FI SHOWROOM

Radio Rentals have opened a High-Fidelity showroom at 70 Baker St., London, W.1. They have transformed the basement of their West End branch into a complete demonstration studio where visitors can, without obligation, browse to their heart's content, hear their latest stereo records played on the latest equipment, and receive the advice of a High-Fidelity specialist based in the studio.

Although the showroom operates on a five-and-a-half day opening, the public are invited to 'phone WELbeck 5387 for a special appointment should the normal hours of business be inconvenient for them.

Hi-Fi equipment is available from leading manufacturers which include Goodmans, Garrard, Baird, Armstrong, Goldring, Rogers and Leak.

POWER UNIT FOR "LEKTROKIT" RANGE



A.P.T. Electronic Industries Ltd., of Chertsey Road, Byfleet, Surrey, announce an addition to the "Lektrokit" Rack and Chassis System of a new stabilised power sub-unit.

The LKU-321 provides either 6V or 12V d.c. at load currents up to 0·5A and occupies chassis space of one standard "Lektrokit" plate. The construction is in the form of an open rectangular tube so that the natural "chimney effect" assists the cooling of the heatsink. The shunt-stabilised amplifier circuit is wired on a printed card which comprises one side of the chimney, and the input and output connections are brought out by means of soldered pins.

The stability of the unit is better than 500:1 at 6V and better than 1,000:1 at 12V for ±10% mains change. D.C. resistance: 0·05Ω max., ripple is 10mV peak to peak, the size is $3\frac{3}{16}$in. x $3\frac{15}{16}$in. x $4\frac{1}{2}$in. and the price is £12.

Amateur Standards

Both R. W. Walker and GW3SPA, in their replies to Mr. Taylor's letter on the declining c.w. standards of the British amateur today, seem to have the mistaken idea that, just because an amateur has passed the G.P.O. Morse test, everything in the garden must be lovely and no further improvement is necessary.

Yet, one only has to listen on the bands to realise the truth of GW3SPA's own comment " . . . the standard of operating is satisfactory as far as amateur radio is concerned". In truth, the amateur world *has* a standard of its own, and it *is*, generally speaking, merely " satisfactory ".

There is obviously a vast difference between fumbling through the Morse test, as many do, and producing good, reliable Morse, sent at a reasonable speed, over the air. And this is, no doubt, the reason why so many newly-licensed amateurs choose the easy way out, avoiding all further contact with c.w., adopting instead a 100% phone policy.

What an improvement we should find if the compulsory use of c.w. only during the first year were brought back. Under these circumstances every operator would be encouraged to get his transmitter working correctly on c.w. first, ensuring a well-keyed T9 note, and some, at least, of those who now announce their dislike of c.w. operating without having tried it, would find they like it after all.

Bear up, then, Mr Taylor. Why not get yourself a callsign and come and join us on the c.w. bands?

F. Allan Herridge, G3IDG.
Basingstoke,
Hampshire.

Correspondent Wanted

I would like to correspond with someone my own age (13) who is interested in amateur short wave radio.

B. Wright.
1 Eastfield Road,
Barton-on-Humber,
Lincolnshire.

more News and Comment **on page 692**

A Transistorised L.C.R. Bridge

COVER SUBJECT

By Mike Fisher **Part One**

SOME means of measuring the values of resistors, capacitors and inductors is essential in any good radio or electronics workshop, however big or small, and this is equally true of the workshop of the radio control enthusiast. In the case of the latter, however, it is often essential that such tests be carried out "in the field" well away from the convenience of mains power supplies. The measuring equipment must therefore be portable and self-powered if it is to be of any real value to the operator.

The device that meets the above requirements is the transistorised L.C.R. bridge and it is with the design and construction of an instrument of this type that this article is concerned.

It is considered by the writer that some readers may decide to build a bridge with ranges other than those used on the instrument that forms the basis of this article and to this end it will be essential to understand the basic design procedure involved. It has therefore been decided to devote a certain amount of space to this subject. Those readers who have no interest in such details should therefore turn directly to the full circuit diagram and constructional notes.

Theory of the Wheatstone Bridge

The most basic form of measuring bridge is that known as the Wheatstone and it is from this that most other types of bridge are developed.

The circuit diagram of a simple Wheatstone bridge is shown in Fig. 1 and, as can be seen, consists of four resistance "arms" with a d.c. power source connected to the junction of two opposite pairs of arms and a detector, in this case a moving-coil meter, connected across the remaining pair of arm junctions.

The method of operation of the circuit is to place an unknown resistor in the position of Rx and to then adjust the variable resistor RV until a null reading is obtained on the detector. The best way to understand the theory is to regard R1 and RV as forming a voltage divider chain with the voltage connected between points A and B and the tapping-off point at C, while R2 and Rx form a second voltage divider chain connected to the same supply as the first chain and with the tapping-off point at D. The detector, connected between points C and D, will indicate the difference in voltage between the two tapping points. When these two points are at the same potential the detector will indicate zero or a null. These two points can only be at the same potential when $\frac{R1}{RV} = \frac{R2}{Rx}$ or, to put it another way, when R1.Rx=R2.RV. From this it can be seen that at balance

$$Rx = RV.\frac{R2}{R1}$$

From the above it can be seen that the actual values of R1 and R2 have little importance in the balance equation, it being their RATIOS that really count. R1 and R2 are therefore known as the "ratio arms" of the bridge and their ratios are usually made some power of ten. If the scale of RV is then calibrated in ohms it becomes a simple matter to determine the value of Rx, the unknown resistor, by merely reading off the value of RV at balance and multiplying the reading by the ratio of the ratio arms.

If, for example, the values of R2 and R1 were 100Ω and 10Ω respectively the ratio would be 10:1 and the multiplying factor 10, so that if it was found that at balance RV gave a reading of 526Ω it could be seen that the value of Rx was 5,260Ω.

In practice it would be found that if RV was made a 1kΩ potentiometer the lower end of the scale reading would be very cramped and the upper readings in the above case would be limited to 10kΩ. It is therefore general practice to provide the bridge with several switched ranges. This is done by switching the ratios of the ratio arms, always by powers of ten, and it is then found that a single calibrated scale on RV will suffice for all ranges.

Fig. 2 shows the circuit diagram, with switching details, of the complete Wheatstone bridge arrangement that is used on the instrument that is used as the basis for this article. As can be seen, a total of seven ranges is available, giving

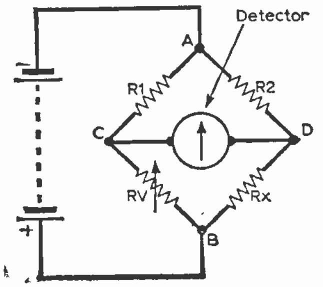
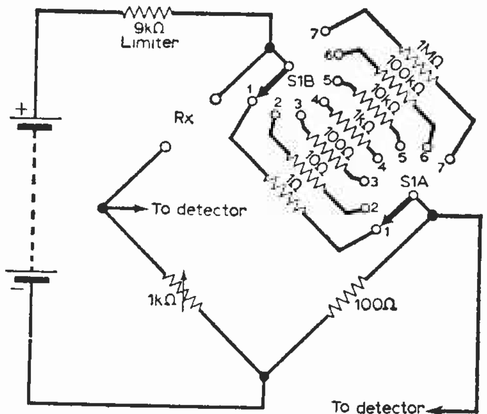


Fig. 1: Simple Wheatstone bridge circuit.



Bridge Range	Switch Position
0–10π	1
0–100Ω	2
0–1kΩ	3
0–10kΩ	4
0–100kΩ	5
0–1Meg	6
0–10Meg	7

Fig. 2: Seven range Wheatstone circuit used on prototype instrument.

readings from 0 to 10MΩ. To prevent excessive current flowing on the lower ranges, resulting in overloading of the supply, a limiting resistor is connected in series with the supply and also acts as a semi-automatic sensitivity control by voltage divider action.

It may be noted that several bridge circuits that have been published in the past have made use of a.c. as the power source for the Wheatstone bridge circuit, thus enabling headphones to be used as the detector in common with the capacitance and inductance measuring bridge circuits. The disadvantage of this system is that if the resistance to be measured contains any reactive components inaccurate readings will be obtained. It would be almost impossible, for example, to measure the d.c. resistance of a tuning coil or choke with such a circuit. D.C. has therefore been used to energise the Wheatstone bridge in the instrument described in this article.

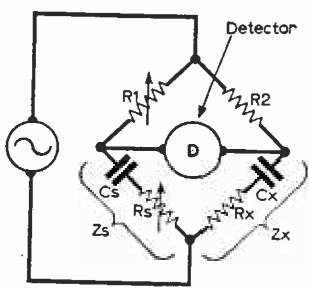


Fig. 3: Simple De Sauty bridge circuit.

Several bridge circuits exist which may be used for the measurement of capacitance but that known as the De Sauty is generally the most favoured.

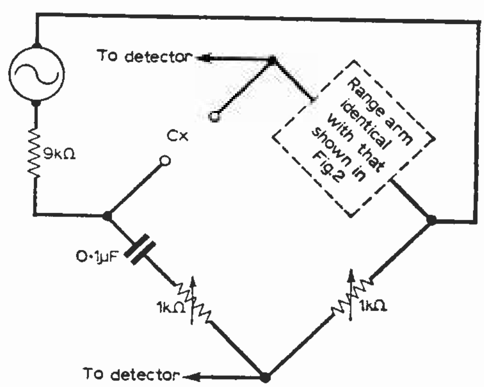
The circuit diagram of a simple De Sauty bridge is shown in Fig. 3 and, as can be seen, the basic configuration is similar to that of the Wheatstone circuit. Each of the lower bridge arms is replaced by a capacitor and series resistor, however, and the bridge is energised from an a.c. source.

In the De Sauty or any other bridge that measures capacitance it is necessary to balance impedances against one another. In this particular case, regarding the chain R1 and Zs and the chain R2 and Zx as voltage dividers again, it can be seen that at balance $\frac{R1}{Zs} = \frac{R2}{Zx}$. It must be realised, however, that an impedance contains both resistive and reactive components, so that in order to obtain a true balance of the bridge it is necessary to balance for both phase angle and magnitude.

In the circuit diagram Cs is a standard capacitance and Rs its loss angle reference. Cx and Rx represent the series combination of impedance of the unknown capacitor, Rx not, of course, being a separate physical entity by an inseparable part of the capacitor.

The frequency of the energising source is common to both reactive parts of the circuit and it can therefore be shown that the frequency of operation plays no part in the actual balance equation. In practice the bridge is balanced by means of both the variable resistor Rs and the main balance control R1, a null being obtained in each case.

At balance it is then possible to read off both



Bridge Range	Switch Position
0–100μF	1
0–10μF	2
0–1μF	3
0–0·1μF	4
0–0·01μF	5
0–1000pF	6
0–100pF	7

Fig. 4 Seven range De Sauty circuit used on prototype.

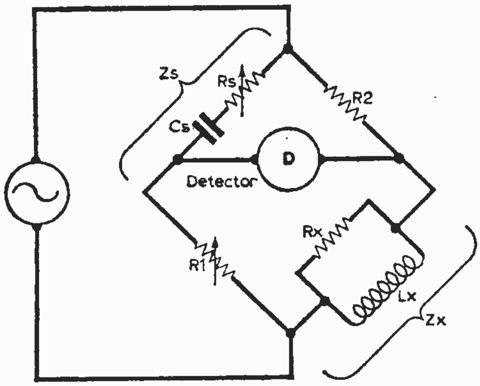


Fig. 5: Simple Hays bridge.

the capacitance and the series resistance of the unknown capacitor.

At balance it can be shown that

$$Cx = R1.\frac{Cs}{R2}$$

and $$Rx = Rs.\frac{R2}{R1.}$$

The loss angle of the capacitor under test can also be worked out from the formula:

tan S=Rs.Cs.6·28f., but as it is necessary to know the precise frequency of operation this formula can be disregarded for the instrument under consideration.

From the formula for Cx it can be seen that the ratio arms of this bridge comprise R2 and the standard capacitor Cs. If the ratios of these two are arranged to powers of ten the same calibration points as used for the balance control (Rv) may be used for both bridge types.

The circuit of the complete De Sauty bridge, as used in the instrument under consideration, is shown in Fig. 4. It can be seen that seven ranges are available, giving readings from 0 to 100μF.

The most favoured bridge for the measurement of inductance is the Hays Bridge. The circuit diagram of a typical example is shown in Fig. 5 and once again it can be seen that the same basic configuration as that of the Wheatstone bridge is used consisting of four "arms".

In the Hays bridge a standard capacitor is connected in the opposite arm to the unknown inductance. Again the bridge works on the principle of balancing impedances. As most readers will realise, a capacitor introduces a phase shift in the opposite direction to that of an inductance; by placing the inductance and the capacitance standard in opposite arms it is possible to cancel the phase shift of the circuit.

It should be noted that the Zx arm has been shown as consisting of the unknown inductance with its unknown *equivalent parallel* resistance. Rx, and that this is balanced by using an equivalent *series* resistance Rs with the standard capacitor Cs.

As the resistive as well as the reactive components of the unknown inductance must be balanced in order to obtain a true reading it is necessary to use both Rs and R1 in order to obtain a final balance.

It can be shown that at balance

$$Lx = R1.R2.Cs$$

and $$Rx = R1.\frac{R2}{Rs.}$$

If the frequency of the energising source is accurately known the loss angle of the inductor can be worked out from:

$$\tan S = \frac{1}{6{\cdot}28.Rs.Cs.}$$

It may be noted that the Q of an inductance $= \frac{1}{\tan S}$ but it should also be noted that the figure obtained only applies to the Q at the particular frequency of test.

From the formula for Rx it can be seen that in the case of the Hays bridge it is R2 and Cs that form the ratio arms. The same calibration of R1 as was used for the two earlier bridges is again used and when balance of the bridge has been obtained the value of the unknown inductance is found by reading the value of R1 and multiplying by the value given by the ratio arms.

The seven-range circuit used in the instrument that forms the basis of this article is shown in Fig. 6.

The circuit wiring and components of a practical bridge or any other piece of electronic equipment must inevitably contain stray inductances and capacitances. If 100% accuracy of readings on all ranges is to be obtained these strays must be either

Bridge Range	Switch Position
100μH	1
1mH	2
10mH	3
100mH	4
1H	5
10H	6
100H	7

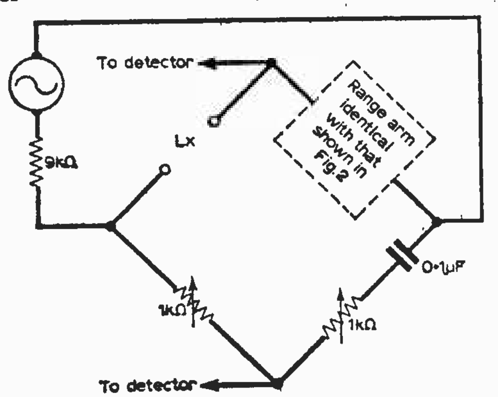


Fig. 6: Seven range Hays circuit used on prototype.

balanced or accounted for. In very high quality commercial bridges a system known as the *Wagner Earth* is used to this end and involves, amongst other things, the balancing to earth of both the detector and supply source and the extensive screening of all components, wiring, etc., and the balancing of any strays that still remain. This is a most complex and expensive process and beyond the scope of this article. Errors of reading will only occur to any noticeable degree, however, on the most extreme ranges of an instrument that is not so treated. If the bridge described in this article, for example, is quite literally lashed together to conform to the circuit diagram and the scale of R1 is calibrated directly by its resistance it will be found that, providing standards of 0·3% or better are used, readings accurate to 1% will be obtained on all ranges above 1,000pF. Below this errors will begin to creep in and it will probably be found that it is impossible to get a balance at all using a Cx of 15pF. It is most unlikely, however, that readings to this low level will be required.

Accuracy of Readings

Regarding the accuracy of readings that can be obtained it may be noted that the *worst* error of reading that can be obtained (ignoring the error due to strays mentioned above) is three times greater than the accuracy of the standards used. Thus, if 1% standards are used throughout, errors as great as 3% may be found in the final reading. It is therefore recommended that standards of better than 0·3% be used throughout if an overall accuracy of better than 1% is required.

It is also found that high-quality commercial bridges use *accurate* frequency oscillators to provide the energising source on the a.c. ranges in conjunction with tuned detector amplifiers. This is done for reasons already mentioned, i.e. so that accurate measurement of power factor, Q, etc., can be obtained. It is felt by the writer that, as in the case of the *Wagner Earth*, refinements of this kind are of little interest or use to the average constructor and they have therefore not been included in the bridge under consideration. As has already been pointed out, frequency of operation will have little or no effect on the accurate reading of values of capacitance or inductance in the circuit used.

In order to keep costs of the prototype instrument to a minimum, components that were readily at hand were used; no particular efforts were made to miniaturise by purchasing special components. In point of fact the two transformers used in the transistorised circuitry were taken from an old valve equipment.

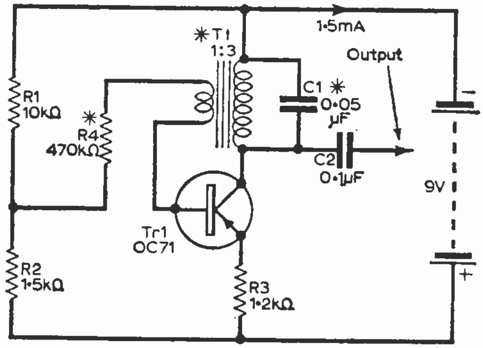


Fig. 7: 1kc/s oscillator.

The a.c. energising source consists of a simple single transistor transformer feedback oscillator the circuit of which is shown in Fig. 7. The only transformer available when the prototype circuit was built was a 3:1 interstage audio valve type and the circuit was built around this. Many other transformers are suitable for use in the basic circuit shown, however, but as their use will involve changes in other circuit components, further discussion of the circuit will be left until the "Constructional Notes" section of this article is reached.

For energisation of the Wheatstone bridge circuit 9V d.c. fed to the bridge via a 9kΩ limiting resistor is used.

The Detector Circuit

As has already been mentioned, the bridge described in this article differs from most other amateur built types in the fact that d.c. is used to energise the resistance measuring circuit, thus making possible certain kinds of test which could

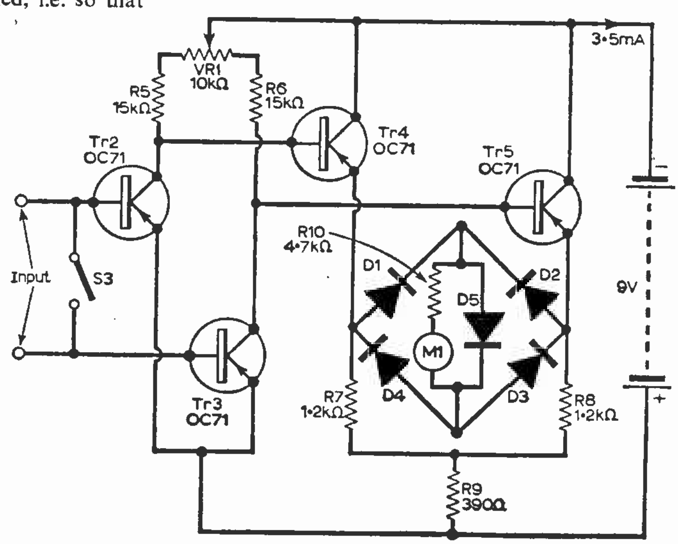


Fig. 8: A.C./D.C. detector circuit.

not otherwise be carried out. The major disadvantage of this system is that the detector circuit must of necessity be far more complex than in other types of bridge. Phones with their high sensitivity can clearly not be used as an indicator on d.c. unless a chopper-type circuit is included in the instrument and that would involve considerable complication. The solution to the problem is to use a visual balance indicator and it was decided that the only suitable device at the low voltages involved was a moving-coil meter, and as a centre zero type was not available at the time when the circuit was built the circuit had to be built around a conventional "end-of-scale" zero kind.

Circuit Requirements

The problems or requirements of the circuit were as follows: The indicator had to respond equally well to a.c. and d.c. signals. The meter had to give a reading that was very sensitive to magnitude of signal but independent of polarity of signal, i.e. it had to give a very sensitive "null" reading. Finally the meter or indicator had to give a very positive indication of the balance point, showing a needle deflection of, say, 1/10 of scale for a current change of 2μA at the balance point, but had to withstand out-of-balance currents of over 1mA without smashing the pointer against the stop or causing any damage to the circuitry. A non-linear response was called for.

The above problems were finally solved by using the circuit shown in Fig. 8. This consists basically of a d.c.-coupled amplifier feeding a long-tailed pair, each transistor in this pair having its own emitter load as well as the common one. Between the emitters of these two transistors is connected a bridge rectifier feeding a 50μA meter. If the two transistors are perfectly balanced their emitters will both be at the same potential and no current will flow through the meter. Should any unbalance occur a difference voltage will be generated between the emitters and a current will flow through the meter, the rectifier ensuring that the direction of meter current flow is independent of polarity or out of balance.

Non-Linearity

Non-linearity of response is obtained by wiring a resistor in series with the meter and connecting a germanium diode in parallel with the combination as shown. The diode is a non-linear device the forward resistance of which varies with applied voltage. When only a few millivolts are applied, as in the case when the meter shown is passing only a couple of microamps, the resistance of the diode is quite high, in the order of tens of kilohms; little shunting effect due to the diode therefore takes place. As the applied voltage is increased, however, the diode resistance falls and begins to act as a shunt, and when a couple of hundred millivolts are applied the diode resistance falls to such a low value that it forms a virtual short across the meter circuit. Non-linearity is thus obtained.

Balance of the circuit with zero voltage input is obtained by adjusting the collector loads of the two input transistors with the 10kΩ preset pot. On a.c. the balance point of the circuit will have little or no effect on the accuracy of readings but in the case of the resistance range, where d.c. is used, this is not so and considerable error may be introduced if the detector balance control is not correctly set. Unfortunately it is not possible to apply base bias to the first two transistors in this circuit and a certain amount of drift from balance point takes place. It is therefore necessary to carry out fairly frequent checks of balance and to this end a shorting switch is wired across the input terminals of the circuit: the method of setting up is to close the shorting switch, which is of the self-return type, and then set the balance with the 10kΩ pot.

The input to the circuit is applied between the two base connections of the input transistors, directly in the case of d.c., via a transformer in the case of a.c., it having been found that d.c. components existed in the a.c. bridge circuits during measurement, which caused misleading indications.

It is important to note that the generator circuit and the detector circuit both use separate 9V batteries.

The current consumption of the detector varies between 3 and 4mA and the consumption of the a.c. generator is a mere 1·5mA. The maximum current consumption from the d.c. supply on the resistance ranges is 1mA, so that the maximum total consumption of the complete instrument is 6·5mA.

(TO BE CONTINUED)

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by R. F. Farley, G3SSJ

A Thumbnail History of Radio

PART 3: WIRELESS FOR ENTERTAINMENT

IT is interesting to note that only a few weeks before his death in 1956 Edwin Armstrong said that nobody had understood the valve until six years after its introduction in 1907. Be that as it may, except for use as a telephone amplifier the valve had little use prior to 1914, however, about this time it was realised that a single triode would function as a heterodyne oscillator, detector and amplifier.

The Great War demanded continual improvement in communications with the result that both production and development expanded rapidly. By the end of the war receivers were produced using as many as six stages of high frequency amplification followed by a detector and several low-frequency stages. Captain H. J. Round was one of the foremost British pioneers in this field and gave his name to one of the early triodes.

Early Valves

The two most common types of valve were the "R" type valve and the "V24", although the latter did not make its appearance until towards the end of the war. The V24 was considered especially suitable as a high frequency amplifier but its characteristics would doubtless raise a smile today. It operated with an anode voltage of from 25 to 30V and the filament current was 0·75A at 5V. It had an approximate voltage magnification of 6. The famous R valve required a filament current of 0·67A at 6V, with up to 70V on the anode depending on the state of the vacuum. Both types were to survive well into the 1920's. Gain from the R type valve seems to have been largely a matter of luck. When at the end of the war these valves became available to amateurs on the surplus market, an especially soft valve was often sought after. Great magnification of c.w. signals was possible due to the ionisation effects although grid current was considerable.

On the field of battle the problem of transporting heavy batteries was considerable. This led to a number of experiments to lower the impedance of the valve by adding a fourth electrode. Captain Scott Taggart patented such a device which could be operated by a single low tension battery. Interest in "high tensionless" circuits was revived towards the mid-1920's, but little development on the low impedance valve took place until after the Second World War.

In America amateur radio equipment was being sold extensively. Crystal sets with large loose coupled tuners and even spark transmitters could be had off the shelf. It was during 1916 that broadcasting was started experimentally by the Westinghouse company. Edwin Armstrong served as a captain with the American Army in France for two years. In those days aircraft were located by purely acoustical means, and this was far from effective. Armstrong designed a receiver for locating aircraft by picking up the radiation from the ignition system.

By the end of the war spark transmitters were fast becoming obsolescent although some survived into the 1930's.

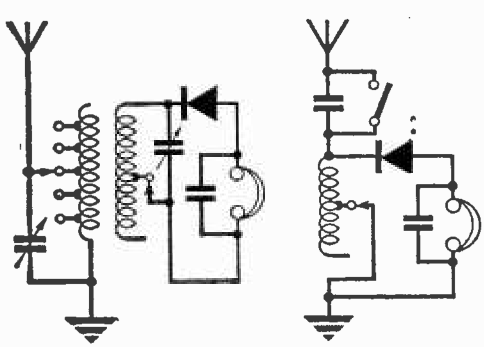


Fig. 1: Circuits of early crystal receivers.

Alexanderson's Alternator

It was the Alexanderson alternator that provided the high powers for trans-Atlantic round-the-clock working on low frequencies, though some arc stations were also in use.

Alexanderson was born in Sweden in 1878 but after graduating in Stockholm he settled in America, where he later became chief engineer of R.C.A., but it was whilst working for the General Electric company that he developed the first successful high-frequency alternator for Professor Fessenden. It was a very costly piece of development engineering because of its mechanical problems, for its armature had to rotate at high speeds and its mass was great. This meant that bearing wear would be very high unless the bearings were machined to fantastic degrees of accuracy. There was also the problem of centrifugal force. Since frequencies of many kilocycles were required the armature had to be driven through a step-up gear-box; there were then no motors to operate directly at these speeds. There is an excellent example of Alexanderson's alternator in the Science Museum, together with a wonderful collection of historic wireless instruments.

In America the first regular broadcasting station, KDKA, succeeded the experimental station of the

Westinghouse company. This triggered off an American broadcasting boom and gave further impetus to British enterprise.

The Marconi company set up a 6kW transmitter at Chelmsford and it was here that Lord Northcliffe financed the famous Melba broadcasts for the "Daily Mail". Dame Nellie Melba was at that time the leading international opera star and her historical broadcast was made on June 15th, 1920, before a distinguished audience of V.I.P.s The broadcast was successfully received throughout Europe and aroused great public enthusiasm. Melba sang into an ordinary telephone carbon hand microphone, but at that time so wondrous was the achievement that the distortion passed unnoticed.

Also at this time a regular series of concerts was being broadcast from The Hague and these figure prominently in the advertising material of manufacturers. A two-valve receiver could be bought for about £30 but most listeners built their own. Even so, the cost was high and licensing conditions were carefully bound in red tape, the Defence of the Realm Act having only recently been relaxed. References were required before licences could be granted to "approved persons" for experimental purposes only, although the Wireless Society of London fought hard for better facilities. The Wireless Society of London later became the R.S.G.B. Amateur transmitting licences were also issued for powers generally not exceeding 10W. Some amateurs found it necessary to broadcast frequent programmes of gramophone records. Particularly well known at the time was Station ZAZ at Guildford, owned and operated by Mr. William Le Queux, the novelist. Less fortunate amateurs contributed their skill to ZAZ, which provided them with an outlet they could not afford themselves.

After a short time the broadcasts from Chelmsford were banned by the G.P.O. because they were interfering with cross-Channel air communication, but after further negotiations the Marconi company started a regular series of broadcasts in February, 1922, which are unique in broadcasting history. From a hut at Writtle the brilliant Peter Eckersley, supported by a wonderful young team, showed what the microphone could do. The power at Writtle was only 200W and even this was almost strangled by legislation.

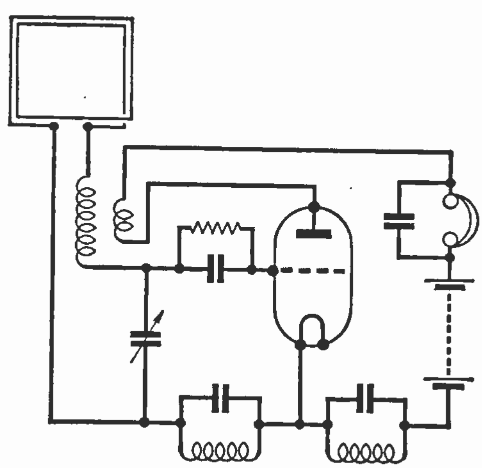


Fig. 2: The Armstrong "Super Regen". Used by the more adventurous to receive weak amateur transmissions below 200m.

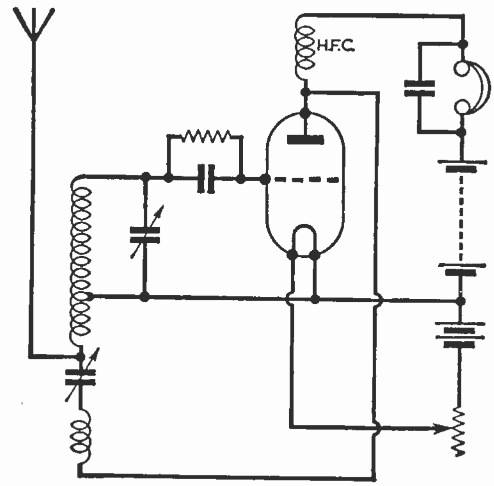


Fig. 3: The Reinartz circuit.

Following each three minutes of broadcasting a period of three minutes' silence was demanded, so the obvious choice of material was gramophone records. But enterprise thrives in the face of adversity and one evening Eckersley began improvising in front of the microphone. He was immensely witty and his inventiveness enabled him to use the absurd restrictions to advantage. Before long the whole staff at Writtle were contributing programme material of a largely impromptu nature. At the end of every broadcast Eckersley improvised a little rhyme, inviting listeners to report on reception and give details of the "hook-up" they were using. Sadly no recordings exist of these pioneer broadcasts but 2 Emma Toc is still very much alive in the memories of old-timers. Ordinary phone hand microphones were still in use at 2MT and its aerial was a 140ft, four-wire inverted "L" supported by masts 110ft high.

During the same year broadcasting began from 2LO at Marconi House in the Strand with a power of only 100W. Broadcasting was also being carried out on an experimental basis in the provinces by several of the larger electrical firms. In the meantime the American scene had become one of chaos. Hundreds of stations were coming on to the air but it was a great achievement to receive less than three at a time! Even Radio Caroline's most ardent supporters would wince at this.

BBC Formed

Fortunately in England the British Broadcasting Company was formed before things got out of hand. Its prime object was public service. Its first Director of Programmes was Arthur Burrows, a man of serious temperament, which distinguished

—continued on page 675

A Guitar Magnetic Pick-up Unit

BY

A. CLEMENT

FIRSTLY it is essential that the instrument to be electrified has steel strings in order to produce a signal in the pick-up coil when a string is plucked. Nylon or gut strings therefore must be discarded in favour of steel and when considering the coiled string numbers 3 to 6 tape-wound type are recommended.

Magnets

These magnets, obtainable from any good iron-mongers, are known as Eclipse "button type" the size used is in fact the smallest in the particular range. See Fig. 1.

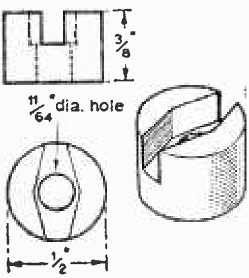


Fig. 1: Details of the Eclipse "button-type" magnets as used in the pick-up.

Base

Perspex or similar plastic $\frac{1}{8}$in. thick is used for the base and the holes for mounting the magnets are drilled as shown in Fig. 2 and countersunk on the reverse side to accommodate the 4BA brass countersunk screws. The brass retaining nuts must be filed until the nut will drop into place between the magnet pole pieces. This method of fastening ensures that the nuts are held locked in place. A suitable adhesive could also be used for mounting the magnets, although this means has not been tried.

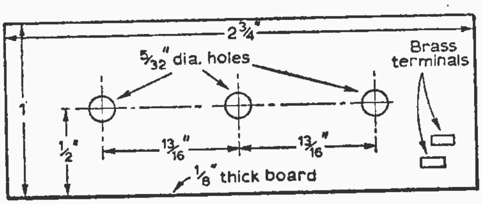


Fig. 2: Drilling details of the $\frac{1}{8}$in. thick plastic used for the base.

Coil Formers

Cut a strip of gummed paper $\frac{3}{8}$in. wide and wrap around one of the magnets, moistening the paper after the first complete turn; a 6in. or 7in. length should be long enough to make the tube rigid.

The top and bottom of each former can be cut from a variety of materials—card, plastic or celluloid, etc.—although the prototype used celluloid and this was very satisfactory. After the centre hole of these pieces has been made to fit the tube cut or file a small "*v*" notch as shown in Fig. 3 and drill a small hole adjacent to this. Assemble the formers, using glue such as clear "Bostick" or model aero cement.

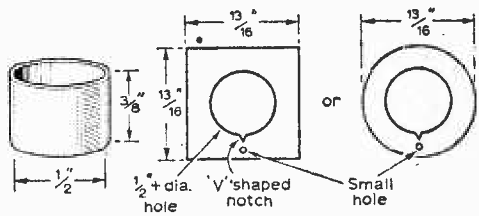


Fig. 3: Coil formers showing "v" notch and adjacent hole.

Coil Windings

The coils are wound from enamelled copper wire. The gauge is not critical and whilst 38s.w.g. was used originally this was only because it was available from the junk box. Anything thicker would not give sufficient turns on the formers, although up to 46s.w.g. or so could be used equally well.

A small piece of this flexible wire is soldered to the start of each winding and lead through the "*v*" notch. The enamelled wire is then wound on until the formers are completely "*full*" and the end is taken out through the small hole.

With the magnets in the correct position on the base the pole pieces should be in line one with each string, and in order to achieve this it may be necessary to alter the spacings of the strings where they pass over the bridge. The coils can now be placed in position and wired in series. Two small brass terminals cemented to the base are used to anchor the two free ends of the windings and the lead to the amplifier is taken from these two points through the hole in the cover.

Cover

This is best made from brass or aluminium, although any other non-ferrous metal will do. Again the gauge is not important and anything between 22 and 28s.w.g. would be quite satisfactory. Bend as shown in Fig. 4 by the dotted lines and when the unit is finally complete the small lugs can be bent under the base to hold the cover in position. Screened microphone cable is used to connect to a suitable amplifier.

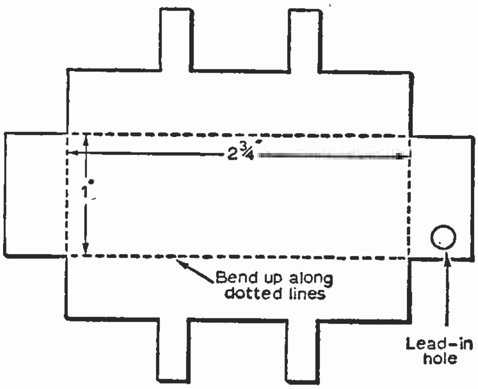


Fig. 4: Cover of the pick-up made from non-ferrous metal.

COMPONENTS

3 Eclipse ½in. button magnets.
3 ½in. x 4BA brass countersunk screws and nuts.
1 piece of ⅛in. Perspex 1in. x 2¾in.
1 piece 22s.w.g. aluminium 4in. x 3in.
1 bobbin of enamelled copper wire 38-46 s.w.g.
Gummed paper, celluloid and screened cable, etc.

Concluding Notes

Due to the lack of d.c. current in the coil windings the signal strength is naturally very weak and an amplifier with a suitable preamplifier stage such as an EF86 is virtually essential. Satisfactory testing can be carried out by connecting to the pick-up terminals of most radio sets, although the volume control will need to be turned full on. The distance between the unit top and the strings should not be too great for maximum effect and the sound can be varied by altering the position of the unit. The nearer to the fingerboard the more mellow the tone, whilst if placed near to the bridge a more staccato tone is obtained. In this connection two or more units can be used to good effect if suitably switched.

It will be seen that no details have been given for mounting the unit as this will depend on the type of guitar used and, of course, how far the prospective user is prepared to go in drilling the soundbox, etc., of his instrument. ■

A Thumbnail History of Radio—*continued from page 671*

him from his colleagues in his former days at Writtle. He remained with the BBC until his death in 1948.

The next few years were to witness the gradual expansion of broadcasting in the regional scheme with greatly increased powers and in 1929 Brookman's Park transmitter was opened, its four power units each capable of delivering 200kc/s. It was Eckersley's brainchild and remained in service until 1963 almost without modification.

Advertising Charlatanism

With broadcasting came a wave of advertising charlatanism almost unparalleled in history. You could not hope to hear The Hague concerts clearly unless you used so-and-so's high-grade coils. Crystals capable of operating six pairs of earphones from the power received from Continental stations figured prominently. One firm of loudspeaker manufacturers committed an almighty howler, their illustration showing a concert pianist hammering a grand piano, drawn the wrong way round so that the bass strings were on the right-hand side! Another firm manufactured a wonderful high-frequency amplifying valve which consumed "absolutely no current"; the envelope contained only a small condenser between the grid and anode pins. Numerous circuits appeared, often differing little except in name. These were the days when the field of technical authorship had a large element of ex-Army men calling themselves captain! An impressive title in those days.

Reflex circuits using valve and crystal combinations were popular for economic reasons, while the more daring enthusiasts could experiment with the Armstrong Superregenerative and Flewelling circuits. By the end of 1923 the crystal was steadily giving way to the valve in the home. Mr. W. S. Barrel published details of a supersonic heterodyne late in 1923.

Using only single tuned i.f. circuits, Mr. Ken Alford, G2DX, the British pioneer amateur, published details of his superhet early in 1924. He was also the first to patent the r.f. stage to improve the performance of the frequency changer and reduce second channel interference, but he never received any royalties and the big companies used the idea.

This was the time of the great pioneer work by amateurs on short waves, but this is another story. Most home constructors were still thrilled to receive the Savoy Orpheans or John Henry from 2LO, which now ran a power of 1½kW. BBC stations were also operating in Birmingham, Cardiff, Manchester, Newcastle and Glasgow, all worked on a power of 1½kW, and could be heard on a crystal set within 20 miles provided the aerial and earth system was good. ■

FOR THE BEGINNER

AN EFFICIENT EARTH SYSTEM

BY ALAN FORD

IN the early days of radio the installation of an efficient aerial and earth system was considered of paramount importance but in these times of super-sensitive receivers which require neither aerial nor earth the art has died somewhat. However, the serious short-wave enthusiast and particularly the transmitting amateur must still attend to these points.

From time to time excellent articles appear dealing with the design of short-wave aerials. It is usually assumed that the reader will arrange for a high-efficiency earth where this is required. It is the writer's experience that few enthusiasts take much trouble over the earth system and the effectiveness of the whole arrangement suffers in consequence.

The earth itself and the sea is a conductor. In theory it has a negligible resistance, since its area is so vast. However, connection from the receiving or transmitting apparatus is made usually only at one point and the effective resistance depends upon this. If the earth connection consists only of the familiar rod in the ground, conduction can obviously take place only between its surface and the area of soil immediately surrounding it. This area of contact is not very large (see Fig. 1).

Until recently rising water mains provided a somewhat better proposition than a simple rod. However, plastic sheathing materials and polythene connections now in general use preclude this. It is, of course, illegal to use any gas piping as an earth connection. What is needed is some method of presenting a large area of contact to the surrounding earth. Odd sheets of metal bonded together and buried would be effective but an ideal solution presents itself in the shape of a domestic water tank.

A local builder or plumber will gladly part with a faulty tank he has replaced or, failing this, a demolition contractor is unlikely to get through a week without finding one on his hands. The usual size of domestic water tank is around 4ft x 4ft x 3ft, which gives an outside surface area of 80 square feet or even greater for the open-top type. This is obviously a vast improvement on the usual rod.

Importance of Site

The site for the earth is also of importance. Apart from the question of a convenient place to dig a 4ft to 5ft hole two factors should be borne in mind. First, if possible, an area of fairly moist soil should be chosen where the types of soil in the garden vary. Secondly, and more important, the earth connection to the apparatus must be as short and direct as possible or there will be considerable risk of stray resonant effects which in the case of transmitting systems could cause interference to television reception in the area.

Having chosen the site a great deal of digging

—continued on page 679

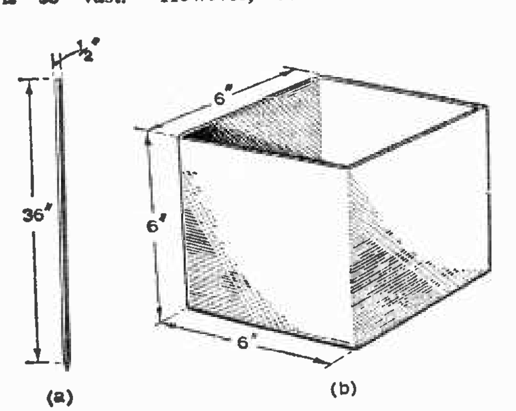


Fig. 1a: The area of contact of the usual earth rod is $2\pi rh$. For the usual rod ½in. thick and 36in. long, this is 56 sq.in. 1b: The area of a metal tank is obviously much greater, even if the tank was 6in. x 6in. x 6in. The surface area would be 216 sq.in.

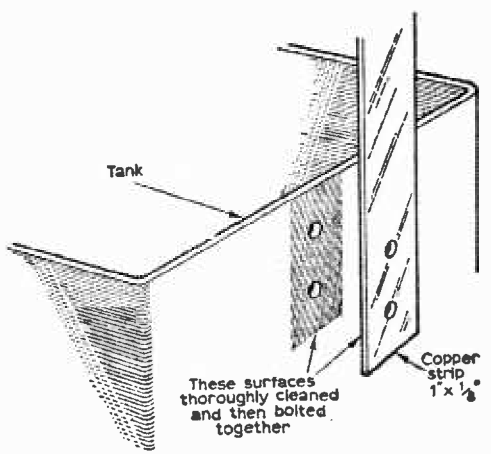


Fig. 2: Method of connection to the tank. The joint must be completely covered with bitumastic paint.

MINIATURE OSCILLOSCOPE

PART TWO BY H. T. KITCHEN

The Metalwork

Before the metalwork is started on a check should be made to see if the components to be used will fit into the stated dimensions. The potentiometers and the timebase switch should not exceed 1¼in. diameter with the exception of the Y shift and X gain controls, which must not exceed ¾in. If sufficiently small controls cannot be obtained a suitable increase in the stated dimensions will have to be made. In order to keep the overall size down a c.r.t. base was dispensed with and all leads going to the c.r.t. were soldered directly to their respective pins. (It was afterwards discovered that a suitable base was unobtainable locally anyway!) This is quite safe provided a good, hot, clean iron is used and all joints made in the minimum of time.

The material used is 20 s.w.g. aluminium to the dimensions given in Figs. 5 and 6. It is easier to drill or file all the holes before the bends are made, due allowance being made for material thickness. The dimensions of the under-chassis screen are not given, since it should be easily fabricated. It is bolted to the chassis and front and rear panels, resulting in a light yet rigid assembly. Part of the front end will have to be contoured to fit the neck of the c.r.t., the minimum amount of metal being cut away so that it can perform its function as an electrical screen between the Y amplifier and the t.b. The sawtooth voltages generated by the t.b. have fairly large amplitudes and without this screen would completely block the Y amplifier.

The power supply section can be built in any convenient form and positioned a safe distance, magnetically speaking, from the oscilloscope proper and connected to by means of a multi-way cable.

Wiring Up

No layout drawings are given, since the method of construction will be apparent from the photographs. Two long tag strips either side of the dividing screen and the components are wired from these strips to the valveholders or, in some cases, from tag to tag or valveholder to valveholder. A small hole is drilled in the dividing screen in line with V1 and V4 to allow the sync o/p from V1b to be passed via C7 to V4.

Although the experienced constructor should have little trouble getting the oscilloscope to work satisfactorily the writer feels that this design, due

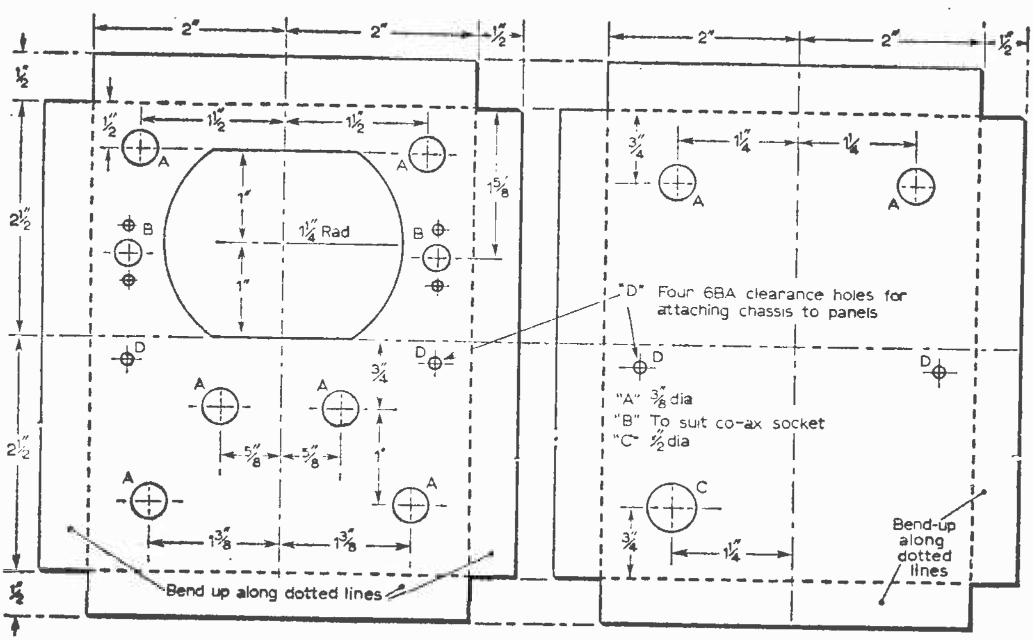


Fig. 5: Front panel (l.) rear panel (r.).

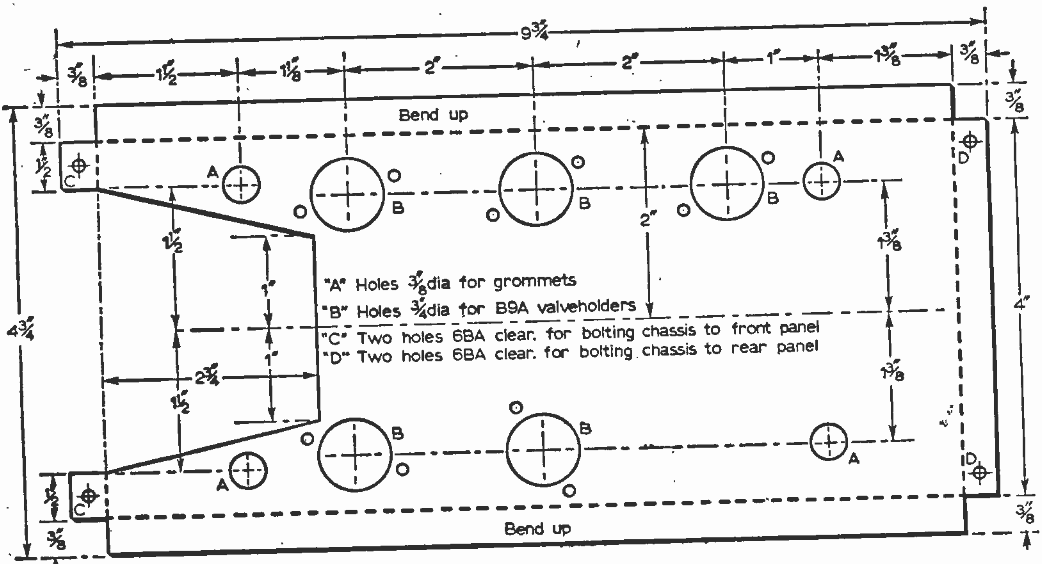


Fig. 6: Chassis drilling dimensions.

to its compact nature, should not be attempted by the beginner.

The probe should be built into a metal can to provide screening. A 35mm film container would be ideal and should be lined internally with insulating material so that if the contents do move no great damage is done. The cable connecting the probe to the oscilloscope should be good-quality low-loss coaxial permanently attached to the probe, since cables of varying length or quality (hence internal capacitance) will alter the strays and thus affect the "picture of quality".

Testing

When wiring up is completed the oscilloscope can be checked for correct operation. After several minutes warming-up time it should be possible to resolve a fairly fine trace by adjusting the brilliance and focus controls. Operating the Y shift control should cause the trace to move up or down just within the aperture limits, whilst if the trace is horizontally displaced a slight adjustment to the value of either R32 or R33 should centralise it. Operating the timebase at its slowest speed should cause the spot to traverse the c.r.t. from left to right. If not, transposing the leads from the o/p stage to the X plates should bring about correct traverse.

A square wave is the best possible way of setting up TC1, which should be adjusted so that neither sag nor overshoot is apparent. It is essential to set up TC1 with the probe in "working order"

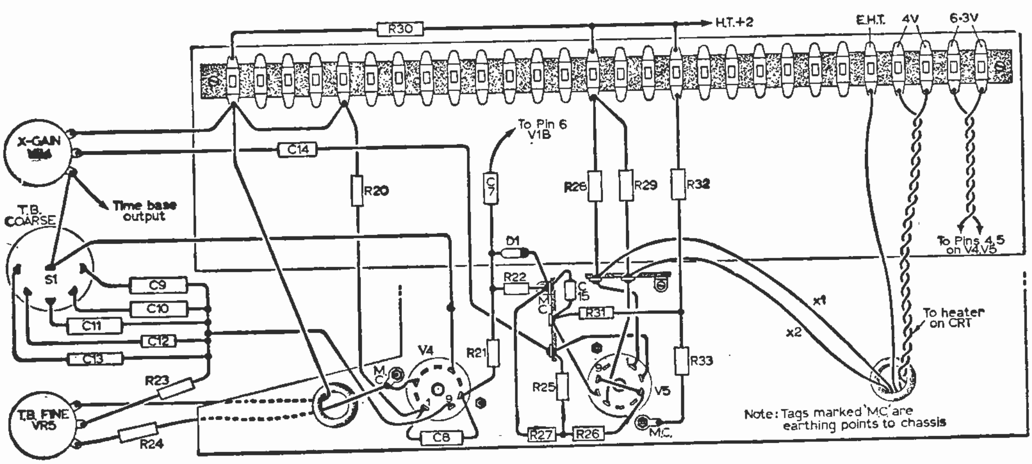


Fig. 7: Wiring diagram of the timebase unit.

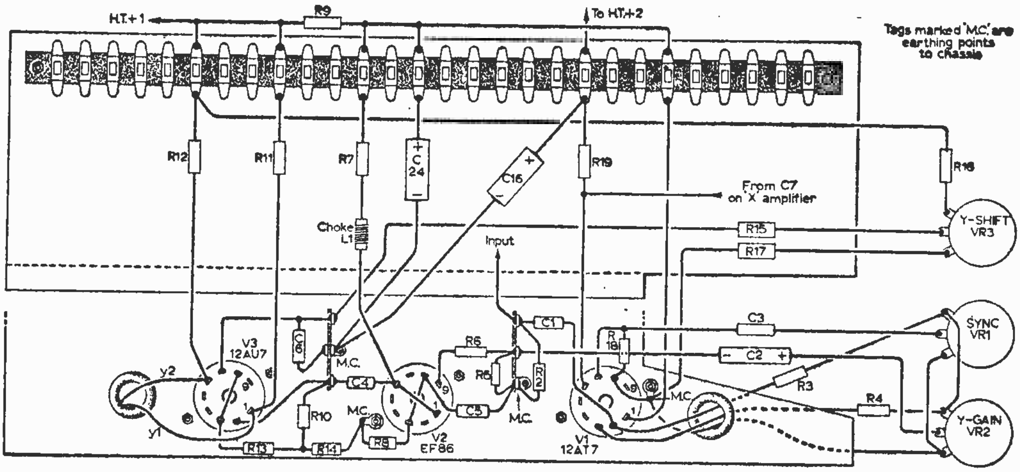


Fig. 8: Wiring diagram of the Y-amplifier unit.

with its cap or lid firmly fastened, which will probably require several attempts.

The surplus equivalent of the GEC E4205-B-7 is the VCR139, which in the author's experience is a variable tube, variable in the sense that some specimens are good and others not so good, which means that some experiment with the focusing and brilliance values *may* be necessary. There is also a possibility that some specimens may be averse to direct coupling, though this is rather a remote possibility. ■

AN EFFICIENT EARTH SYSTEM—*continued from page 676*

will be necessary. It takes a surprising amount of time and energy to dig a hole of about 50 cubic feet! It is very difficult to do the job tidily but in the case where the chosen site is under a lawn, for instance, some careful planning is worth while. A sheet of canvas laid over the area of lawn surrounding the site will prevent the excavated earth from ruining the appearance of the grass. The lawn should be sliced off in turves which can be carefully replaced when the tank is buried.

Soil Packing

The tank itself should be prepared by removing or tightening any loose rivets and attaching a really stout connection of copper strip, about 1in. x ¼in., of the kind used as busbars on large switchboards is suitable. Ordinary connecting wire is hardly satisfactory—it will corrode in time and a secure connection to the tank is difficult to make. About 6in. at the end of the strip should be filed and rubbed down until it is bright and clean and a corresponding area at the top of the tank should be similarly prepared (see Fig. 2). The strip should be bolted to the tank, using half a dozen stout bolts, tightening to the limit. The whole joint should be covered with bitumastic paint to prevent corrosion. The hole should be deep enough for the top of the tank to be about a foot below the surface.

Preparation of the Tank

When the tank has been lowered into the hole, soil should be packed *tightly* round it and also inside if the tank has an open top! The copper strip can then be routed by the most direct path possible to where the apparatus is installed.

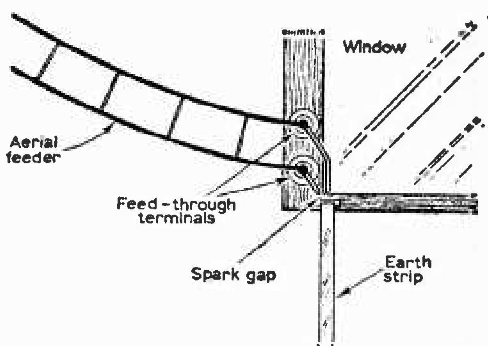


Fig. 3: Discharge gap to protect apparatus from lightning damage.

It will probably be found most convenient to lead the strip in through a window frame and along the back of the operating bench. The connections from transmitters, receivers or aerial tuning units can be made to large terminals bolted to the strip. An earth system of this kind is very suitable for lightning protection. The feeder from the aerial may be brought to feed through insulators near to the earth bar and another pair of strips arranged as a discharge gap (see Fig. 3). ■

on the Short Waves

MONTHLY NEWS FOR DX LISTENERS

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

The Broadcast Bands—by John Guttridge

RECEPTION conditions recently point to things being little better this winter than last, very few stations now being left in the 19m.b. after 2000. The lower frequency bands are also again suffering from severe overcrowding. One of worst offenders in this respect is Radio Moscow which continues to poach on other stations' established channels regardless of whether it puts in a stronger signal or just causes an annoying heterodyne. Now to station news.

Germany (East): *Radio Berlin International* (Berlin-Oberschoweide, Nalepastrasse 18-50) now broadcasts English to Europe at 1730—1800 on 6,080/6,115/7,300/9,730, 2015—2045 as 1730 plus 1,511, and 2300—2330 on 6,115/7,300/1,430.

Holland: *Radio Nederland* (P.O. B.222, Hilversum) airs the Happy Station programme in English on Sundays at 0730—0850 on 9,715/17,830; 1030—1150 5,980/6,025/9,715; 1400—1520 6,025/15,425/ and 1530—1650 on 17,810/21,570.

Poland: *Radio Warsaw* (Al Niedpodleglosci 75/77, Warsaw) has English to Europe at 1830—1900, 1930—2000, 2130—2200 on 6,135/7,125; 2030—2100 5,950/7,145; 2230—2300 7,270/9,540/1,502 and 2303—2330 on 227.

Rumania: *Radio Bucharest* (P.O.B.111, Bucharest) is offering a diploma and badge to the first 1000 listeners to send in 12 reception reports within three months.

Sweden: *Radio Sweden* (Box 955, Stockholm 1) English transmissions subject to recent frequency changes are 1230—1300 11,810/15,195; 1400—1430 15,420/9,620; 1445—1515 11,915/15,315; 1615—1700 11,705; 0145—0215 9,705; 0315—0345 9,705.

Vatican: *Vatican Radio* now has English to Europe at 1500 on 15,120/11,740/9,645/1,529 and 1815 on 9,645/7,250/6,190/1,529.

Angola: *Emissora Official de Angola* (C.P.1321, Luanda) has English from 1705—1745 on 7,235/9,535. Has ordered four 100kW Tx to come into operation next year.

Radio Commercial de Angola (Casilla Postale 269, Sa da Bandeira) transmits as follows: On 3,995 1900—2200, 4,795 0530—0900, 1600—1855; 7,155 1030—1300.

Bechuanaland: Radio Station ZND, (P.O. Box 63, Lobatsi) is now using the new Gaberones station from 1530—1700 on 3,356. Mondays to Fridays there is news in English at 1600.

Congo: *Radiodiffusion de la Republique Democratique du Congo*, (Boite Postale 3171, Leopoldville). The National programme is transmitted from 0400—0730 (0900 Sundays) on 7,170/4,735/4,880/11,795; 1000—1300 (1500 Sundays) 7,170/11,795; 1500—2300 4,735/7,170/11,795. There is news in English at 0445,0545, 0645, 1045, 1145, 1245, 1645, 1845, 2045 and 2200. A regional programme is also carried on 4,880.

Radio Interprovinciale du Katanga (Boite Postale 7296, Elisabethville) transmits from 0400—0700 (0800 Sundays) 1000—1200 (1300 Saturdays and Sundays) and 1430—2000 on 5,958.

Radio Bakwanga uses 7,295 from 1000—1200 and 1600—1900.

Radiodiffusion UFAC, (Boite Postale 97, Elisabethville), has English from 1600—1700 on 4,890.

Ghana: *Radio Ghana*, (Broadcasting House, P.O. Box 1633, Accra) is now using its new 250kW transmitters. New English transmissions are 0430—0515 and 0600—0645 on 9,760; 0645—0730 on 9,545; 1645—1730 and 1815—1900 on 15,285 and 1500—1545 on 21,720. A large new QSL giving all details is now being issued.

Mauritius: Mauritius Broadcasting Corporation, (Malherbes Transmitter Building, Forest Side) sometimes uses 9,710 from 0230—1830. Normally 4,850 is scheduled for use from 1300—1830.

Nigeria: Nigerian Broadcasting Corporation (Broadcasting House, Lagos) will not QSL through bureaux. English external service transmissions are at 1500—1600, 1700—1900, 2100—2200 on 7,275/9,690/11,900/15,255.

Somalia: *Radio Mogadiscio*, (Mogadiscio) has replaced 7,160 by 7,130. English is at 0345—0400 and 1800—1830.

Spanish Guinea: *Emisora de Radiodifusion Santa Isabel*, (Apartments 195, Santa Isabel, Fernando Poo) has been heard closing down at 2300 on 6,247.

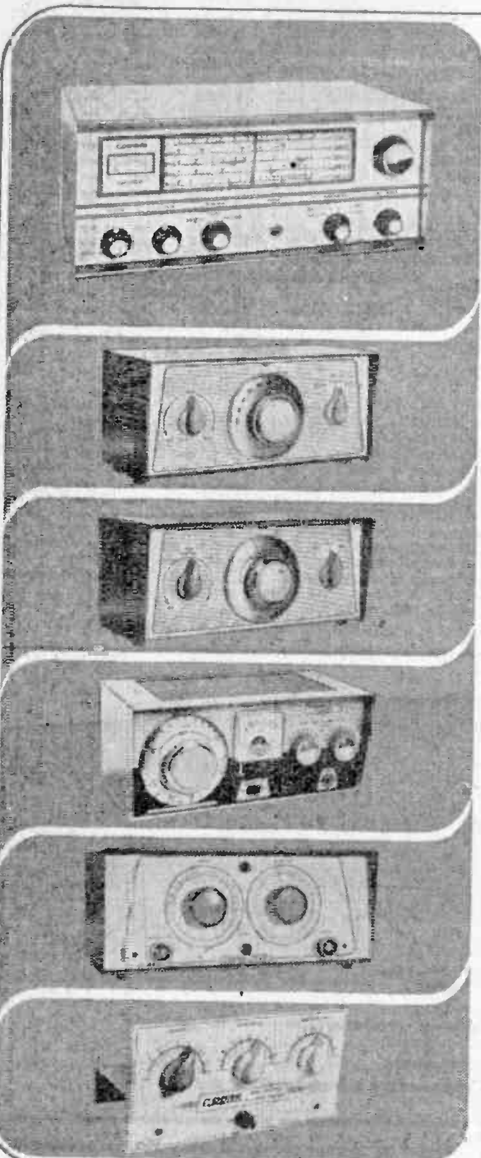
South Africa: *Radio South Africa* (P.O. Box 8606, Johannesburg) should now be using its new 250kW transmitters. The Africa service schedule is now 0300—0400 6,150/7,270; 1000—1300 15,220/17,805; 1300—1655 15,220/11,900; 1655—1800 9,525/11,900; 1800—2115 9,525/7,270.

Iran: *Radio Iran* (Ministry of Information, Meydan Ark, Tehran) now announces frequencies of 7,135/11,730 for its Foreign Service. It has been heard however on a measured frequency of 11,790 during the 2000—2030 English broadcast.

India: *All India Radio* (New Delhi) now uses 9,665/11,780/15,105/17,855 for its 1000—1100 English transmission to Asia. At the same time this transmission can also be heard on 11,710/15,165 directed to Australasia.

Finally a composite thanks to all who provided information this month. Any information on South American stations would be appreciated. At present this appears to be a much neglected area.

CODAR — QUALITY



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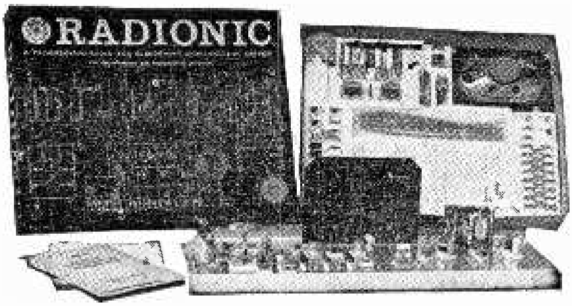

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The Amateur Bands—by David Gibson G3JDG

WE'LL soon be calling this the "Twenty Metre Column". The activity on this band coupled with the huge pile of 14Mc/s logs is quite fantastic. Neither is there any need for expensive equipment. All sorts of reports from all sorts of gear coupled into an amazing variety of aerials. One minute's silence, please, for the coathanger gang; no reports at all from weird antennas this month. What about a thin line of aluminium paint down the side of the house fed at the bottom?

From the logs that arrived it appears that a superhet or an expensive communications job pulls in no more than the t.r.f.s. How about a t.r.f. versus superhet month? Don't be sceptical if you own the latter or too pessimistic if you have the former. When listeners with broadcast receivers start sending in reports on New Zealand "hams" running 100W or so anything might happen.

The l.f. bands, too, have brought some interesting logs and these show that DX is not confined to 14Mc/s. A special pat on the back to all the 1·8, 3·5 and 7Mc/s reporters: it's not as easy on these bands as it is further up the r.f. spectrum and digging out the DX requires a determined effort and a sharp pair of ears.

The L.F. Bands

Barry Dale (Cheshire), t.r.f., 60ft long wire, *1·8Mc/s:* ON4UN, 5A2TR. *3·5Mc/s:* GC, HBØ, K2, K4, LA7, OE, OH, OX, OZ, SM4, VE2, VO1, W3, W4, WA4, WA9, YU, ZL4OM (New Zealand at 0649hours), 4U3, 5A2, 9M4LP (Singapore). *7·0Mc/s:* TG9, XE1, YV4, ZL2BCG. A very fine log indeed. **James Brown** (Cardiff), "hotted up" 19 set, 80m dipole. *3·5Mc/s:* DJ, DL, EI, FP8CA, G, GW, GI, GM, HBØ, HB9, I1, K1, OE6, OHØ, OH2, OK1, ON4, OX5, OZ5, PAØ, SM1, SP7, VE1, VE3, VO1, VS6AJ (Hong Kong), W1, W2, W2/W1, 4U1, 4U4, 4U5, 4U6, 4X4. **J. Peterson** (Bushey), home-brew transistor superhet, 30ft wire around the loft, 3·5Mc/s, s.s.b.: LA 57, OK 59, ON459+, OZ2 59, XO1ES 57, VO1GO 57, ZB2AO 55.

R. Iball (Worksop), SX28, 80ft long wire, 1·8Mc/s: K1PBW, VO1FB, W1BB/1, W2EQS, W2IU. *3·5Mc/s:* VE3BWY, W1DBQ, W1GF, W3FAK, W9KSE, WB2RQZ, WN2SKF, WN2TUU, WN4AIB, ZL2BCG. *7Mc/s:* CP1EA, CP5EZ, HK4EX (Columbia), UA9DH, W6AM, ZL2AWJ. **23968214 Harvey, C.** (Chepstow), B.C. receiver, 80m dipole, sends in a huge log of G, GW, etc., heard on 3·5Mc/s with two interesting specials, GB3RH and GB3SEE.

Twenty

John Fitzgerald (Great Missenden), Hitachi WH837 eight-transistor broadcast receiver, 14Mc/s doublet, sends in what can virtually be described as a miniature edition of the 1965 call book. With another receiver used as a b.f.o. John raised CR4AJ, CR6BX, CR8AE, CR9AK, DU1AP, DU6TY, F9UC/FC, FG7XC, FM7WQ, FP8CA, HI8XAJ, HK5AOH, HL9TO, HP1JC, JA6AD, JA9IL, KL7EKB, LA8FG/P (Jan Meyen Islands), M1B, MP4BCC (Bahrein Islands), PY2BZD/Ø (Trinidade Island), TJ1AC, TU2AA, UAØEH (Sakhalin Island), UM8FZ, VE1, 2, 3, 5, 6, VO1, VE1AED/SU, VE3CVL/SU, VK1VK, VK2NN, VK3AHO, VK4NR, VK5DT, VK9AG (Territory of New Guinea), VP2KD, VS6AJ, W1, 2, 3, 4, 5, 8, 9, Ø, WNWNV/8F3 (Indonesia), XE1JJJ, XE3L, XW8AX, XZ2TZ (Burma), YA1AW, ZL1KG, ZS3E, ZS4OF, 4S7IW, 4U1SU, 4W2AA (Yemen), 5T5AD, 5Z4FE, 9K2AM, 9M2OV, 9M4LP, 9M6AP, 9M8KZ, 9N1MM (Nepal). Heaven help us if he ever gets a beam antenna!

C. Pedder (Preston), R1155L, 40ft long wire, BV1USA (Formosa), CT, DU, G3BID/LX/M, JA, KX6BQ, PY2BZD/Ø, VPZDO/MM (off Perth, Western Australia), W6IBU/KG6, XW8AX, XZ2TZ, 4U1, 5, 6, 9M4.

The new firm of **Messrs. Dunning and Black** (Kent), HE30, 20m dipole, send in an impressive list which includes CR4AJ (Cape Verde), DU1AA, EA8CR (Canary Islands), FG7XL (Guadeloupe), FP8CA, HP1JC, JA6—AB, AD, BEE, NP, JA8HK, KA1AA, KR6BQ (Okinawa), KZ5BW, MP4TBO, PJ2AA, PZ1BW (Dutch Guiana), TI2SS, VK4FJ, VK9NT, VP2SK, VP6WR, VP7DI, XE2LR, XU1AA, ZB2AP, ZL2JO, ZL3UY, 3A2CR (Monaco), 4U1TTU, 4X4BW, 5A4TQ, 6Y5XG. **D. J. Mortimer** (Gloucester), CR100 fed from a Band I and Band III television aerial! (I just knew there'd be one somewhere.) CR4AJ, FP8CA, HK2YO, JA6BEE, KG6APS, KJ6BZ, KL7EKB, KM6DJ, KR6GF, KØHGM/KS6 (Samoa), KX6BQ, MP4TAV, OX3SE, TF3EA, TJ8AC (Cameroons), VK—2NN, 3AM, 3AHO, 4LB, 5DT, 6GC, VP2KJ, VS9AE, W6, W7, XW8AX, YA1AW, ZPØBK, ZS6OY, 4S7IW (Ceylon), 5X5FS, 5Z4GF, 6Y5RA, 7X2MD, 7Q7PBD, 9G1DY, 9J2FK, 9K2AM, 9M2SS, 9Q5QR.

F. Pemberton (Ricksmansworth), two-valve battery t.r.f., 15½ft indoor aerial, KC6, KH6, KH6/KS6, KL7, KM6, TF2, UAØ, VK, VU2, WA6, W7, XE1, YV1, 4S7NE. **David Blackwell** (Yeovil), home-brew 1V3, 20m dipole: CR4AJ, FP8CA (St. Pierre), JA1MP, KL7ESR, KM6DJ, OX3SE, PY1SD, PZ1BW, VP2KJ, VK—3AM, 6MN, 7CK, 9JO (Cocos Keeling), 9WA, 9TN, VU2CK, ZS3E, 4X4JU. **D. Griffiths** (Ilford), domestic receiver 6ft loaded whip, CR4, CR6, ET3, FO8, FP8, JA6, KP4, OD5, PJ2, PY2/SU, VE3/SU, TU2, VK9, VS9, XW8, YA1, ZS5, 4W2, 9M2.

Fifteen and Ten

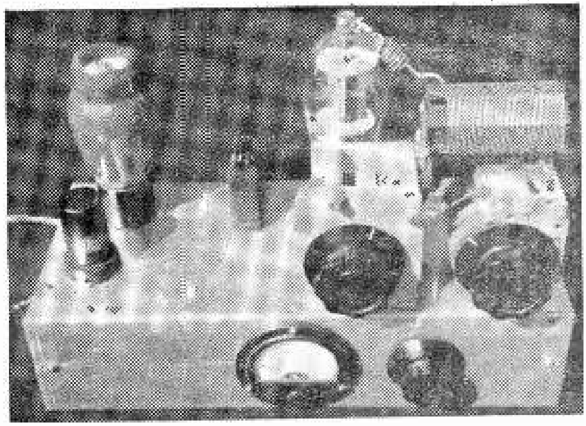
Nearly all 15m logs were from listeners already reporting on other bands. **B. Dale** raised PY2, ZS1, 2, 6, 5A1, 9G1, 9Q5, while **R. Iball** netted JA1, JA6, K1/AM, PY2/Ø, VS9, W5, ZD7, ZP5, ZS2, 4S7, 4W2, 9F3. **J. Fitzgerald** raked in CR6,

—continued on page 702

HAM FEATURE

A SIMPLE TWO-BAND PHONE TRANSMITTER

BY F. G. RAYER G3OGR



THIS transmitter was built as a standby for 160 and 80m band working and is of very simple design and construction. Very good results have been obtained and the transmitter can give a quite substantial radio frequency output, well modulated.

From the circuit, Fig. 1, it will be seen that a carbon microphone is used coupled to V1 by the transformer T1. To avoid a battery, microphone current is taken from the junction of R4 and R5. Three different carbon microphones were tried with this circuit and all were satisfactory. A 6L6 acts as modulator and can easily give adequate modulation with an input of about 8 to 12W to V3. T2 is a mains pentode speaker matching transformer of fairly generous size, the secondary being unused.

V3 has the output tank coil L2, which tunes to both 160 and 80m bands. It is thus only necessary to insert a 160 or 80m band crystal and tune up with VC1 and VC2 as described later.

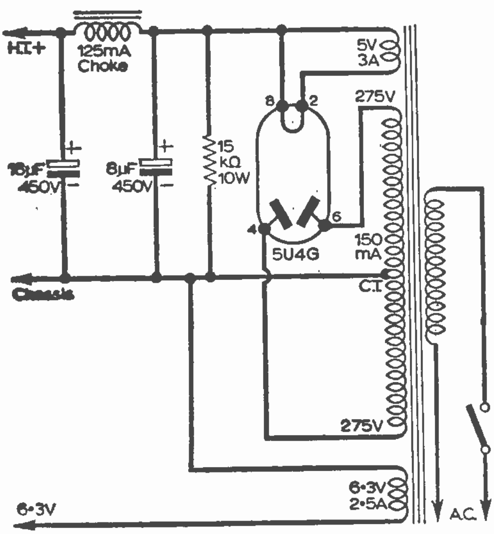


Fig. 1: Suitable power supply for the transmitter.

Transmit/receive switching is included by the three-pole two-way switch. Section A transfers the aerial from the transmitter to the receiver. Section B applies h.t. to the transmitter. Section C earths the receiver aerial circuit on transmit.

Construction is very simple, the meter being on the front chassis runner. The transmitter can be built largely from surplus or old receiver-type spares. It also lends itself readily to increasing its scope by fitting either a harmonic oscillator to drive the p.a. or by adding a v.f.o.

L1 and L2

L1 is an anti-parasitic choke consisting of six turns of 20 s.w.g. bare or enamelled wire about ⅜in. in diameter and ¾in. long. R7 is placed inside it and a *short* connection goes from L1 and R7 to the cap clip for V3.

L2 is wound with 22 s.w.g. tinned copper or enamelled wire on a 1½in. diameter smooth or ribbed former. There are 40 turns spaced to occupy 2¼in. winding length. Some variation in the diameter, length and wire gauge will be unimportant provided the coil is subsequently adjusted if this is necessary.

The anode tuning capacitor VC1 is a 500pF or similar air-spaced variable component and should not be a miniature type, which will have closely spaced plates. The spacing of VC2 is not important and it can be two-gang or three-gang. Sections are connected in parallel, so the total will be about 1,000pF for a two-gang capacitor and 1,500pF for a three-gang capacitor.

Chassis Dimensions

The exact layout is not likely to be very important but a 12 x 5in. chassis is convenient and parts can be located as in Fig. 2. The chassis is 3in. deep to accommodate the meter and T2.

The variable capacitors are bolted to the chassis with their feet or brackets added for this purpose. A bracket from VC1 supports L2. RFC2 stands vertically, a well-insulated lead passing down through the chassis to meter negative.

Fig. 3 shows wiring and components under the chassis. All points MC are tags securely bolted down. Most leads can be run close against the chassis or its side to avoid unnecessary pick-up of r.f. The trimmer TC1 has one tag soldered to tag 3 of the 807 holder.

An adjustable washer cutter will do well to make the meter hole. A 100mA 2in. or similar meter is most suitable but a 50mA instrument could be used. If a more sensitive meter is to hand it can be shunted to read 0-100mA. If a 1mA meter is to read 100mA divide the meter resistance by 99 to find the shunt value. For a 5mA meter divide the meter resistance by 19 to find the shunt required. If the meter resistance is not known adjust the shunt until the wanted range is obtained as shown by comparison with a test meter.

The rear runner was of insulated material but any kind of insulated terminals or sockets will do for aerial or microphone connections. If a coaxial lead is to be used fit a coaxial socket to suit.

Power Supplies

Flexible leads run from the transmitter to the power pack. For easy connecting use black for chassis, red for h.t. positive and some other colour for the heater circuit. The heaters are left on while the equipment is in use in the customary manner. A suitable power pack circuit is shown in Fig. 4. An output of about 125mA at 275V will do very well.

A 250V pack can be used but there is some voltage drop in T2 and the p.a. anode voltage may then be around 220V or so. To avoid unnecessary loss of voltage T2 should be of quite low resistance. A small or midget transformer is not suitable here.

A power supply which can be pressed into service may be to hand. Lower voltages will naturally result in some drop in output for a given p.a. anode current.

Testing

It is recommended that a first test is made by connecting the aerial and earth terminals to a lampholder in which a 240V or similar 15W lamp is inserted. Close both VC1 and VC2 fully. A 160 or 80m band crystal should be placed in the crystal holder.

When the transmitter is switched on, immediately rotate VC1 until the meter shows a dip in anode current. This will be to a point where the meter indicates only a few milliamperes. To increase this current slowly open VC2, meanwhile retuning VC1 for minimum current. The minimum current or dip obtained with VC1 will become higher as VC2 is opened and the lamp should commence to light. Continue this until the

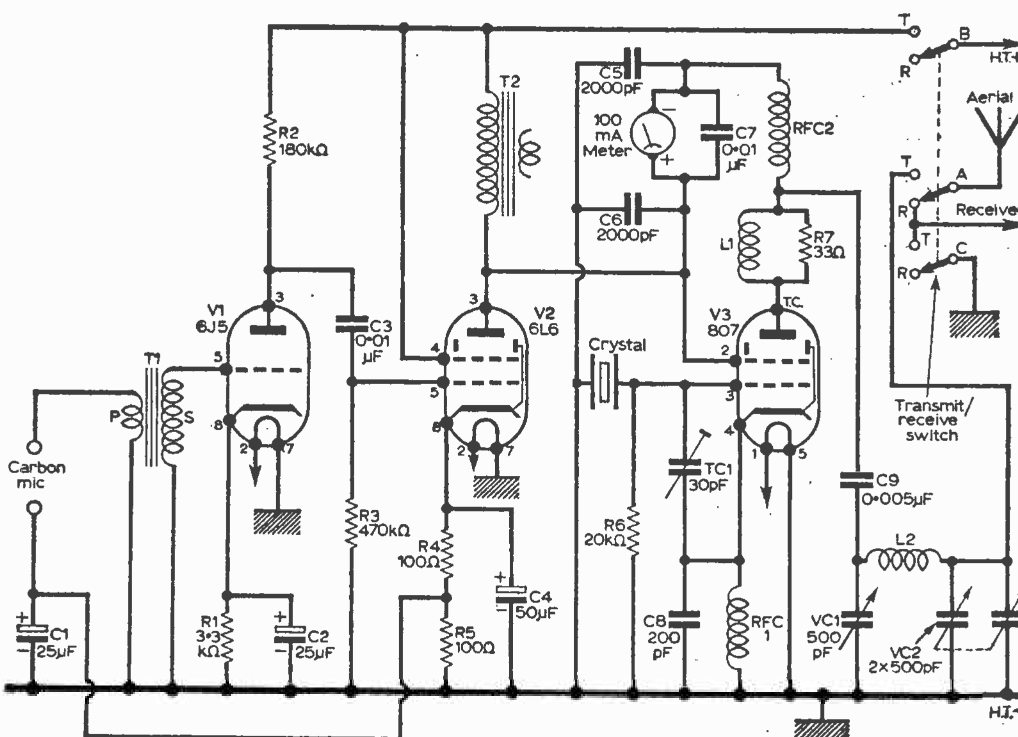


Fig. 2: Simple two-band phone transmitter circuit.

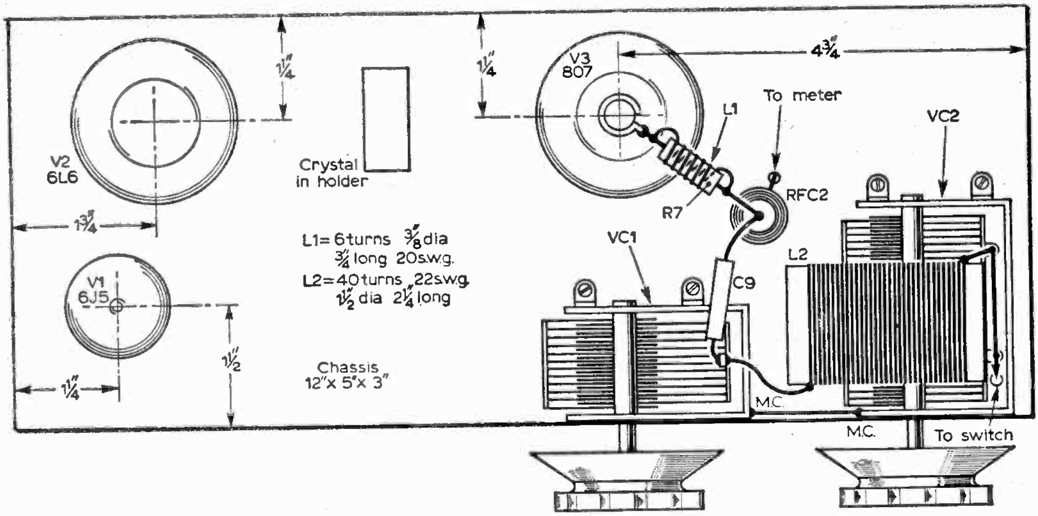


Fig. 3: Dimensions and positions of components.

required input, as shown by the meter, is obtained.

If 250V is available at the anode of V3 an input of 40mA corresponds to 10W and this must not be exceeded in the 160m band. At this input the 15W lamp should light quite brightly. An input of 10-12W can be used in the 80m band.

With 160m crystals it will be found that VC1 is almost fully closed. When 80m crystals are used VC1 is well open. For the 160m band the crystal frequency should be a little inside the 1·8Mc/s to 2Mc/s limits. For 80m the band is 3·5Mc/s to 3·8Mc/s but phone operation is usually in the 3·6Mc/s to 3·8Mc/s section. A check can be made of the anode voltage of V3 with the valve drawing the required current by applying the test meter prods to chassis and negative on the 100mA meter.

With the transmitter working into the lamp the carrier should be easily located with the station receiver. With the microphone connected speech should sound clear and strong on the receiver. Avoid strong feedback between the receiver loudspeaker and the transmitter microphone or howling will begin.

The voltage across R5 should suit most carbon mike inserts and similar carbon microphones. The microphone voltage can be reduced if necessary by reducing the value of R5. At the same time increase R4 so that R4 and R5 added together

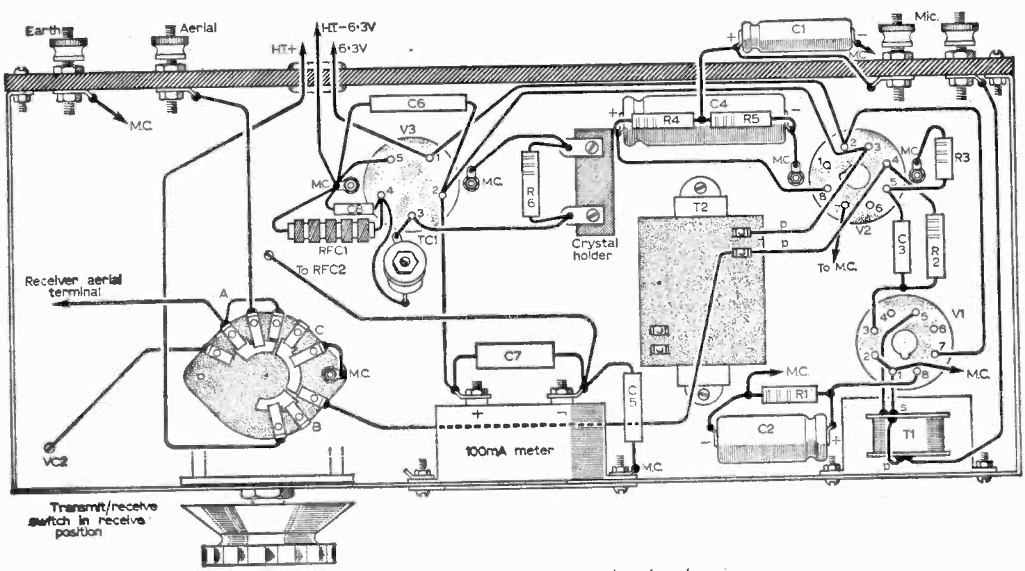


Fig. 4: Wiring and components under the chassis.

give a total of about 170 to 200Ω. Should a 200Ω potentiometer be to hand this is ideal as a substitute for R4 and R5. The microphone can be fed from the slider and the voltage can be adjusted to any value needed.

Should the microphone prove to be too sensitive this trouble can be removed by reducing the voltage. A low voltage also tends to reduce any hiss generated here.

Attempts to use too much audio will cause distortion which can be heard in the station receiver or confirmed by contacts. One advantage of the Class A modulator, as used here, is that audio distortion sets in instead of over-modulation of the carrier.

The setting of TC1 is not very important but a check should be made here while testing the transmitter. Initially TC1 can be about half open. Opening TC1 to near minimum will cause some loss of r.f. output, as shown by the lamp brilliance falling, or a reduction of aerial current.

Aerials

For two-band working with the same aerial an end-fed wire is popular. About 136ft is a good length to use. This will present a high-impedance load to the transmitter on 80m (half wave) and a low-impedance load on 160m (quarter wave).

The output circuit will also load into many other lengths but the feed impedance will be different, so that the tuning positions for VC1 and VC2 are changed.

If a tapped loading coil is used in series with the aerial or an aerial tuner is added the transmitter will operate into *any* length of wire from about 10ft. upwards. Adjusting the tappings on the loading coil allows an impedance to be reached which falls within the adjustment range of the transmitter output circuit.

In other cases, if the load is very low, a 1,000pF mica capacitor can be added across VC2. This is most likely to be wanted when operating the transmitter into a short aerial on 160m.

Good Earth Helpful

A good earth is generally helpful, especially with short aerials. Should the aerial be near a half-wave on the band in use the addition of the earth can result in very little difference in signal strength but when the aerial length is much less than a half-wave the earth resistance should be low.

If a 350mA r.f. meter or similar instrument is to hand this can be included in the aerial lead and readings can be noted. The current shown will largely depend on the aerial impedance and thus on the aerial length. However, once the readings are noted they will then show that the accustomed r.f. output is being obtained on future occasions. Should the aerial impedance be particularly low the 350mA meter should be replaced by one able to take a larger current. ■

COMPONENTS LIST

Capacitors:

C1	25μF 25V
C2	25μF 25V
C3	0·01μF mica
C4	50μF 50V
C5	2000pF mica or ceramic
C6	2000pF mica or ceramic
C7	0·01μF
C8	200pF mica or ceramic
C9	0·005μF mica
TC1	30pF beehive air-spaced
VC1	500pF variable (not miniature type)
VC2	2-gang or 3-gang 500pF each section

Resistors:

R1	3·3kΩ ½ watt	R5	100Ω 1 watt
R2	180kΩ ½ watt	R6	20kΩ 1 watt
R3	470kΩ ½ watt	R7	33Ω 1 watt
R4	100Ω 1 watt		

Miscellaneous:

V1 6J5 V2 6L6 V3 807

Two octal holders. UX5 holder. Crystal holder. 160m or 80m band crystals.

T1 Carbon mike transformer, about 1:50 ratio.

T2 100mA or similar 5kΩ primary output transformer.

3-pole 2-way wafer switch. 100mA meter. Chassis 12 x 5 x 3in. deep.

RFC1 2·5mH RFC.

RFC2 2·5mH 60mA RFC.

Three knobs. Terminals or socket strips, etc.

A TRANSISTORISED S.W. CONV

G A

THIS unit was first designed to enable a relatively young, inexperienced constructor to convert a fairly simple home-built medium-wave receiver to bring in the popular short-wave bands of 1·8-2·0Mc/s and 3·5-3·8Mc/s.

The design requirements were that the unit should be simple to build and that it should be easy to set up with the minimum of test instruments. Over-riding these considerations was the economic factor in that the converter had to be built for less than £1. The reader may judge for himself the success of the design in fulfilling these requirements when it is stated that the unit has been operating satisfactorily for the last 18 months and has left the builder with a surplus of 7s. 6d. on his original estimate.

A block diagram of the unit is shown in Fig. 1. Now, since the main receiver was tuneable only over the medium wave band, the r.f. output from the converter had to lie in the region 0·6-1·5Mc/s. This meant that the oscillator frequency had to be such that when it was beating with the incoming signal at r.f. the resultant i.f. signal was in this band.

For reasons of simplicity of construction and ease of alignment it was decided that the local oscillator would be crystal controlled. Since we are operating over two bands this might suggest that two crystals would be needed. However, in the present design we are lucky in that we can make one crystal do the work of two. If we make the oscillator run at 2·6Mc/s, then should we wish to tune an r.f. signal at 2·0Mc/s the i.f. output would be at 0·6Mc/s and similarly the i.f. output for a 1·8Mc/s signal the i.f. output will appear at 0·8Mc/s. Thus the band 1·8-2·0Mc/s can be covered easily by the broadcast receiver. If we now consider the 3·5 to 3·8Mc/s band we can see that, using the oscillator frequency of 2·6Mc/s, a signal will appear at the converter output in the range 0·9 to 1·2Mc/s. This is convenient for two reasons. It means that (1) we do not have to switch a pair of crystals and (2) almost the whole of the broadcast receiver scale is used in covering these two bands, so that there is no scale overlap and a smooth calibration over the scale may be used if this is thought necessary.

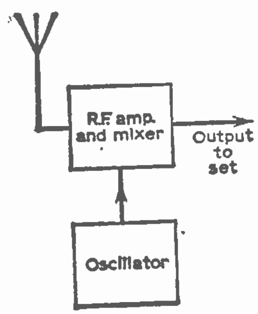


Fig. 1: Block diagram of the short-wave converter.

COMPONENTS LIST

Resistors:
R1 470kΩ

Capacitors:
C1 200pF
C2 5000pF
C3 330pF
VC1 365pF variable
VC2 100pF variable

Semiconductors:
Tr1 OC45
Tr2 OC44

L1, L2, L3, L4, L5, L6 — See coil table

Miscellaneous:
Xtal holder (to suit). S1 S.P.S.T. toggle. Printed circuit board. 9v battery, etc.

The Theoretical Circuit

The theoretical circuit of the converter is shown in Fig. 2. The oscillator section is designed around an OC45 (Tr1). The oscillator is crystal controlled. the crystal being placed between the base and collector of the transistor. The collector current of the OC45 is drawn through L3 which is tuned to the crystal frequency by C1. The purpose of C2 is to decouple the coil to earth thus reducing the possibility of unwanted feed-back and so enhancing stability.

The oscillator output is taken via L4 to the emitter of Tr2. Tr2 is an OC44 and serves the dual purpose of an r.f. amplifier and mixer, and. by virtue of the fact that it draws emitter current through L4, it is coupled to the oscillator section. The aerial is coupled by L2 to L1 which is tuned by VC2, the tuning capacitor. The tap on L1 is used to match the base input impedance of the transistor to that of the aerial coil. C3 is switched across L1 to provide the necessary tuning capacitance for the lower frequency band. The combined r.f. and local oscillator signals are in this way amplified and appear across L5. this winding being tuned by VC1 which is a "peaking" capacitor. L6 is used to couple the converter to the main set.

Construction

The construction of the circuit is fairly conventional and the circuit would appear to be reasonably tolerant as to layout since experience

RTER

has shown that the unit functions well under nearly all the possible configurations of the components.

The circuit of the original was built up on an "etched" circuit board—although more orthodox methods will be equally satisfactory. It is not proposed to go into the procedure of etching circuits as this has been dealt with in previous issues of this journal, suffice it to say that ample copper should be left on the board for connection purposes and the conducting strip should be well cleaned before the soldering operation. An outline template for the circuit board is shown in Fig. 3. As can be seen from the layout, no attempt has been made to miniaturise the circuit, but if the reader wishes to do so he may well find that the converter could be made much smaller and he might discover that the unit will fit inside the case of the basic receiver.

The crystal is of the standard type and this may be purchased for a few shillings at many surplus stores. It is, of course, not necessary to purchase a crystal which will resonate at the exact frequency specified as any frequency within the band, 2·5—2·65Mc/s will prove satisfactory. Of course, if the constructor is prepared to allow an overlap on the receiver scale then crystals of frequencies other than these may be used—provided that the final output is within the frequency coverage of the main set.

The coil winding details are given as Fig. 4.

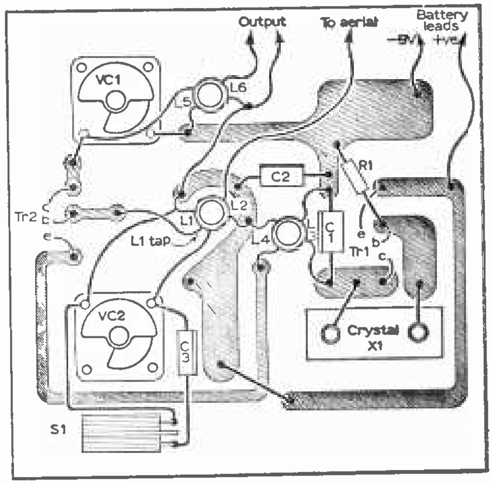


Fig. 3: Component layout on "etched circuit" board

The setting up and operation of the circuit is quite simple. Having connected a suitable power supply to the circuit a screened lead should be connected from L6 to the receiver and an aerial connected to the aerial socket on the converter. The core of L2 is then set so that the top of the core corresponds with the top of the coil winding and VC2 is then rotated until a signal is tuned in. The core of L3 is then adjusted for maximum response from the converter and VC1 rotated until the point of maximum response is found. It should now be possible to tune over the whole band—peaking where necessary with VC1. The gain over the whole coverage should be even with no sharp peaks or drops which cannot be levelled out by adjusting VC1. If this is not so, or if the whole of the band cannot be covered, then the core of L2 should be re-set and the operation repeated. When a satisfactory arrangement has been found the converter should be switched to the second band and the operation repeated.

It may well be that the optimum settings of the

—continued on page 722

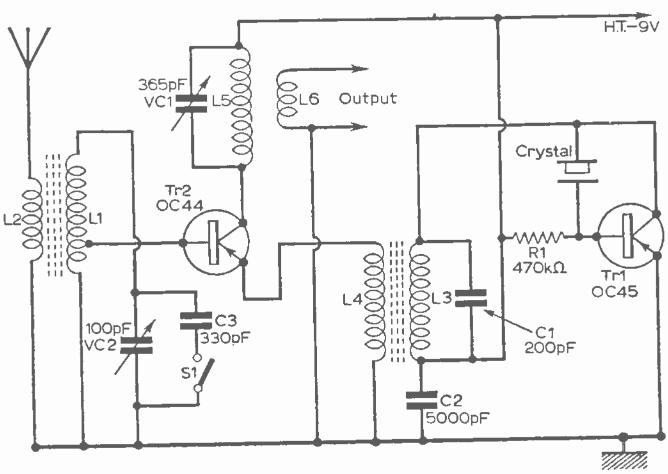


Fig. 2: The theoretical circuit.

CIRCUIT DISGUISES

BY R. LEYLAND

THERE is a simple way of looking at circuits that reduces much of their complexity. Many of the differences that exist between circuits are due to the way in which external connections are made to them and especially the manner in which the d.c. supplies are introduced.

Now, at a fundamental level, d.c. supplies do not form part of the circuit. Although the circuit usually draws most of its energy from a d.c. power source it is essentially concerned with signal waveforms, i.e. with alternating currents and voltages.

Many of the circuits that seem to bear no resemblance to each other are in fact alternative arrangements of some basic network. Circuit variations are not, of course, merely for the novelty. Different arrangements have their own particular applications but the ability to analyse and compare them gives one a valuable insight into their working.

Basic Circuits

We can penetrate circuit disguises by recognising that many of the components in the circuit are there merely to pass or to block direct currents. It is easy to distinguish these by their large values and by their positions from the components upon which the a.c. performance depends. If we redraw the circuit diagrams, leaving out these components, we can derive the basic a.c. circuits and in the process discover that some apparently unrelated circuits are equivalent. The only components retained, apart from valves or transistors, will be those concerned with tuning or with modifying the frequency response and waveform.

As a first step we omit the battery or d.c. supply and join together the positive and negative supply lines, for these are essentially the same when only a.c. conditions are considered, there being no alternating voltage between them. The next step is to remove any choke, leaving an open circuit, and to replace coupling and bypass capacitors with short-circuits, i.e. to bridge each of them with a direct connection. It will also be possible to remove some of the associated resistors whose function is to supply d.c. to the electrodes of the valve or transistor.

Each circuit can have at least three alternative forms according to whether the anode, grid or cathode is earthed. If the variations are to be strictly equivalent, however, they may require to have a floating input or output, which is not always feasible.

For instance, it can be mentioned briefly that the Miller integrator, used in oscilloscope sweep circuits, is equivalent to the cathode-follower charging circuit and also to the Bootstrap integrator, but neither of these alternative forms is as useful. In these circuits, incidentally, a direct voltage reference is needed which cannot be omitted from the circuit.

However, the switching circuit which produces the flyback converts this in effect to a step or impulse input, so it is not the same thing as a steady d.c. supply.

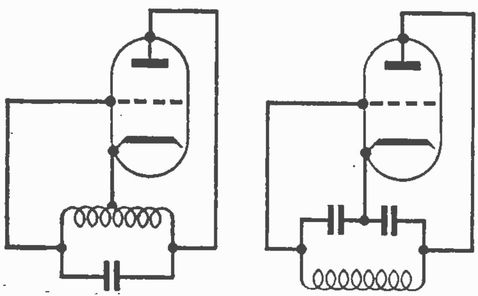
Tuned Oscillators

By applying these principles we can reduce various oscillator circuits to a very simple configuration (Fig. 1), the important point being that the emitter of a transistor or the cathode of a valve is connected to a tapping on the tuned circuit and this may be on either the inductive or the capacitive arm. There are, of course, many other types of tuned oscillators, some employing separate coupling coils, etc., but these will serve as examples.

The combination of a coil and capacitor to form a tuned circuit tends, through resonance, to maintain the oscillation at one particular frequency. Part of the tuned circuit is between the grid and cathode, and supplies an input to the valve. The output from the valve is to the part of the circuit that is between the anode and cathode and makes good the circuit losses, so maintaining the oscillation.

It is clear that the grid will receive an input waveform that is opposite in phase to that on the anode. Or we may say instead that the cathode input is in phase with the anode. The valve itself, of course, gives a corresponding phase reversal between grid and anode, so that the feedback is positive. There is no phase shift in the tuned circuit at the frequency of oscillation.

A step-down of voltage occurs from the output to the input and it is necessary to consider such factors as the relative impedance levels of the



(a) Hartley (b) Colpitts

Fig. 1: Basic tuned oscillators.

valve and tuned circuits and, with transistors, the low input impedance.

In some forms of Hartley Circuit the way in which it is usually drawn, with the cathode tapped up on the coil, tends to suggest that negative feedback is present, but reference to the basic circuit will show that only positive feedback is involved. It is, however, possible to add negative feedback to any of these circuits by including a resistor without a bypass capacitor in the cathode lead or in the emitter lead of a transistor, where it is of considerable assistance in controlling the performance.

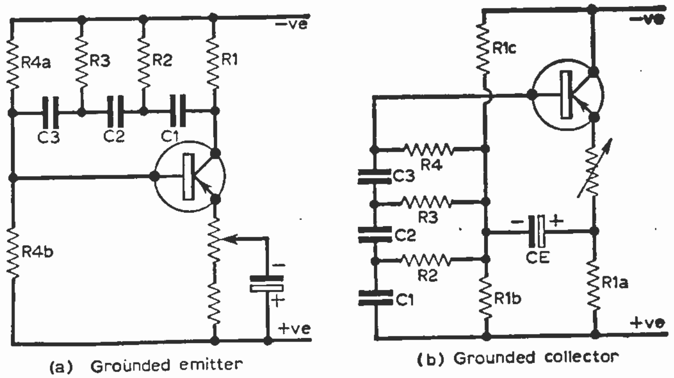


Fig. 2: Phase shift oscillators.

One point that emerges is that in oscillator circuits the point chosen for grounding is often merely a matter of convenience.

In amplifier stages, however, there are significant differences between the different configurations, involving interelectrode capacitances and also negative feedback, whose presence in a grounded emitter stage gives a more uniform high-frequency performance.

Phase-Shift Oscillators

Phase-shift oscillators employing a single transistor, as in Fig. 2, require a high-gain transistor because of the attentuation in the ladder network, and a high load resistance will probably make necessary a higher voltage supply than the usual 9V. It is, however, possible to use two transistors in sequence to obtain a higher gain.

The arrangement shown at Fig. 2a is the customary one and can be described as "grounded emitter". By separating the basic circuit, however, we can attempt to transform it into a grounded collector version.

As it was pointed out earlier, alternative arrangements are sometimes less satisfactory, requiring, for example, in a tuned oscillator the inclusion of chokes, or having the disadvantage that the moving vanes of a variable capacitor cannot be earthed.

However, in this instance of a phase-shift oscillator a grounded collector version can be devised as in Fig. 2b. Unusual as the new circuit looks it nevertheless works. Note the bootstrap arrangement (CE, R1b, R1c). This solves the problem of base current supply without shunting the ladder network. Resistance values will not be the same in the two circuits because the base is at a higher voltage in the grounded collector version.

The phase-shift oscillator produces its own input by rotating the voltage vector at the output through 180° by means of the ladder network. Owing to the attenuation the rotated vector is much smaller in magnitude.

An interesting aspect of the grounded collector version is that the small "rotated" output of the network is added on top of the emitter voltage, so that a resistance capacitance network is here being used to provide a small step-up in voltage. It is hardly necessary to add, however, that this arrangement will never replace transformers.

Another type of circuit that appears in a

—*continued on page 697*

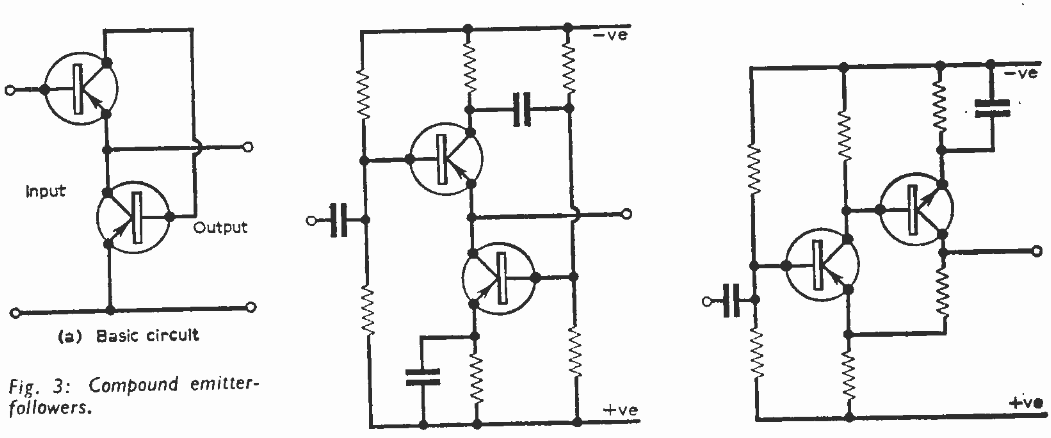


Fig. 3: Compound emitter-followers.

The Meaning of Amateur

RECENT visits to Amateur (Ham) radio stations have produced the surprising fact that a large majority appear to be using commercial equipment.

Surely the name "Amateur" means literally amateur as opposed to professional, yet a greater and greater number seem content to wear the amateur tag yet use professional gear.

It would be interesting to know why people do buy this very expensive equipment as opposed to "rolling their own". There are ample circuits in handbooks and magazines, and PRACTICAL WIRELESS has produced quite a few designs of its own.

A. Heathfield,
Harpenden,
Hertfordshire.

Good Old Octals

I HAVE read in PRACTICAL WIRELESS over the past few months, various people's views on the use of octal-based valves as opposed to B7G and B9A based types.

I am surprised that none of your correspondents has mentioned in his arguments one of the great advantages of octal-based valves, namely the fact that they make much better contact in their valve holders (providing they are not paxolin) than do B7G or B9A valves.

How many constructors can say that they have never had trouble arising from B7G and B9A valves making poor contact in their holders?

R. J. Lindsey.
Whittlesey,
Peterborough.

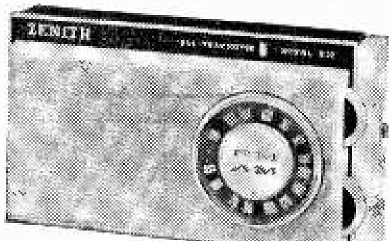
Radio Servicing

[I WOULD like to thank, collectively, all those readers who wrote in on the subject of articles dealing with servicing radio receivers, following the letter from Wm. G. Hall in the August issue of PRACTICAL WIRELESS. The response was quite surprising and, apart from one solitary dissenter, unanimous in support of the idea.

Accordingly, I am now arranging for a series of articles to be prepared by specialist contributors, all with considerable professional experience behind them, and it is hoped to make an early announcement on this special series in the next issue.—Editor]

NEWS AND...

ZENITH AM/FM RECEIVER



United Mercantile Co. Ltd., distributors of Zenith radio equipment announce the Royal 810 personal-size f.m./a.m. portable transistor radio.

The Royal 810 has thirteen tuned circuits, eight of these on f.m. and five on a.m., a broadband r.f. stage for greater f.m. sensitivity, precision Vernier tuning and full quarter-wave telescoping f.m. aerial.

A socket is provided on the set for an external power supply which is available at extra cost. Dimensions are 3·6in. x 6·5in. x 1·9in. and the price is £34 16s. 3d.

PRACTICAL WIRELESS FILMSHOW

The date of Friday, 4th February, has been fixed for the "Practical Wireless" and "Practical Television" Filmshow. Two films will be shown. For further information, see next month's "Practical Wireless".

OSCILLOSCOPE FROM ADVANCE

The OS15 oscilloscope is aimed particularly at the educational field and for general purpose use in industrial applications. It has been designed for simplicity of operation and ease of servicing.

As the OS15 is most suited to educational needs, Advance are offering it as a special price to educational establishments.

Servicing is simplified because only one type of valve is used throughout and the majority of components are mounted on a single printed circuit board.

The OS15 features a bright, clear display on a 5in. helical PDA tube, the display area being 8cm x 10cm.

The total bandwidth of the vertical amplifier extends from d.c. to 3Mc/s with a sensitivity of 100mV/cm and the timebase from 1sec/cm to 0·5μsec/cm, using switched and continuous controls. The latter control (X gain) provides an expanded trace of up to two screen diameters along the X axis. Any part of the expanded trace can be viewed at the centre of the screen. Calibration accuracy is typically 5% in both axes.

Triggering facilities are fully comprehensive from either internal or external sources, including the triggering of the timebase from frame pulses of a composite TV waveform (TV mode).

The OS15 is contained in a metal case, covered in a blue grained PVC. Measuring 10⅞in. high x 8¾in. wide x 16¼in. deep, the instrument weighs 18¾lbs.

The ex-works price is £55, or £49 10s. to educational establishments.

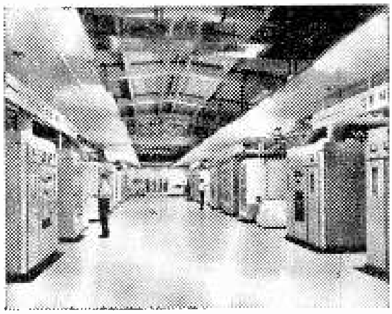
GPO RADIOTELEPHONES A SUCCESS

By the end of the first eleven weeks of operation of the London two-way v.h.f. Radiophone System, some 255 motorists had placed firm orders for installations.

The capacity for the system at present is about 350, although this figure is subject to some revision. The "busy period" varies from week to week but tends to be from 9 a.m. to 1 p.m., with the calls averaging about 18 an hour.

..COMMENT

MARCONI EQUIP VOICE OF AMERICA



The photograph shows the impressive main transmitting hall of the "Voice of America" relay station at Woofferton in Shropshire, England. Six of the largest Marconi high power short wave sound broadcasting transmitters are now in operation providing a total of 1½ Megawatts o, h.f. power.

This power is effectively doubled by an advanced modulation technique used on each transmitter. This technique, which is known as trapezoidal modulation, is new in its application to broadcast transmitters. It allows the signals to overcome heavy interference and gives an intelligibility at the receiving end equivalent to a conventional transmitter of more than double the power.

The transmitters, type B6122 radiate 250kW and are mounted three on each side of the hall. They are housed in free standing cubicles which may be moved, providing considerable flexibility in station layout. They can operate in the frequency range from 5·95 to 26·1Mc/s.

HOME OFFICE ORDERS 600 MORE PACKSETS

Six hundred Packsets for use by British Police Forces and Fire Services have been ordered by the Home Office from the Telecommunications Division of Ultra Electronics Limited.

This is the third successive year in which Packsets have been ordered in quantity by the Home Office. By the time that deliveries have been completed, there will be more than 2,000 in Police and Fire Service use.

The Ultra 3A4 Packset, weighing less than 3lbs., forms part of the "Vigilant" range of communications equipment. It operates in communications bands up to 179Mc/s, with provision for a maximum of three channels. Battery life is up to eight hours between charges, and the operational range is up to five miles.

MARCONI DOPPLER IN QUANTAS 707 AIRCRAFT

A major export order, worth approximately £A500,000, is announced for Marconi Doppler Navigation systems and airborne navigation computers to be fitted in the entire Qantas Airways fleet of Boeing 707 aircraft.

The photograph shows a Qantas captain setting up a new track angle on the display unit of the navigation computer, installed in one of the Qantas aircraft.

Track angle and distance-to-go can be set up for two successive legs of a flight. The position of the aircraft on the appropriate leg is then indicated by the "across track error" in nautical miles to the left or right of the selected track, and by the distance remaining to be flown along the track. This distance runs down automatically as the flight progresses. In automatic operation, the computer changes onto the next leg of a flight as the distance-to-go reaches zero.

Correspondents Wanted

I WOULD like to hear from P.W. readers in Great Britain or in any other country who are owners of "Gramdeck" recording equipment. I am 18 years old.

Henry Raymond.
Duchess of Kent Hospital,
Sandakan,
Sabah,
Malaysia.

I AM interested in communicating with radio fans the world over, especially the United Kingdom. I am a Detective Constable and interested in radio experimenting.

David Jack.
Caroni Police Station,
Trinidad, W.I.

I would like to correspond with any SWL or constructor of my own age, in any foreign country. I am 16 years old and very interested in transistor circuits and SWL.

David Hendon.
Copthorne,
Wix Hill, West Horsley,
Surrey.

I AM interested in short wave listening and electronics in general. I would like to correspond with anyone who shares these interests and who is of my own age (12).

Malcolm Beet.
17 Firs Avenue,
Alfreton,
Derbyshire.

I WOULD like to correspond with any radio servicemen from any country as I am interested in radio/TV service technology. I will promptly answer any letter received.

M. J. Solanki.
P.O. Box 66,
Kitale,
Kenya Republic,
East Africa.

I WOULD like to tapespond with anyone of my own age (15) from any country, who shares the interests of SWL and radio construction of all kinds. I have a Cossor 4-track 3¾ i.p.s. Maximum spool size 5¾ in.

Anthony Jones.
73 Newfield Drive,
Crewe,
Cheshire.

TAPE RECORDER

Conversion to Four Tracks

THE four-track recorder, since its introduction some years ago, has achieved a great popularity, due to its economy, attained without any noticeable loss in performance compared with corresponding two-track types. Probably many others besides the writer considered the possibility of converting their two-track machines to four tracks. but one hesitates to begin what may be extensive modifications to an expensive piece of equipment if successful results are uncertain. The writer approached the task with this attitude and found it much simpler than expected. Perhaps others will be encouraged to follow.

The first difficulty was to obtain a good pair of four-track heads, because, as the reader is no doubt aware, two heads are used in the vast majority of tape recorders (cheap battery imports are an exception, but it is not worth while converting these). It is obviously preferable to employ heads such as are used by the manufacturer in the four-track version of the tape deck to be converted, but this may be impossible or too expensive. The writer achieved satisfactory results on a

By A. J. McEvoy, B.Sc.

Collaro "Studio" deck using a surplus set of heads available from Lasky's Radio at £2 19s. 6d. Conversion can now begin.

If the manufacturer's heads are to be used, it is likely that no changes to the mountings are required; they will fit into the space vacated by the old heads. However, some metalwork may be necessary if heads of a different make or model are to be used, but usually, as in the case of the writer's machine, this will be limited to drilling new bolt holes. The chief difficulty in mounting the heads is to ensure proper positioning with respect to the tape as it passes them, so that there will be no "crosstalk" between right-going and left-going tracks. To simplify this procedure it is advantageous if the two new heads are mounted on a common mounting plate, or can be mounted on the plate used for the old heads.

The width of the tape is divided into four strips for recording purposes, and the first and third

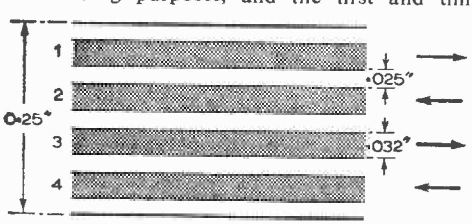


Fig. 1: Specified spacing of 4-track recording.

counting from the top must correspond with the gaps in the heads. These gaps can be seen as fine short lines on the faces of the heads. If, as was the case with the heads used by the writer, both heads are rigidly mounted on a plate by the manufacturer, this adjustment is made by setting the level of the mounting plate; otherwise the heads must be adjusted individually. The most convenient way, if no proprietary mounting adjustment is supplied on the recorder, is to obtain a number of thin fibre washers and place these on the bolts securing the mounting plate or the individual heads to the deck of the machine until the top of the gap on the erase head is level with the top of the tape. The correct level will later be reached by tightening the bolts and compressing the washers. The heads must be mounted so that when the tape is being rewound it is not in contact with the heads, since rapid wear would result. For recording or replaying the tape is brought into contact with both heads by pressure pads linked to the switching mechanism.

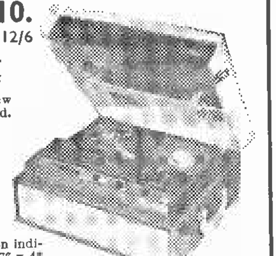
At this stage the new heads are connected to the electrical circuitry of the recorder. The connections to the old heads are removed, after taking careful note of where the wires lead. The new circuitry is shown in Fig. 3, a two-pole two-way switch being used for track selection. The erase head, which is easily identified by its wider gaps, its lower impedance, and the fact that it is mounted to the left of the record head in a pre-mounted pair (so that, in operation, an old programme is erased before a new one is recorded, as the tape moves from left to right) is wired first. Any thin insulated wire is satisfactory, such as that used for earphones.

Of the four terminals appearing at the rear of the head, those for the different tracks can easily be distinguished by their grouping. One from each track are joined directly to the erase signal source; the other pair go to the switch, the slider of which will then complete the erase circuit through one or the other. The wiring for the recording head is similar, but here lightweight screened cable must be used and leads kept short in order to minimise hum. The switch may be mounted at any convenient place on the recorder; in this instance the writer soldered it to the casing of the heads after their final adjustment.

The recorder may now be switched on and tested, preferably using a tape pre-recorded on a commercial four-track machine; this will ensure that the standard track positioning is attained. On replay the material recorded on one track should be audible, and moving the track switch should bring in a different recording. If there is "cross-talk" or mixing of the material on different tracks, or the sound reproduced is totally unintelligible, indicating that material recorded on one of the

26½gn TAPE RECORDER for ONLY £19.10.

carr 12/6

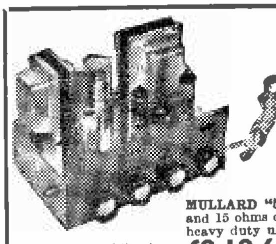


Bargain of the Year Offer -Cancelled Export Contract

Famous manufacturers brand new unused and factory tested 2 speed. 3¾ and 7½ i.p.s. twin track tape recorder 3 Watt output. Tape position Rev.-counter, fast forward and rew'nd. take 7" reels, mike and gram input. Straight through amplifier facilities. Output sockets for ext. speaker, monitor or external amplifier Super-imposed switching magic eye recording level and mains neon indicator. Volume and tone controls 7" x 4" speaker. Attractively styled cabinet with detachable lid mike and reel storage facilities. A.C. 200/250 volts operation. Complete with crystal mike. tape spare reel and screen lead etc.

MULLARD "3-3" & "5-10" HI-FI AMPLIFIERS

3 ohm & 15 ohm output



"3-3" Amp. 3 valve, 3 watt hi-fi quality at reasonable cost. Bass Boost and treble controls quality sectional output transformer, 40 c/s-25 kc/s + 1 dB, 100mV for 3W, less than 1% distortion. Bronze escutcheon panel. Complete Kit only £6.19.6. Carr. 5/-. Wired and tested £8.10.0.

MULLARD "5-10" AMPLIFIER. 5 valves 10W 3 and 15 ohms output. Mullard's famous circuit with heavy duty ultra-linear quality output transformer

Basic amplifier kit price **£9.19.6** Carr. and Ins. 7/6.
Ready built 11½ gns.

CONTROL PANEL KIT. Bass. Treble and Volume controls with 4-position selector switch for radio tape and 11in. x 4in. escutcheon panel.
AMPLIFIER KIT AND CONTROL PANEL KIT, £11.19.6. Ditto, really wired. £14.19.6.
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TAPE REELS. Mnfrs. surplus 7", 2/3; 5¾", 2/-; 5". 2/-; 3", 1/3; spool containers. 3", 1/6; 5", 1/9; 5¾", 2/-; 7". 2/3.

Alumin. Chassis. 18g. Plain Undrilled, folded 4 sides, 2" deep, 6" x 4", 4/6; 8" x 6", 5/9; 10" x 7", 6/9; 12" x 6", 7/6; 12" x 8", 8/-, etc.
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Jack Plugs. Standard 2½" Igranic Type, 2/6. Screened Ditto, 3/3. Miniature scr. 1¾", 2/3. Sub-min. 1/3.
Soldering Irons. Mains 200/220V or 230/250V. Solon 25W Inst., 24/6. Spare Elements. 5/6. Bits, 1/3. 65W. 29/6. etc.

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Incorporating 4 Sp. Garr rd Auto-Slim unit and Mullard latest 3 watt printed circuit amplifier (ECL 86 and EZ 80), vol., bass and treble controls, with 8" x 5" 10,000 line speaker. Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue-relief. Size 17¼" x 16" x 8". A stylish unit capable of quality reproduction. Circuit and const. details 2/6 (free with kit).
COMPLETE KIT £13.19.6
Carr. and ins. 12/6 Ready wired 30/- extra.
Illuminated perspex control panel escutcheon, 7/6 extra. Four contemporary mounting legs 6in. 10/6; 9in. 11/6; 12in. 12/6 extra.

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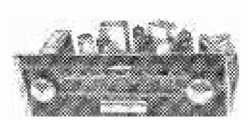
Condensers 150 v. working: .01 mFd., .02 mFd., .03 mFd., .04 mFd. 9d; .05 mFd., .1 mFd., 1/-; .25 mFd., 1/3; .5 mFd., 1/6, etc.
Midget Tuning Condensers. J.B. "OO" 208 pF and 176 pF, 8/6. ditto with trimmers, 9/6. J.B. 220 pF and 105 pF conc. slow motion 10/6. 365pF single 7/6. Sub. min. ¾in. Dilemin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

Phono Plugs, 9d Phono Sockets (open) 9d. Ditto (closed). 1/-. Twin Phono Sockets (open). 1/3.

6 VALVE AM-FM TUNER UNIT



Med. and VHF 190m-550m, 86 Mc/s-103 Mc/s, 6 valves and metal rectifier. Self-contained power unit. A.C. 200/250V operation. Magic-eye indicator, 3 push-button controls, on/off. Med., VHF. Diodes and high output Sockets with gain control. Illuminated 2-colour perspex dial 11½"x4", chassis size 11⅝" x 4" x 5¼".

A recommended Fidelity Unit for use with Mullard "3-3" or "5-10" Amplifiers. Now available as complete kit as illustrated, inc. power unit. Carriage 7/6.
Ditto, but less power unit, £9.19.6.
Circuit and construction details, 4/6, free with kit.

£10.19.6 carriage 7/6.

Condensers—Silver Mica. All values 2pF to 1,000pF. 6d. each. Ditto Ceramics 9d. Tub. 450V T.C.C. etc. 0.001 mFd to 0.01 and 0.1/350V.. 9d. 0.02-0.1/500V.. 1/-. 0.25 Hunts 1/6, 0.5 T.C.C. 1/9, etc., etc. Close Tol. S/Micas—10% 5pF-500 pF 8d. 600-5,000pF. 1/-. 1% 2pF-100pF. 9d. 100pF-500pF, 11d. 575pF, 5,000pF. 1/6. **Resistors**—Full Range 10 ohms-10 meg, ohms 20% ¼ and ½W, 3d., ¾W, 5d. (Midget type modern rating) 1W, 6d., 2W, 9d. Hi-Stab. 5% ¼W, ½W, 6d. (100 ohms-1 meg). Other values 9d. 1% ½W. 1/6 etc., etc.

Volume Controls—5K-2 Meg. ohms. 3in. Spindles. Morganite Midget Type 1⅛in. diam. Guar. 1 year. LOG or LIN. ratios less Sw. 3/-. DP. Sw. 4/6, Twin Stereo less Sw 7/6 100k to 2M ohms with DP Sw. 9/6.
WAVECHANGE SWITCHES. 1 p. 12-way 2 p. 2-way, 2 p. 6-way, 3 p. 4-way, 4 p. 2-way, 4 p. 3-way, long spindle, 3/6 ea.

EXPANDED ANODISED METAL. Attractive gilt finish ½in. x ⅛in. diamond mesh 4/6 sq. ft. Multiples of 6in. cut. Max. size 4ft. x 3ft., 47/6. plus carr. Do., finer pattern mesh 4/6 sq. ft., multiples of 12in.. max. size 3 ft. x 2 ft., 27/6 sheet.

ENAMELLED COPPER WIRE—½lb. reels 14g-20g, 3/-; 22g-28g, 3/6; 36g-38g, 4/9; 39g-40g, 5/-, etc.

JASON FM TUNER UNITS. Designer-approved kit of parts. **FMT1,** 5 gns. 4 valves, 20/-. **FMT2,** £7.10.0. 5 valves, 35/-. **JTV MERCURY** 10 gns. 3 valves. 22/6. **JTV2** £13.19.6. 4 valves, 28/6. **NEW JASON FM HANDBOOK,** 2/6. 48 hr. Alignment Service 7/6. P. & P. 2/6.

TRIMMERS. Ceramic (Compression Type)—30pF, 50pF, 70pF, 9d.; 100pF/150pF, 1/3; 250pF, 1/6; 600pF, 1/9. **PHILLIPS.** Bee Hive Type (conc. air-spaced)—2-8pF, 1/-; 3-30pF, 1/-. **KNOBS**—Modern Continental types Brown or Ivory with Gold Centre; 1" dia.. 9d. each; 1¾", 1/- each; Conc. knobs ivory with Gold Centre 1¾" dia, 2/9 per pair. Matching ditto 2/6 ea.
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METAL RECTIFIERS. STC Types—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

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

7 VALVE AM/FM RADIOGRAM CHASSIS

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Vertical pointer. Horizontal station names. **Gold on brown background.** A.C. 200/250v. operation. Magic-eye tuning. **Circuit diagram now available.** Aligned and tested ready for use £13.19.6. Carr. & Ins. 7/6.
Comp. with Tape. O P socket, ext. sp'k'r and P/U sockets and Indoor F.M. aerial and 4 knobs—walnut or ivory to choice. 3Ω P.M. Speaker only required. Recommended Quality Speakers 10" Rola, 27/6. 13¼" x 8" E.M.I. Fidelity. 37/6. 12" R.A. with conc. Tweeter, 42/6. Carr. 2/6.

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TYGAN FRET or Vynair. 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/-, etc.

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alternate pair of tracks is being picked up, it follows that the preliminary setting of the heads described above was insufficiently accurate, and should be re-examined. Otherwise, the proper setting can now be found by tightening the mounting bolts until maximum volume is achieved. If the heads are fixed by the manufacturer to the mounting plate, both heads will now be correct; otherwise the erase head must be adjusted for optimum performance in a similar manner. Since its gaps are longer, adjustment is less critical, but care must be taken lest adjacent tracks be partially erased when it is operating.

This completes the mechanical aspects of the conversion.

The amplifier of the recorder will have been designed with a frequency response such as would correct reproduction to C.C.I.R. standards using the old heads; there will therefore be some discrepancy when the new heads are in use. However, it is not likely to be worth the constructor's time to attempt to change the time constants in the correction network; to calculate the changes would require more details of both heads and amplifier than are likely to be available and the effects of experimental changes are barely noticeable. The tone control easily compensates for the new conditions. The enthusiast may, however, wish to obtain a little more gain, since the signal picked up by the smaller quarter-width gap might not load the amplifier fully. Fig. 2 shows a circuit found suitable by the writer.

Operation is fairly straightforward. The transistor used in a common emitter configuration must be an n-p-n type, since the collector is to be positive with respect to the emitter. The valve to which the modification is to be applied is any of the low-level amplifiers in the early stages where the signal is still small and the current in the valve low. The writer applied it to half of an ECC83 double triode which was biased to draw 0·5mA, a very suitable current for the transistor in series. The constructor must remember points like these if he wishes to apply this circuit to other types of valves.

C2 is the by-pass capacitor already in use with the valve. It now acts also as a smoother to supply the transistor circuit with an even d.c. The output of the transistor appears across R2 and is

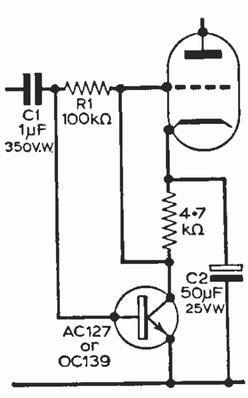


Fig. 2: The Pre-amplifier circuit used by the author to obtain extra gain from low input signals.

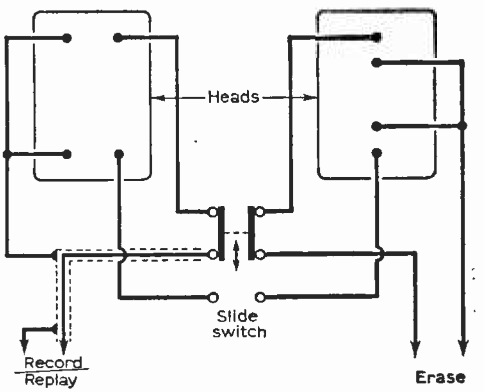


Fig. 3: Wiring of the track selection switch.

direct coupled to the grid of the valve. R2 also provides the grid bias of the valve, while R1 provides base bias for Tr1. The usual potentiometer biasing system is not required to maintain thermal stability, since the valve limits the current; if the current in Tr1 were to increase due to thermal effects the potential across R2 would also increase; as a result the grid of the valve becomes more negative with respect to the cathode, decreasing the current passed.

All other systems in the tape recorder remain unchanged. Modification to the four-track system is not therefore such an expensive, difficult or time-consuming task as the writer at first feared and the cost will soon be reclaimed in increased utilisation of his tapes. He is sure others will have the same success. ■

CIRCUIT DISGUISES

—continued from page 691

number of variations is the compound emitter follower (Fig. 3) which uses negative feedback from a second transistor to lower the output impedance and raise the input impedance. The arrangement of Fig. 3b is applicable with either valves or transistors but that of Fig. 3c uses a conjunction of p-n-p and n-p-n transistors and there is no corresponding circuit with valves.

There is no fundamental difference between the action in a circuit of n-p-n and p-n-p transistors. The phase relationships are the same and it is merely a question of d.c. polarities and consequent suitability for direct interconnection.

It should be noted therefore that n-p-n and p-n-p transistors in Fig. 3c can be interchanged if the negative and positive supply lines are interchanged at the same time. This literally turns the circuit upside down.

By inserting a resistor in the collector circuit of the second transistor it is possible to obtain some amplification without phase reversal and this arrangement can be used successfully in a Wien bridge oscillator.

TAPE TAPE TAPE TERMINOLOGY TAPE

PART FIVE

by H. W. Hellyer

SPOOL

Reel on which the tape is wound. Although not completely standardised, spool diameters fall within fairly well defined limits: for portables 3in. to 3¼in., for domestic machines, table models, 5in., 5¾in., 7in., and for professional models 8¼in. and the N.A.B. standard 10½in.

Spool shapes vary greatly with various patented hub-locking and tape-fixing methods (see also Hub-Lock).

SPOOL DRIVE

Method of tape drive which dispenses with capstan and pinch roller and depends on winding action of take-up spool. Disadvantage is that the speed varies with the diameter of the winding spool, i.e. the amount of tape wound on. This prevents the interchange of tapes between machines.

STANDARDS

See also Equalisation. Standards relate to equalisation of record and replay response to allow for non-linear characteristics of the medium. The European standard is laid down by the Comite Consultatif International Radio (CCIR) and the American standard by the National Association of Radio and Television Broadcasters (NARTB or NAB).

The aim is to provide a guide for machines and tapes whereby any tape made on any machine can be replayed on any other machine with no loss of quality which would occur by an alteration of the frequency response curve.

This curve is obtained by calculating the output voltage from an assumed perfect head with an infinitely narrow gap over the expected range of frequencies.

If the output thus derived is fed into a time-constant combination of capacitor and resistance —at one particular frequency the impedance of the capacitor will equal the resistance—and the straight-line graph of the loss-free head plotted to intersect the measured curve, an asymptote can be drawn to intersect the curve 3dB down to give a "turnover frequency".

This gives us the recording characteristic and a replay chain has to be designed to compensate for the slope of the curve and produce an output which is a replica of the original sound.

The standard can be defined by the time-constant of the combination: thus for a speed of 7½in./sec. the original standard was 100μsec with a turnover frequency of 1·6kc/s. With improvements in record/playback heads and materials it has been possible to revise standards and these have a shorter time-constant.

At 7½in./sec. the 70μsec standard is now used and for 3¾in./sec. the standard has been reduced from 200 to 140μsec. The turnover frequency is related to the time-constant in the following way: $F_t = 160CR$ where F_t is the turnover frequency in kilocycles and CR is the time-constant in microseconds.

In practice there is a 6dB-per-octave rise in the curve from a playback head reproducing the signal of a constant recording, as in Fig. 17a, which requires an amplifier with a response as in Fig. 17b to obtain an output reasonably flat up to and beyond the turnover frequency as in Fig. 17c.

This is done in several ways, a typical feedback circuit with selected component changes for different speeds being illustrated, Fig. 18. For example, at 3¾in./sec. $CR = 1{\cdot}2M \times 180pf = 216\mu sec$ with a turnover frequency a little above 800c/s.

STACKED HEADS

Two or more gapped heads with gaps disposed vertically one above the other. Used for stereo recording and replay.

STEREO RECORD AND PLAY

Two-channel method using two separate amplifiers and either a stacked half-track head or the two tracks of a quarter-track head. A four-track machine can be adapted for stereo replay by the addition of a separate amplifier channel but recording needs the provision of a bias and erase oscillator also for the second track.

Stereo records are made in quarter or half track. Replay of half-track stereo on four-track machines is not effective owing to track spacing —(see Tracks)—although half-track mono recordings are usually able to be replayed quite well.

STOP FOIL

Strip of metallised tape spliced as leader or interval section in a tape for use as automatic stop or tape reversal contact.

STORAGE

Tape should be stored in conditions of even temperature and humidity and not spooled too tightly. In conditions of high temperature and low humidity tape becomes brittle. When again subjected to normal humidity the tape will tend to

Sheet Paxolin

Ideal for transistor projects
Special offer
12 panels 5 x 8in. 5/-.

Bargain of the Year

A complete kit of parts to build 6 transistor/2 wave superhet receiver at only 39/6. Post and Ins. 3/6.

"CORONET" Mk. IV

It fully covers the medium waveband and that part of the long waveband to bring in B.B.C. Light. The circuit includes a highly efficient slab aerial and 2½in. P.M. speaker. Overall size approximately 4½ x 2¼ x 1¼in. Supplied complete with carrying case and instructions.

MAINS POWER PACK

Designed to operate transistor sets and amplifiers Adjustable output 6v—9 to 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1-PP3-PP4-PP6-PP7-PP9 and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor, 5000 and 500 mfd condensers, zener diode and instructions. Real snip at only 14/6 plus 3/- post.

This Months' new Bargains

Indicating Unit Type ME. This is in a metal case size 8½ x 8 x 9 approx. The front panel has magic eye, two "adjust" controls and on/off switch and there is an open space size approx. 6½ x 4 in which a paxolin panel could be fitted. Internally there is a complete Mains Power Pack on a separate panel, the transformer is for 230/240 main input, it gives 350-0-350 H.T. 6.3 & 5v L.T. The Power Pack is complete with 5z4 rectifier, choke and smoothing condensers:—in addition there is a magic eye and 4 E.F. 50 valves with all ancillary components. We don't know what the unit was originally intended for, but it could very easily be turned into a valve Voltmeter, Capacity bridge, electronic megometer, etc., etc., at 27/6 plus 7/6 post, which is less than the price of the transformer alone.

Gram or Tape Motor. Made by Garrard for their best Changers, each one "LAB" balanced. Offered size 2¼ x 3 x 2. regret only 110v available. Offered at 12/6 plus 2/9 post.

Beethoven Coil Pack. Covers medium wave and two shorts (regret exact coverage not known) uses 6 coils, 6 trimmers and 4 pole wave change switch and it's aligned ready for use. 7/6 plus 2/6 post.

Wall Mounting Thermostat. By Satchwell intended for use to control tubular or any type of space heaters indoors or in a greenhouse—Adjustable over 40/80 deg. Complete with mounting screws 29/6. plus post 2/9 (normal price is at least twice this).

Morganite Sealed Pots. Another batch of these has arrived and we can now offer quite a range namely: 5K. 50K. 100K. 250K. ½ meg. 1 meg. 2 meg. all at 6/- per dozen per value. plus 2/9 post on first dozen. then 1/- per dozen. Less than one dozen price is 9d each, even this is only about one-tenth of the catalogue price and this is undoubtedly one of the best pots available.

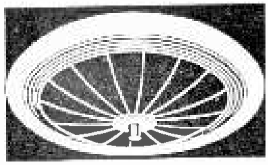
Tuning Condensers. 2 gang .0005 mFd air spaced standard size with good length spindle 30/- doz. or 3/9 each, post 2/9 up to six, 3/6 per dozen.

Tuning Condenser. Bakelite type .0005 mFd for tuning or reaction, ¼ inch splindle 25/- per doz. or 3/- each, post 2/9 per doz.

OZONE OUTFIT—for removing smells and generally improving any oppressive atmosphere. Kit consists of Philips Ozone Lamp and mains unit, only needs box. 19/6 plus 3/6 postage and insurance.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/9.

CIRCLE-LITE



Brings sunshine into your home. 150 watts of light but uses only 40 watts. Beautiful fittings with glass, not plastic centre, fluorescent tube and choke control. Made by Philips. Will give a lifetime of service. Regular price £4.15.0.

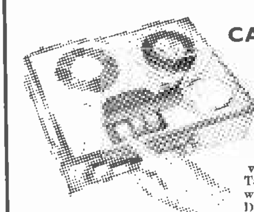
Special Bargain Price **65/-** plus 8/6 carriage and insurance. Please state colour of glass centre white, pink, blue, red, black, yellow or cream. Also whether plug into lamp holder or ceiling. mounting model 80 watt model 99/6.

AIRCRAFT RADIO RECEIVER

Type CW 0460 48 D
This is part of the equipment RU19. American made equipment for the Navy. It is a 5-valve receiver with a really beautiful precision tuning mechanism. Brand new and in original packing but less coil units. Limited quantity only. 19/6 plus 3/6 P. & P.

THIS MONTH'S SNIP

CAPSTAN DRIVER
Tape Recorder

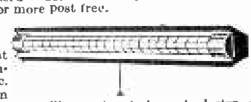


Although some well made spool driven machines give remarkably good results there is no doubt that to achieve anything like perfection and to have versatility a Capstan Driven Tape is essential. Now at last we can offer you a Capstan Driven. completely portable, battery operated instrument at a remarkably low price. So low in fact that you can easily afford to have a second machine for use in your car, office. home etc. or to give to reps or relations to exchange tapes.
SPECIFICATION:—200/7000 C.P.S.—400 MW output—double track-twin speed (3¾ and 7½) fast rewind time—5" spool gives one hour playing with standard tape weight 7 lbs. Size 8 x 11 x 5½. Complete with batteries, microphone—tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop. Special Snip Price This Month. £11.11.0. Post & Insurance 6/6.

TWO-WAVE BAND 7 TRANSISTOR POCKET RADIO

Is a fine medium & long wave superhet transistor complete with carrying handle earphone and battery. A very good little set that will get all the "Pirates" and which will make an ideal present for child or adult. Very recently advertised at £5. Offered to you at £3.19.6 plus 3/6 post and insurance. Two or more post free.

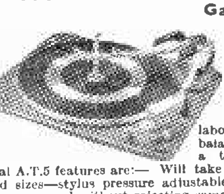
INFRA RED HEATER



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

AUTOCHANGER BARGAIN

Garrard Auto Record Player Model A.T.5

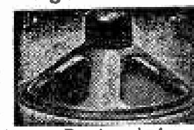


This is undoubtedly the finest Auto changer made in fact its large heavy, non-magnetic, die cast turntable and bias compensated constant pressure stylus together with its laboratory series motor with balanced rotor make it almost a transcription unit. Other special A.T.5 features are:— Will take 8 records which may be mixed sizes—stylus pressure adjustable—may be stopped whilst playing a record without rejecting same record—fitted with latest pick-up for playing stereo or mono records.
OFFERED AT THE AMAZING PRICE OF £6.15.0 plus 6/6 carriage and insurance.

SNIPERSCOPE

Famous wartime "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. It follows that as light from an ordinary lamp is rich in infra-red these cells will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price 5/- each. Post 2/-. Data will be supplied with cells if requested.

Speaker Bargain

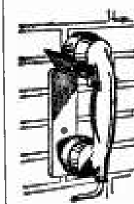


12in. High-fidelity loud-speaker. Highflux magnet type with either 3 ohm or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 29/6 + 3/6 post and insurance.

SPOT OR FOG LAMP

Made by Lucas, Flat or pencil beam, 36 watt Suitable for car, boat, caravan, etc. Complete with 6 or 12v bulb, flex, cables and fixing bolt. Remarkable bargain. Price 12/6 + p. & p. 3/6.

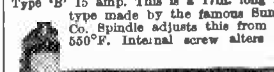
SELF ENERGISED TELEPHONES



These require no batteries: in fact they have only to be connected by a pair of wires. They can thus be fitted into existing bell circuits. Results are extremely good and maintenance costs are nothing. Handsets only 15/- each. post etc. 2/6. Two, post free.

THERMOSTATS

Type 'A' 15 amp for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob quickly adjustable from 30-80°F. 9/6 plus 1/- post. Suitable box for wall mounting. 5/-. P. & P. 1/-.
Type 'B' 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550°F. Internal screw alters the



setting so this could be adjustable over 30° to 1,000°F. Suitable for controlling furnace, oven kiln, immersion heater or to make flamestat or fire alarm. 8/6 plus 2/9 post and insurance.
Type "C" is a small porcelain thermostat as fitted to electric blankets, etc. 1½ amp. setting adjustable by screw through side. 3/6. P. & P. 6d.
Type "D" We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing if a length of our blanket wire (16 yds. 10/-) is wound round the pipes, 7/6. P. & P. 1/1.
Type "E" This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, 7/6. plus 1/- post.

9-Way push-button switch

Each way having two single pole change over and one shorting switch, good length push rods 30/- per doz. 3/6 each post 2/9 per doz.

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16 yds. length 70 watts, self regulating temperature control. 10/-, post free.

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1D5	6/-	6BW6	8/6	6Q7G	5/6	12AT6	4/6	30FL1	10/6	AU2	30/-	EBC90	3/6	EL32	3/-	NGT7	25/-	R3	4/-	UL41	6/9
1H5	7/6	6BW7	8/6	6Q7GT	9/-	12AT7	3/3	30L15	13/-	AU5	6/-	EBF80	5/-	EL33	17/6	OZ4	4/-	R19	7/-	UL84	5/6
1LD5	5/-	6C4	1/9	6SA7	7/-	12AU6	5/9	30L17	12/6	AZ1	8/9	EBF83	7/3	EL34	9/6	PC86	10/-	RG5/500		UM80	7/-
1N5GT	8/-	6C5G	4/-	6SC7	6/6	12AU7	5/-	30P12	10/-	AZ31	7/9	EBF89	5/9	EL41	7/3	PC88	9/3		50/-	UU6	13/6
1R5	5/-	6C6	3/9	6SG7	4/-	12AX7	4/6	30P19	14/-	CBL1	12/6	EBL1	17/6	EL42	7/6	PC97	7/-	S130	10/-	UU7	10/6
1S4	5/-	6C8G	6/-	6SH7	2/6	12BA6	6/-	30PL1	11/-	CK502	5/-	EBL21	10/6	EL84	4/6	PCC84	5/6	SP4	9/-	UU9	3/-
1S5	3/3	6CD6G	23/6	6SJ7	5/-	12BE6	4/9	30PL13	12/6	CL33	12/6	ECC40	7/-	EL90	6/-	PCC89	8/6	SP41	1/6	UY21	7/6
1T4	2/6	6CH6	8/-	6SK7GT	4/9	12BH7	5/9	30PL14	12/6	CY31	10/-	ECC81	3/3	EL95	6/-	PCC189	10/-	SP61	1/-	UY41	4/6
3A4	3/6	6CW4	14/-	6SL7GT	4/9	12C8GT	7/6	35A5	17/-	DAC32	7/6	ECC82	5/-	EM34	9/-	PCF80	6/6	SU25	19/6	UY85	4/9
3Q4	6/6	6D6	2/9	6SN7GT	4/-	12E1	19/6	35L6	5/9	DAF91	3/3	ECC83	4/6	EM80	6/-	PCF82	6/-	SU2150	12/6	VCR97	27/6
3Q5	6/6	6E5	5/9	6SQ7	6/-	12J5GT	2/3	35W4	4/9	DAF96	6/-	ECC84	5/6	EM81	7/-	PCF84	8/-	T41	9/-	VCR517B	
3S4	4/9	6F1	9/-	6U4GT	10/-	12J7GT	7/3	35Z3	10/-	DCC90	7/-	ECC85	5/9	EM84	6/-	PCF86	8/6	TDD4	7/-		30/-
3V4	6/-	6F5G	5/-	6U5G	7/6	12K7GT	3/-	35Z4GT	3/9	DF33	8/-	ECC88	8/9	ESU150	27/6	PCF801	9/9	TH41	30/-	VCR517C	
5R4G	8/-	6F6G	4/-	6V6M	8/-	12K8GT	8/3	35Z5	5/6	DF70	5/-	ECF80	6/6	EY51	6/6	PCF802	9/9	U10	7/-		30/-
5U4G	4/-	6F8G	4/6	6V6G	3/6	12Q7GT	3/-	37	5/-	DF91	2/6	ECF82	6/-	EY86	6/3	PCF803	10/6	U14	7/-	VMP4G	17/-
5V4G	8/-	6F11	12/6	6V6GT	7/-	12SA7	6/6	42	4/6	DF92	2/6	ECH21	19/-	EZ35	4/9	PCF806	12/-	U19	30/-	VR105/30	5/-
5Y3GT	4/6	6F13	5/-	6X4	3/6	12SG7	3/6	50B5	6/6	DF96	6/-	ECH35	13/-	EZ40	5/6	PCF808	12/6	U25	10/-	VR150/30	5/-
5Z4GT	8/-	6F14	13/6	6X5G	4/9	12SH7	2/9	50C5	6/3	DH77	8/6	ECH42	8/-	EZ41	6/-	PCL82	6/6	U26	10/-	VT25	12/6
6/30L2	10/-	6F23	9/6	6X5GT	7/6	12SJ7	3/9	50CD6G	24/9	DK32	7/9	ECH81	5/6	EZ80	5/6	PCL83	5/-	U78	3/6	VT31	30/-
6A7	15/-	6G6	2/6	7B6	11/-	12SK7	2/9	50L6GT	6/-	DK91	5/-	ECH83	6/6	EZ81	3/6	PCL84	7/-	U191	11/-	VU111	6/-
6A8G	6/6	6H6	1/3	7B7	7/-	12SR7	5/-	75	5/-	DK92	7/9	ECL80	6/-	GZ30	8/6	PCL85	7/3	U251	11/6	VU120	10/-
6AC7	3/-	6J5M	6/6	7C5	10/-	14S7	20/-	78	4/6	DK96	6/6	ECL82	6/6	GZ32	9/-	PCL86	8/9	U301	12/-	VU508	25/-
6AK5	4/6	6J5G	2/6	7C6	6/-	19AQ5	7/6	80	5/-	DL70	7/-	ECL83	9/-	GZ34	9/9	PENA4	20/-	U403	6/6	W81M	5/-
6AL5	3/-	6J5GT	4/3	7D5	8/-	20D1	10/-	813	80/-	DL92	4/9	ECL86	8/6	KT36	28/6	PENB4	20/-	U801	18/6	X78	26/6
6AM5	2/6	6J6	3/-	7H7	5/-	20F2	11/-	85A2	8/6	DL93	3/6	EF9	20/-	KT61	17/6	PEN45	6/-	UABC80	5/6	X79	25/-
6AM6	2/9	6J7M	8/6	7R7	13/-	20L1	12/6	150B2	11/6	DL94	6/-	EF36	3/-	KT66	12/-	PEN46	2/9	UAF42	7/-	XH1-5	5/-
6AQ5	6/-	6J7G	4/3	7S7	18/6	20P4	14/-	150C4	12/6	DL95	6/6	EF37A	9/6	KT81	10/-	PL36	9/6	UBC41	6/6	XP1-5	5/-
6AS7	23/6	6J7GT	7/-	7Y4	5/-	20P5	12/-	801	5/-	DL96	6/-	EF39	5/-	KT88	20/-	PL81	7/-	UBC81	7/-	XSG1-5	10/-
6AT6	3/6	6K6GT	5/-	9BW6	8/-	25A6	6/6	807	7/9	DM70	5/-	EF41	6/6	KTW61	4/3	PL82	5/-	UBF80	5/9	Y63	7/6
6AU6	6/-	6K7M	5/-	10C1	9/-	25L6GT	4/6	866	10/-	DY86	7/-	EF50	2/-	KTZ41	3/-	PL83	6/-	UBF89	6/3	3EG1	40/-
6B8G	2/-	6K7G	1/3	10C2	13/-	25Y5	6/-	954	4/-	DY87	7/9	EF80	4/6	ML4	17/6	PL84	6/3	UCC84	8/6	3FP7	12/6
6BA6	4/9	6K7GT	4/6	10F1	13/6	25Z4	6/3	1625	5/-	E88CC	14/-	EF85	4/6	ML6	12/6	PL500	14/6	UCC85	6/6	5CP1	30/-
6BE6	4/9	6K8M	8/6	10F3	13/-	25Z5	7/-	4022AR	5/-	EA50	2/-	EF86	6/6	MSP4	12/6	PX4	18/6	UCF80	8/6	CV1526	40/-
6BH6	7/-	6K8G	3/-	10F9	9/9	25Z6	8/6	5763	10/6	EABC80	5/6	EF89	4/-	MU14	4/-	PY33	8/6	UCH42	7/-	ACR13	
6BJ6	6/6	6K8GT	8/3	10F18	9/-	28D7	5/-	7193	1/6	EAF42	7/6	EF91	2/9	MX40	12/6	PY81	5/6	UCH81	6/3		£3.0.0
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CNP3

expand and, if spooled too tightly, the expansion will be uneven. Care should be taken to avoid magnetic fields and to stack spools so that constant uneven pressure cannot warp them.

Storage in sealed metal cans is recommended for long periods of disuse. When replaying, first respool loosely to relieve any tensions that may have been set up during long storage.

STRAIGHT-THROUGH AMPLIFIER

Tape amplifier with equalising circuits switched out and signal applied to normal output stage for use as normal, level-response amplifier.

SUPER-IMPOSITION

Method of recording a new signal on an existing one by removing the erasing power or removing the tape from the erase head while recording. When the first method is used it is necessary to modify the oscillator circuit to allow for the absent erase head loading and still maintain bias.

In practice, matching of signal levels is quite difficult and this system has been largely superseded by multiplay techniques. In conjunction with *fade erase* and *variable bias* it can be effective as a means of recording commentary over background music when producing tapes for ciné work.

SYNCHRONISING

Method of ensuring that the tape is kept in step with film or slide projector for sound commentary, background, etc.

Two principal methods are used for cine film projectors; (a) stroboscopic disc driven by tape and illuminated by projector lamp. Projector speed adjusted for stationary stroboscope pattern; (b) synchronising pulses recorded on tape to control projector speed. Recording is made on spare track, or on special "pilot tone" narrow track while the film is being made and on replay the pulse is used to control speed of the projector.

Variations in speed of tape recorder cannot be tolerated as much as slight variations in projector speed, hence the method of allowing the recorder to control the projector and not vice versa. A direct method is the looping of tape over the spindle of a synchronising unit which electrically controls the projector speed. Synchronising units are available separately.

A professional method is the use of sprocketed magnetic tape on a special machine with speed control provision.

Slide projectors can be operated by solenoid and relay actuated by pulses recorded on tape, or metal foil strips.

TAKE-UP SPOOL

The spool on to which the tape is wound after passing the head system.

TAPE

The medium on which signals are recorded. Formed by a magnetic coating bonded to a flexible backing. Coating in general use is iron oxide.

Width of tape is standardised (BSS 1568) at 0·246 ± 0·022in. Narrower tapes are now being used in casettes and for other special purposes; wider tapes are commonly used for multitrack recording, video recording and computer work.

Coating thickness of standard tape is about 0·45 thousandths of an inch on a base of approximately 1·5 thousandths of an inch thick. Long Play tape has a base of 1 thou., and a coating of 0·4—0·5 thou. Double Play tape has a base half as thick as this, and Triple Play also uses a 0·5 thou. base but a reduced coating, to 0·2 thou. Recent developments have led to one company marketing a quadruple play tape, with even less overall thickness. Relative lengths per spool size and playing times are shown in Table 1.

In general, tape with a thinner coating is less sensitive, but has a better high frequency response and requires less bias.

Base materials (originally paper) have differing properties, making them suitable for particular applications. Cellulose-acetate, used for standard tape, tears easily, tends to absorb moisture, and becomes brittle as it ages, but is relatively cheap. Polyvinyl-Chloride (PVC), tape is stronger, flexible and does not absorb moisture so readily. It tends to stretch, but can be pre-stressed during manufacture. Polyester tape is tough and does not stretch. It has good temperature and humidity characteristics. Although very suitable for thinner tapes, its stiffness makes it more difficult to handle as a standard thickness.

The adhesive used to hold the coating to the backing is known as the "tape binder". Its chemical properties are generally closely guarded secrets. A brittle binder makes the coating chip as the tape flexes. A binder with a tendency to become sticky at high temperature causes high frequency flutter through tape sticking at guides

(TABLE 1)

Reel Size (ins.)	Tape length (feet, in.)				Playing time at 3¾ in./sec.		(Mins, secs.) (Single-track)	
	Std.	LP.	DP.	TP.	Std.	LP.	DP.	TP.
3	150	250	300	450	8m.	13·20	16m.	24m.
3¼	175	250	400	600	9·20	13·20	21·20	32m.
4	300	450	600	900	16m.	24m.	32m.	48m.
4¼	—	600	900	1200	—	32m.	48m.	64m.
5	600	900	1200	1800	32m.	48m.	64m.	96m.
5¾	850	1200	1800	2400	45·20	64m.	96m.	120·8
7	1200	1800	2400	3600	64m.	96m.	120·8	180·12
8¼	1800	2400	3600	—	96m.	120·8	180·12	—

and heads. A stiff binder tends to make the tape curl with age and temperature change. Binders usually contain lubricants and preservatives, but additional tape lubricants are now available.

TAPE CLEANSER

In addition to the lubricants previously mentioned, some liquid cleansers are available for application to fixed felt pads (also referred to as tape cleaners), over which the moving tape passes.

TAPE GUIDE

Flanged or grooved pillars or pins of non-magnetic material, positioned to guide the tape into its correct path past the heads.

TAPE POSITION INDICATOR

Device used to assist in finding required place on tape without using any form of marking. Simplest form consists of graduated scale marked on top-plate, amount of tape on spool providing edge for taking reading. Alternative method consisted of feeler arm which touched outer winding of spooled tape, and pivoted inner end registered on a scale.

Later types use clock or digital scales, driven from either spool, capstan or separate idler. Spool driven types are not entirely accurate as outer turns have greater diameter than inner turns, but revolutions are the same. Linear scale and greater accuracy is obtained by a capstan drive or capstan driven idler.

Many spools are themselves marked to indicate footage, but accuracy of reading depends on tightness of respooling, which can vary greatly.

TAPE PRE-AMPLIFIER

Special type of pre-amplifier, incorporating equalisation circuits, and, if used also for recording, pre-emphasis and perhaps bias oscillator circuitry. (See also pre-amplifier.)

TAPE RECORD

(See also Pre-Recorded Tape.) Used to denote a commercial recording, as a parallel to Disc Record.

TAPE SPEED

See "Speed".

TAPE STROBE

Stroboscopic device used to indicate speed directly by looping tape over pulley on which a strobe disc is mounted, the disc markings being calibrated, or otherwise tabulated, in inches per second or centimetres per second. (The latter types may be intended for use under lighting of a 60c/s frequency, as may some USA types marked in in/sec.)

TELEPHONE PICKUP

Induction coil system used near telephone receiver to pick up and record telephoned messages.

TEST TAPE

Pre-recorded tape to certain defined standards used for testing the playback channel of a tape recorder. Usually, in addition to the specified standard characteristics, a test tape will have indicated levels, and various frequency bands. White noise test tape, containing frequencies throughout the whole audio spectrum, at equal amplitude, is used for certain system tests.

THERMAL NOISE

The characteristic hiss of white noise may also be an indication of thermal noise caused by current flowing through a resistance, or noise generated within a valve because of the electron stream. Low-noise valves have been specially developed to reduce these effects, and changing carbon compound to carbon deposited, wirewound or metal-oxide resistors in current carrying circuits can also reduce the annoying effect.

TIME CONTROL

Switch used to start and/or stop a tape recorder automatically at a given moment. Used widely with sleep-recording systems, and can consist of a simple time-switch linked to the supply, or a more sophisticated device which completely neutralises the mechanical and electrical parts of the machine.

(To be continued)

On the Short Waves—*continued from page 683*

CR7, CX8(Uruguay), ET3, KP4, KV4, LU3, PY4, TN8 (Congo), TU2, VE3, VS9, YV5, ZS6, 3A2, 5A1, 5H3, 5X5, 5Z4, 9G1, 9J2, 9Q5.

A. H. Trickey (Bristol), R208 plus pre-selector, 75ft long wire, is our sole reporter for 28Mc/s: CT1ON, DM2BBD, DL7GX, F2PY, UP2ADZ.

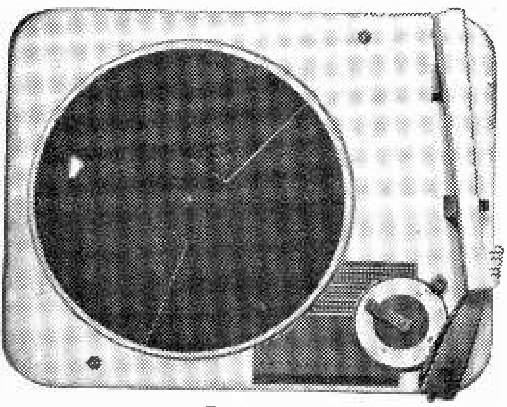
News and Notes

Top band looks promising for the winter trans-Atlantic tests. ISWL/9941 reports W1BB/1 coming in at 579. **D. Mortimer** says Gus Browning was due to commence radiating from OY land at the time of writing. Anyone hear Gus from this QTH?

St. Kitts Island, Nevis Island and St. Vincent Island all active under a VP2 call-sign, with VP2KJ on Nevis Island active most evenings around 2200 on 14Mc/s. Rumours of a group of OD5s climbing up a mountain and signing ODØ. **J. Brown** (Llandaff) bemoans DL/DJ s.s.b. nets on 80. He also tells of VS6AJ on 3·798Mc/s s.s.b. around 2300.

Contests for the merry month of November include : 6-7th, 7Mc/s DX contest (c.w.); 6-7th, 4U2/4S7 contest ('phone); 13-14th, second 432Mc/s contest; 20-21st, second 1·8Mc/s contest; 28-29th, CQWW contest (c.w.). Many thanks for the logs. Always pleased to hear from you. Deadline for this month—27th.

An integrated hi-fi turntable unit from only 11 gns?



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Model 1000 (GC8 Mono PU)	£8. 9.6	£1.18.6	12 of 13/5	£9.14.6
Model 3000 (9TAHC Stereo/Mono PU)	£12.15.0	£2.12.0	12 of 19/-	£14. 0.0
AT60 (GC8 Mono PU) ..	£12.19.6	£2.12.6	12 of 19/5	£14. 5.6
A70 (Deram PU)	£25.19.6	£5. 3.6	12 of 39/-	£28.11.6
LAB80 (Deram PU) ..	£31.19.6	£6.19.6	12 of 47/9	£35. 2.6
SINGLE RECORD PLAYERS				
SP25 (GC8 Mono PU) ..	£12.15.0	£2.12.0	12 of 19/2	£14. 0.0
SP25 (Deram PU) ..	£16.10.0	£3. 6.0	12 of 24/9	£18. 3.0

IMPORTANT—When ordering units with the Decca Deram Pick-Up, please state whether Stereo or Mono required.

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127M AM/FM Tuner Amplifier	£26.10.0	£5.10.0	12 of 39/4	£29. 2.0
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Illustrated price lists are available free on Loudspeakers, Gramophone Equipment, Martin Audio Kits and Test Equipment. Please send 4d. stamp for postage.

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Mullard OA81 Diodes, 1/6 each.
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TCC and Dubilier Metalpack: .1mfd., 500v., 6d. each, 5/- dozen.
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GOODMANS Axiom 10 10in. 10 watts.	£6.12.4	£1.12.4	6 of 20/-	£7.12.4
GOODMANS Axiette 8 8in. 6 watts.	£5.10.11	£1. 7.11	6 of 17/2	£6.10.11
WBHF1012, 10in. 10 watts	£5. 1.3			
WBHF1016	£8. 1.9	£2. 1.9	6 of 23/4	£9. 1.9
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TMK Model 500	£8.19.6	£1.16.6	14. 0	£10 4.6

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A COMMENTARY BY HENRY

PRACTICALLY WIRELESS

No. 16 What's With Tape?

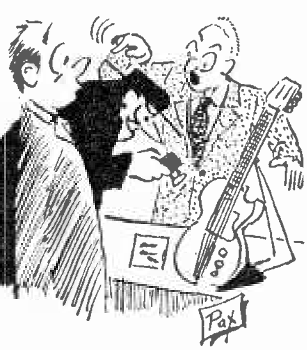
REMEMBER those word-association games we once played? When someone snapped "Pen" and we answered "Ink", "Wood" . . . "Tree", "Chair" . . . "Sit", "Bottle" . . . "Uncle George" and so on.

What would be your instant reaction to *"Tape"?*

If you answer "Spool" let me tell you that events have passed you by. You should have said: "Cassette". At least so think two large groups of tape recorder manufacturers who are doing their utmost to make individual spools obsolescent.

Hints have been in the wind for some time. The German Radio Exhibition which took place in Stuttgart while we were still bemoaning our own sad loss of a Radio Show has amply confirmed our fears.

A consortium of famous manufacturers, Blue Spot, Grundig and Telefunken, have developed a cassette-loading system which is to be termed DC International. The cassette has two playing time sizes, though the physical size is the same i.e. $4\frac{1}{4}$ x 3 x $\frac{1}{2}$in. Tape is non-standard, just over $\frac{1}{4}$in. wide and plays for either 90 or 120 minutes, using two tracks. Latest models of the tape recorders of these makers are to be designed specifically to take this cassette.



My Chicago Spy . . .

That's all very fine but what about all our precious tapes of the family fun-feasts or the church bells of Little Wittering on a wet autumn Sunday that we are preserving for the benefit of posterity? Suppose we want the advantage of the "*tape recorder for pretentious connoisseurs of music*" as Telefunken advertised one of their latest to be?

We dare not open the cassette and try to wind our tape in place. Apart from the fact that it is twice as wide these cassettes operate on the "seesaw" principle—the tape revolves on a hub and as one hub fills the other empties. Two similar spools just could not fit.

So if we buy the latest our tapes are out of date. Conversely the cassette will not fit on any tape recorder except those of the consortium.

This is the next important point. Lack of standardisation, no less. We are by now familiar with the Philips EL3300, a beautiful little machine using a cassette which came out in 1963.

It would be a naive hope that one cassette would fit the other machine or even vice versa. And Philips are pushing on with their cassette development.

So we now have two truly international cassette standards to add to the shelf of boxed tapes that we are always intending to tidy up. And, of course, to keep up with the Joneses a second tape recorder, cassette version, which was already obligatory, now becomes two cassette machines, one for each standard, otherwise we shall not be able to keep up with the repertoire of pre-recorded tapes.

As the editor of one trade magazine has already commented: "*This situation has all the makings of a war rather than a standard and, like war, it is likely to destroy itself rather than succeed*".

Church bells on a wet Sunday

Funny thing, the dealers who market one brand of tape are being offered an attractive album pack of spools of various sizes decked out to look like a collection of first edition novels in a tasty oak display shelf which they keep as a bonus when the tapes are all sold. Could it be an enemy raiding party?

All this takes no account of the next threat to our wallets—video tape recording. Machines at the Stuttgart show by Philips, Grundig and Loewe-Opta are now well below the £1,000 mark.

My spy at the Chicago Music Show this summer informed me that "videograms" (his term) cost no more than top-quality stereo outfits (one thousand dollars—less than £350). I wonder if they will find a way of fitting a cassette, too.

The editor of a leading tape recorder magazine tells us: ". . . *we should still be recording at 60 and 30 i.p.s. on paper-backed tape if the industry had stood still. Cassette loading, like it or not, is here*".

And I have not mentioned Garrard yet, whose pioneer efforts with a $\frac{1}{4}$in. standard cassette seemed to belie the advertising story that "the user doesn't like to fiddle with loose ends". Lots of 'em did!

A LOW-POWER D.C. INVERTER

By D. Bollen

WHEN equipment with mains valves, such as small amplifiers and radio receivers, is to be used away from a conventional power supply the problem of a suitable source of h.t. current arises.

Transistorised inverters provide an attractive alternative to the noisy rotary converter and vibrator because there are no sparking brushes or contacts to cause electrical interference and they are quiet in operation. However, the type normally encountered has two power transistors and a special transformer which, though powerful and efficient, can be somewhat expensive to build.

This article deals with a simple, inexpensive unit requiring only five standard components and one power transistor. The output available is 5W, sufficient for a surprisingly wide range of equipment.

Circuit

The basis of the inverter is an ordinary mains transformer with 6·3V and 4 or 5V heater windings. These are used as collector and base inductances in a straightforward common emitter configuration with positive feedback or, in other words, as an oscillator. In Fig. 2 the 2·2kΩ resistor initially negatively biases the base of the transistor so that it conducts. When oscillation commences the diode drives the base positive, cutting off the transistor for part of the cycle. The amount of positive bias thus created can be preset by VR1 to achieve maximum battery economy and a high conversion efficiency as well as limiting the current drawn by the transistor to a safe value. In the case of the XC141 or OC16 this should not exceed 1½A.

The 250V primary is now available as an output winding. Normally this is tapped to cover the range 200-250V. These taps can be utilised as 25V and 50V outputs. The original secondary may be 250-0-250 or 350-0-350. If the centre tap is ignored this winding provides an output suitable for Geiger tubes, electronic flash, cathode ray tubes and other high-voltage devices. With conventional voltage doubling techniques the output can be increased as desired.

If the secondary winding is used in the normal way the indirectly heated full-wave rectifier should draw its heater current from the battery via a suitable dropper resistor of the correct value and rating (Rx, Fig. 3) and 6·3V valves can, of course, be fed directly from the battery.

An interesting idea, possible with a.c.-only equipment where a mains transformer is already on the chassis, is to mount transistor and heat sink on the chassis as well and switch the heater windings so that the equipment can be mains or battery powered at will. Fig. 3 shows how the switching could be arranged. If the 6·3V winding has a centre tap the battery should not be connected to chassis but left floating.

This will depend on the mains transformer used

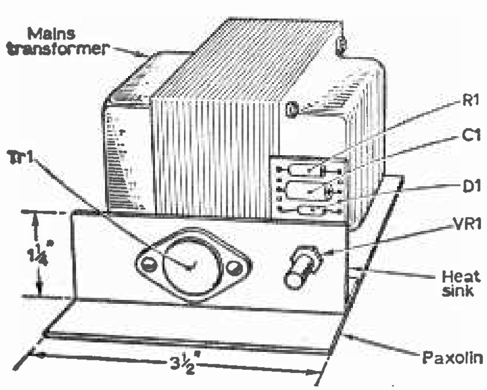


Fig. 1 (above): Method of mounting components.

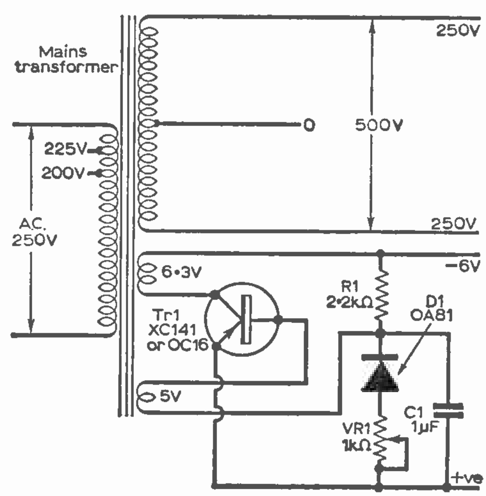


Fig. 2 (right): Inverter oscillator circuit.

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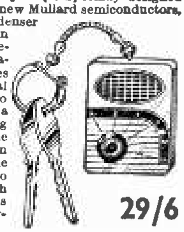

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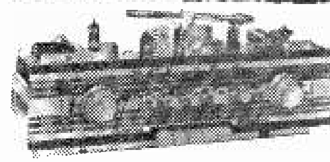

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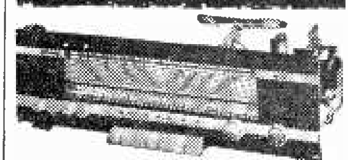

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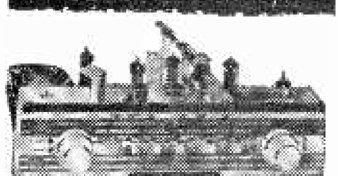

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and the intended application. Obviously the layout will be affected if rectifying and smoothing components are included as will usually be the case.

The transistor should be bolted to a heat sink made of 18 s.w.g aluminium of at least four square inches in area. In the original construction both sink and transformer were mounted on thick paxolin so that mica and insulating washers were not needed to isolate the transistor from its sink, which therefore remains at collector potential. The resistor, diode and capacitor can be positioned on a small tag panel which can be fixed on the heat sink.

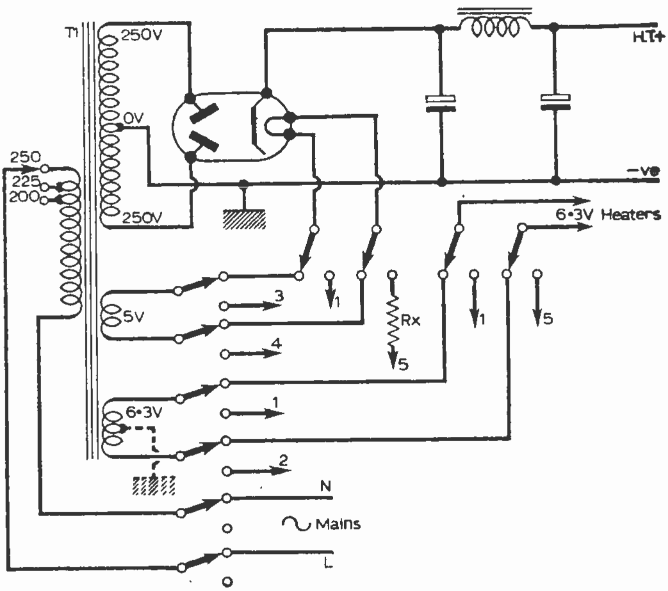
Setting Up

First connect an a.c. voltmeter, in parallel with a 12kΩ 5W resistor, across the 250V primary winding. With VR1 in the maximum resistance position and a 3A meter in the battery lead, switch on. A hum or low whistle will probably be heard, due to the laminations of the transformer vibrating at the frequency of oscillation. If there is no output reverse either the 6·3V winding or the 5V winding whichever is the most convenient to unsolder. When all is well decrease VR1 and check both output voltage and battery current consumption until the optimum ratio is achieved between the two. It is emphasised that with either of the transistors specified the input current should not exceed 1·5A. If the full 250V is not available with a load of 12kΩ then a lower output power must be accepted.

The overall performance will depend to a large extent on the suitability of the transformer and it might well be worth while trying various types before the unit is finalised. If maximum battery economy is required when feeding a reasonably constant load, resistance VR1 can be increased.

For higher outputs, say above 5W, an OC26 transistor could be substituted. This has a collector current upper limit of 3·5A, but in this case it would be necessary to ensure that the 6·3V heater winding was capable of carrying the extra current, which might not be so in the case of some smaller transformers. As a guide it can be taken that the winding's current handling capacity is the same as the maximum current available when the transformer is being used in the normal manner.

Finally it is always preferable to switch off the battery supply rather than to suddenly remove the load on the output in order that undesirable inverse voltage peaks are not developed across the transistor.



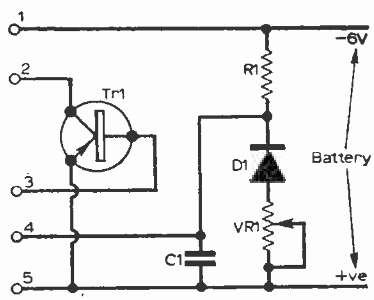


Fig. 3: Switching for mains/battery arrangement.

BOOKS REVIEWED

DESIGN OF LOW NOISE TRANSISTOR INPUT CIRCUITS. William A. Rheinfelder. Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1. 160 pages. Size 5½in. x 8½in. Price 30s.

IF your knowledge of mathematics is not too hot, you may well find difficulty in understanding this book. About third-year maths in telecomms gives you a sporting chance. Between its covers is a very thorough discussion of noise with an emphasis as the title implies, on transistors.

The first four chapter headings speak for themselves—Noise Figure Concept, Measurement of Noise Figure, Noise of Spectral Discontinuity, and Tube and Transistor Noise. Having discussed noise and clarrified all obscure points, the author then proceeds with a further four chapters on design. These cover the whole frequency range from receiver front ends up to 100Mc/s, design above 100Mc/s and low noise audio design. Chapter 8 being devoted to "Typical Low Noise Circuits" which included circuits working at 800Mc/s and a low noise audio pre-amplifier.

William A. Rheinfelder is to be congratulated on the professional and thorough way in which this book was penned. Obviously well thought out, the defining of terms, the thorough treatment of noise in all its forms and the following up with design details and typical circuits.—*D.L.G.*

101 MORE WAYS TO USE YOUR VOM AND VTVM. Robert G. Middleton. W. Foulsham & Co. Ltd., Slough, Bucks. 128 pages. Size 8½in. x 5½in. Price 20s.

THE book bears an honest title. It promises that between its covers the reader will find 101 more ways to use these two pieces of useful equipment, and indeed your reviewer counted exactly that number. However some of these uses are to say the least—unusual.

Use number 97, for instance held me spellbound with how "To Check an Insect Electrocuter". Further uses described required other test gear besides the VOM or VTVM. Audio oscillators, grid dip meters etc. The crowning gem is Use Number 73 which instructs how to check the condition of a radio battery. Under its own heading and in a paragraph all its own the book sternly commands "Connect VOM test leads across battery"!

This book contains some useful ideas but for my money the author is rather scraping the barrel.—*D.L.G.*

SIMPLIFIED MODERN FILTER DESIGN. Philip R. Greffe. Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1. 182 pages. Size 8½ x 5½in. Price 50s.

THIS may sound a rather dry book especially for mathematical eggheads and with little or no use for the average amateur enthusiast. Yet these passive networks seem to creep into practically every corner of radio and electronics.

The audio enthusiast has his equalising networks, the electronic organ enthusiasts wish to use them in tone circuits. The "ham" uses low pass and high pass filters, and attenuators are used in many television installations.

This book covers a wide range of filter design, but simplifies the maths by providing tables for quick calculation and thus eliminates much of the hard slogging. Designs are normalised for 1Ω terminations and for cut-off at one radian per second. Once design is completed it is scaled in frequency and impedance and the end result is practical filter design.

You will need a knowledge of maths for this book. You will also need 50s. But if you want to roll your own filters then this is a bargain.—*L.S.A.*

AMATEUR RADIO MOBILE BOOK. Charles Caringella, W6NJV. W. Foulsham & Co. Ltd., Slough, Bucks. 160 pages. Size 8½in. x 5½in. Price 24s.

HAVING attended various meetings and rallies in the amateur radio world the writer can vouch for the high standard set by the British mobile ham station. These are the people at whom this book will presumably be aimed, but I regret to say that I fear this is one arrow which will fall short of its mark.

The title is *Amateur Radio Mobile Book,* yet it appears to be packed with photographs and diagrams of commercial American gear. In the 16-page chapter on mobile antennae, there are eleven photographs of commercial American equipment, two of them taking a whole page.

Another chapter contains details of how to construct a 6-metre mobile transmitter. This is fine until it is remembered that the British amateur is not licensed to transmit on six metres!

This book represents very poor value for money, and I can only urge would-be purchasers to see it first.—*L.S.A.*

INTERNATIONAL RECTIFIER SOLARCELL AND PHOTOCELL HANDBOOK Application Engineering Department, International Rectifier Corporation. International Rectifier Company (G.B.) Ltd., Hurst Green, Oxted, Surrey. 136 pages. Size 9in. x 6in. Price 20s.

THIS latest publication covering the field of solar and photocell devices is printed and published in the U.S.A., and therefore covers cells manufactured in that country. However, International Rectifier Semiconductor Centres are established throughout the U.K. and all devices mentioned are therefore available in this country. Over 75 circuits are given covering a wide variety of applications—light beam communication, secret locks, photoelectric counters, fire alarms and audio amplifiers—these are just a few of the many circuits covered. Basic concepts plus a host of design data is also included and make this a very interesting publication.—*M.S.C.*

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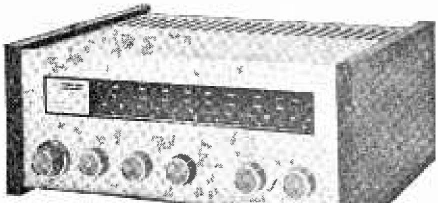

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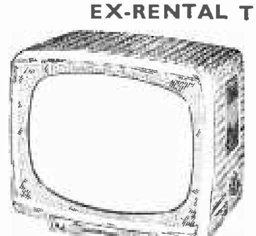

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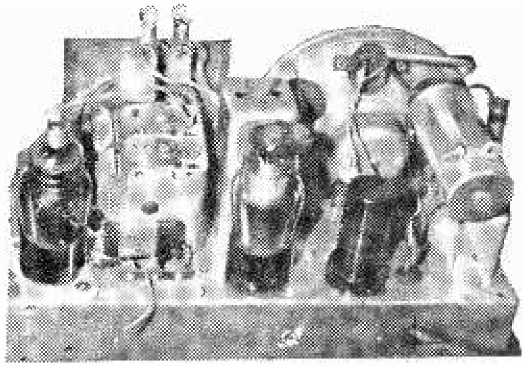

BASICALLY the circuit comprises a frequency changer stage, the i.f. output of which (at 465kc/s) is fed into on anode bend detector, and the resultant a.f. signal passes to a conventional pentode output stage, the whole being supplied with power by means of a metal rectifier for the h.t. supply, and a heater transformer to feed the valve heaters and pilot bulbs. As half wave rectification is employed, the chassis of the necessity connected to one side of the mains supply, but this is standard practice and provided the precautions described later in the text are complied with, no danger will result.

Components

All the components listed are of standard pattern, and freely available from advertisers in this magazine. The only components of specific manufacture are the tuning coils, by Messrs. Denco Ltd.

The heater transformer (T2) possesses small lugs on the top portion of the clamping frame (see Fig. 3) to which a metal clip securing the can of the smoothing capacitor(s) is bolted. R11 and R10 can conveniently be soldered directly across C14a, b. c tags. Being thus mounted above the chassis, they will be able to dissipate heat without damage to wiring or nearby components.

A 5 in. diameter loudspeaker will nicely fit the chassis, and will adequately handle the volume required for domestic listening. A simple cord and drum drive to the tuning capacitor, on whose spindle is mounted a double ended pointer, in conjunction with a two waveband glass dial mounted in the receiver cabinet, gives station indication. The on/off switch is combined with the volume control, and a four pole, 2-way "Yaxley" type switch provides for wavechange switching.

Before fixing the tuning capacitor solder a piece of insulated connecting wire about 4 in. long to each of the lower fixed plate contacts, and thread these wires through the appropriate holes in the chassis, so that connection can be made later to the wavechange switch, etc. The orientation of the valveholders should be carefully noted, constructors not familiar with the British 7-pin valveholder, are reminded that the heater pins of these valves are Nos. 4 and 5; numbering being in a clockwise direction, when viewed from the underside of the valveholder, No. 1 pin being the "odd one out", and Nos. 4 and 5. those closest together. Note the presence of solder tags on the fixing bolts of each valveholder,

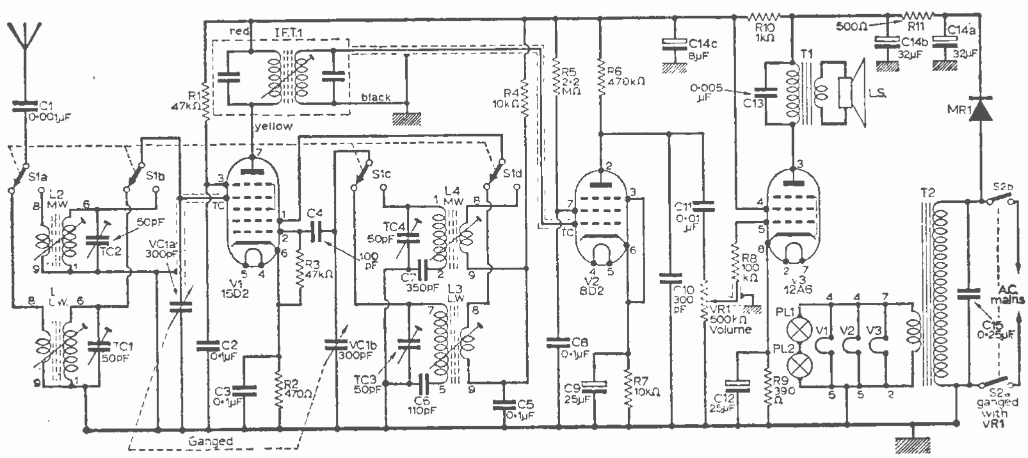

Fig. 1: Complete circuit diagram.

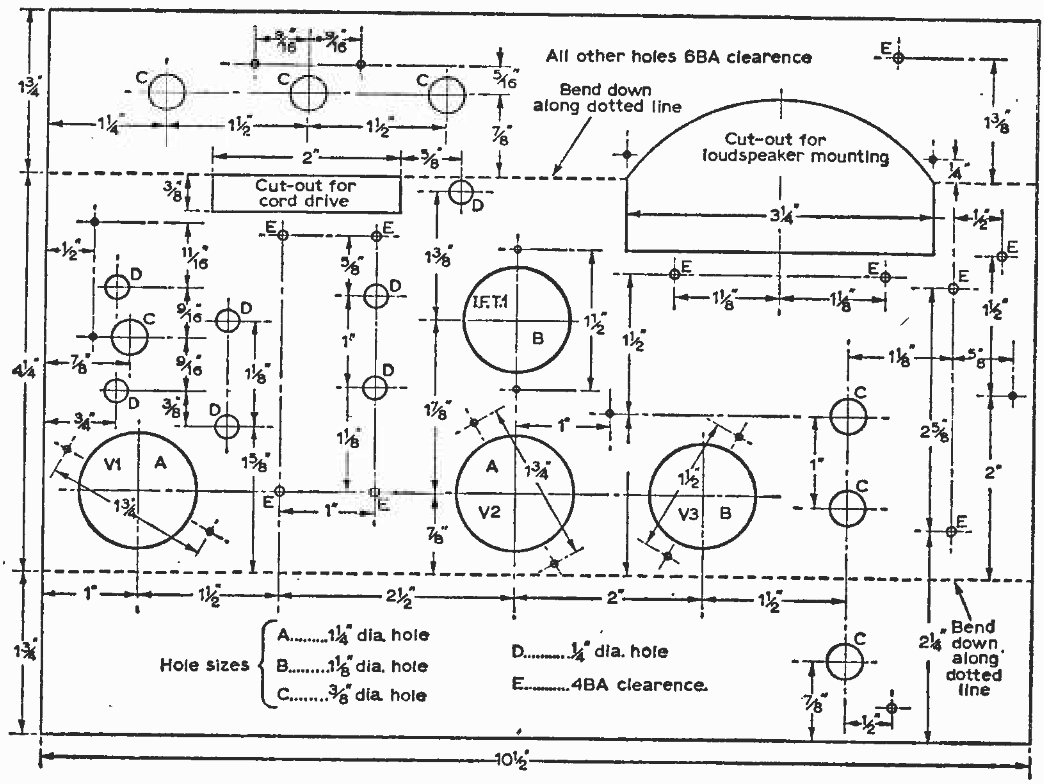

Fig. 2: Chassis drilling details.

adjacent to the heater pins, also on one of the loudspeaker fixing bolts.

The tuning coils should preferably be the last components placed in position, as they may be easily damaged by rough handling. The manufacturers point out that the plastic fixing nuts should be fastened up with care, finger tight, as undue forcing may cause the threaded portion of the coil former to be pulled off the body. The screening cans supplied with the coils are not used in this design, as space is at a premium, and in any case, as the coils in use at any one time are operating on widely divergent frequencies, there is no danger of instability by feedback from unscreened coils.

The drive from the tuning spindle to the tuning capacitor is of conventional pattern, being formed by wrapping the nylon drive cord twice round the drive spindle to secure a good grip, one end is anchored to the lug on the drive drum, the other end via a tension spring, to the other lug thereon. The length of cord should be adjusted so that the tension spring is extended slightly, and a firm slip-free drive should result. The drive drum should be secured to the gang capacitor spindle in such a position that the vanes can be moved from the fully open to fully closed position smoothly and without strain on the drive cord. A metal backplate, pierced with a ½ in. hole to accommodate the gang spindle, is secured to the chassis front runner. This backplate can be easily made from aluminium or tinplate. It should be painted matt black, or other dark colour, so that the brass double ended pointer (which is secured by a small 6BA screw to the tapped end of the gang spindle) shows up readily against it. The glass dial is mounted in the cabinet itself, it can be either glued into position, or held by small metal clips screwed to the cabinet interior when a wooden cabinet is used.

It is important to remember that one side of the mains supply is connected directly to the chassis of the receiver, and the following precautions against shock hazard must be adhered to. The receiver should be placed on an insulated surface, such as dry wooden bench or table, and the constructor should be standing on a dry floor surface—so do not take your set out into the garage as concrete floors are a notorious shock risk. Fit insulated control knobs to each of the control spindles, and prop the chassis up on one end (the end nearest the heater transformer) in such a way that it is unlikely to fall down as a result of vibration or an accidental knock; plug in and switch on. Turn up the volume control, and at maximum setting a very slight " breathing " sound should be audible; if there is a loud hum or accompaniment of crackles, something is amiss;

switch off and again check all wiring and components. If the test meter is available, the h.t. voltage can be checked, this should be about 240V at C14a and about 200V at C14c. Tapping the blade of a screwdriver on the control grid (pin 5) of V3, should produce a healthy "hum" from the speaker, whilst tapping the blade on the grid (top cap) of V1 or V2 should produce a loud "click". If these responses are obtained, you are more than half way to success, and can confidently attempt to receive some signals.

Alignment

As those who own a generator will almost certainly be fully conversant with the process of alignment, it is not proposed to repeat the process here. For the less fortunate, read on. Connect a good aerial to C1, switch to Long Waves (switch anti-clockwise), and sweep the tuning capacitor across the dial, when at some point there is every chance of the BBC Light Programme on 1500 metres being heard, even if very faintly. If no sound at all, considerable patience will be needed;

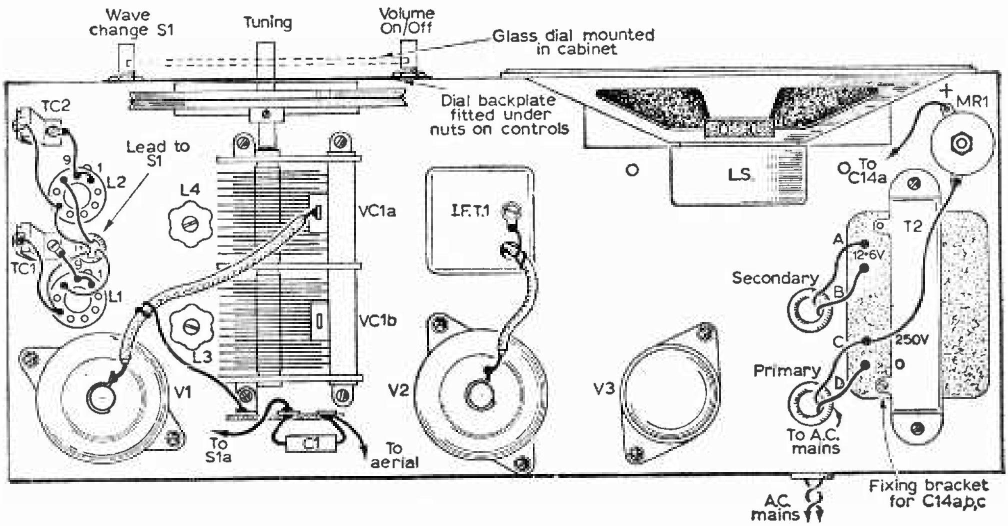

Fig. 3: Top chassis layout and wiring.

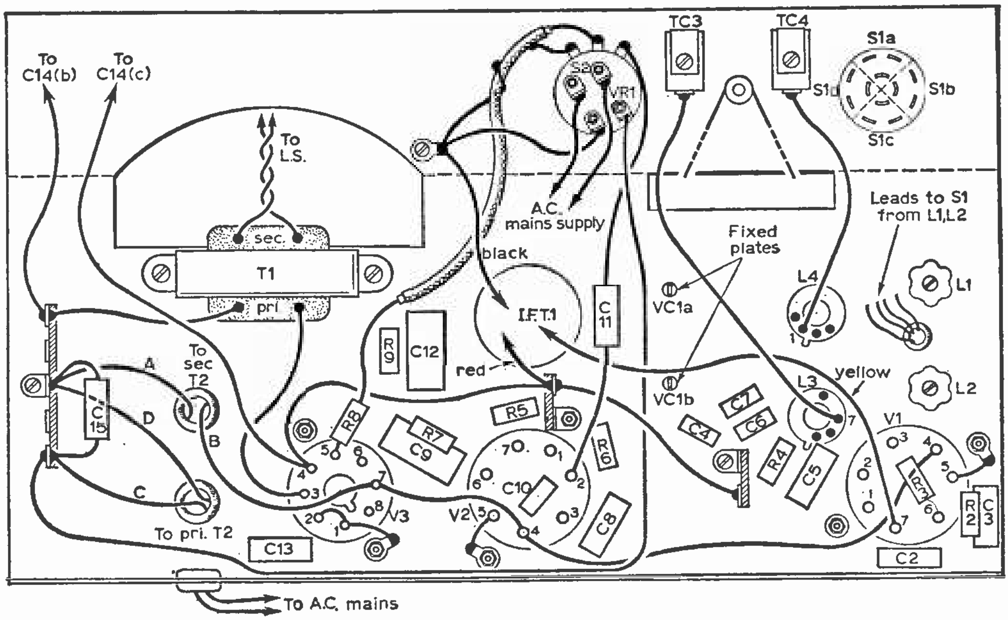

Fig. 4: Under chassis wiring diagram.

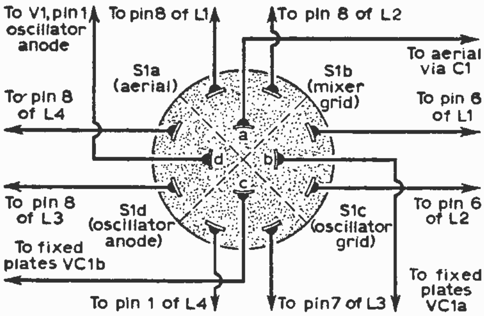

Fig. 5: Wavechange switch wiring.

first screw up all trimmers, then release them by about two turns of the adjusting screw; set the coil cores so that the brass adjusting screws protrude about ¼ in. above the formers. Now try searching for the elusive Light Programme signal once more; if still nothing is heard, screw up TC3 a quarter turn and try again. Repeat the process at "quarter turn intervals"; if nothing can be heard at any setting of TC3, unscrew the core of L3 about two turns and repeat the searching process at various settings of TC3. As soon as a signal is heard, adjust TC3 and L3 for maximum loudness, then peak up by adjusting TC1 and L1, reducing the setting of the volume control to keep the audible output as low as possible. Now very carefully try the effect of adjusting the cores of the i.f. transformer, first in one direction, then in the other; but do not move them more than two complete turns in any direction, otherwise the "pre-aligned" setting of approximately 465kc/s at which they left the component supplier, will be hopelessly "lost". By now, the BBC Light Programme should be received loud and clear, and by adjusting the core of L3 and L1, it should be possible to ensure that this occurs with the pointer indicating the correct dial setting. Naturally this method will not give accurate "tracking" across the full long waveband, but as the BBC Light is normally the only programme required on the Long Waveband, this is of no disadvantage. Now switch to Medium waves (clockwise), set the dial to either Radio Luxemburg or the BBC Light (247 metres), and adjust TC4 and TC2 until the programme is heard. Now turn to the BBC Third Programme (on 464 metres), and adjust L4 and L1 for best response. Now return to Luxemburg setting, and again adjust TC4 and TC2. Repeat these adjustments until no further improvement can be gained, when you should find that the receiver is quite sensitive and "tracks" correctly at all settings of the dial. A reminder should perhaps be given here that the specified tuning capacitor of the 300pF type which matches the "Denco" coils, and not the more common 500pF pattern, must be employed if stations are to tune in at correct dial settings. ■

COMPONENTS LIST

Resistors:

R1	47kΩ	R7	10kΩ
R2	470Ω	R8	100kΩ
R3	47kΩ	R9	390Ω
R4	10kΩ	R10	1kΩ 5W
R5	2.2MΩ	R11	500Ω 5W
R6	470kΩ		

All 10% ½W unless otherwise stated.

Capacitors:

C1	0·001μF	mica 750V
C2	0·1μF	paper
C3	0·1μF	paper
C4	100pF	silver mica
C5	0·1μF	paper
C6	110pF	silver mica 5%
C7	350pF	silver mica 5%
C8	0·1μF	paper
C9	25μF	25V electrolytic
C10	300pF	mica
C11	0·01μF	paper 500V
C12	25μF	25V electrolytic
C13	0·005μF	paper 500V
C14 a, b, c	32+32+8μF	electrolytic
C15	0·25μF	paper 750V
VC1a, b	300pF	twin gang
TC1, 2, 3, 4	50pF	compression trimmers.

Inductors and Transformers:

L1 dual purpose coil, range 1 Blue
L2 dual purpose coil, range 2 Blue
L3 dual purpose coil, range 1 Red
L4 dual purpose coil, range 2 Red
} Denco (Clacton) Ltd.

IFT1 standard 465 kc/s with fly lead IFT6B/465
T1 40mA primary, matching 7500Ω to 3Ω speech coil
T2 230/250 primary 12·6V 1A secondary

Valves:

V1 15D2
V2 8D2 V3 12A6

Miscellaneous:

VR1 500kΩ with d.p. switch
S1 4p. 2w. MR1 250V 40mA (min.)
5in. p.m. speaker, 2 British 7-pin valveholders, 1 international octal valveholder, grid clips, chassis 10½ x 4¼ x 1¾in., glass dial, back plate, pointer, drive spindle (rear drive), drive drum, nylon cord, tension spring, etc.

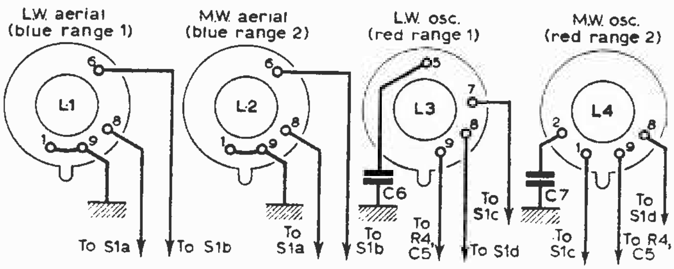

Fig. 6: Details of coil connections.

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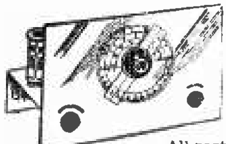

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P. & P. 2/6.

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6 Transistor Portable complete with battery, case and earpiece. **62/6** P. & P. 2/6

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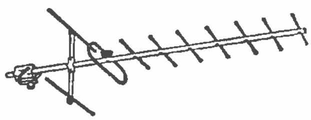

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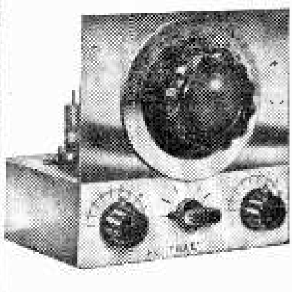

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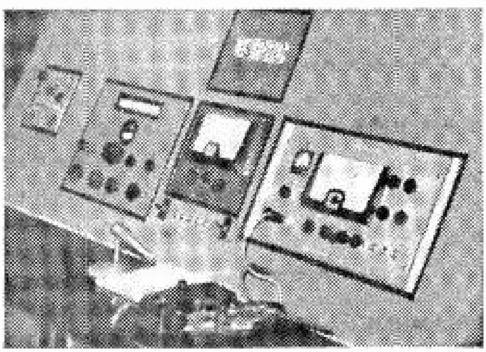
CLUB SPOT

No. 2 PLYMOUTH RADIO CLUB

THERE has been some sort of radio society in Plymouth ever since 1926 but "The Plymouth Radio Club" as now constituted dates from 1956, when the few staunch members of the local "R.S.G.B. Group" broke away and formed the P.R.C., affiliated to the R.S.G.B. Since that time the Club has transformed from the informal meeting of a few enthusiasts in a small room to the current position of nearly 70 members with 35 licensed members.

Meetings are held every Tuesday throughout the year except for the first two weeks in August, when informal meetings are held on the world-famous Plymouth Hoe. Three meetings every month take the form of "organised" functions such as lectures, discussions, business meetings, etc., the fourth meeting being left free for "rag-chewing" and informal discussions. Morse classes are held every week prior to the commencement of the evening's programme and a team of experts can take any aspirant from 0 to 40 w.p.m. (or higher if desired). During the winter months film shows are held once per month and many of the latest and most advanced films—technical or lay—are screened during the October to April session.

There is a large amount of inter-club activity in the South-West of England and apart from many quizzes, informal social evenings, etc., we organise an inter-club picnic on Dartmoor every August. This is always a highly successful event. Visitors on holiday and contingents from all the surrounding area clubs are welcomed and enjoy an unorganised but pleasant afternoon with amateurs, wives, families, friends, SWLs, etc.



Club station G3PRC. Left to right Clan "D" Wavemeter, CR100, K.W. Geloso Converter, K.W. Vanguard.

Our annual dinner and social evening is usually held at the end of January or the beginning of February each year and again on this occasion many friends from contemporary clubs are welcomed, the attendance usually being around 80. The highlight of this event is always the "grand draw" when up to 50 valuable radio prizes are offered. There is also a "ladies' draw", together with a few speeches by the officers, a little dancing and the evening usually passes all too rapidly.

Whilst on the subject of officers a word about them would not be out of place. The ranks of the committee are, as in every radio club, microcosm but including more than a few well-known call-signs. The president, G5ZT, is probably best known as the first person to make a two-way contact by amateur television in the early 50's. Decades ago, indeed before the war, he was a pioneer of the h.f. bands and, whilst he achieved post-war DXCC, the majority of his time nowadays is spent on v.h.f., where he holds many "firsts", including the first-ever QSO GTOGC on 4m. The two vice-presidents are known for their contributions to amateur radio away from these shores—G3BRJ in the Far East, especially Singapore, and G3WL has held many exotic calls in YK, TA, SU, VP3, to mention but a few. Between us all bands from 160m to 70cm are actively used on all modes, c.w., a.m., SSB and even RTTY.

There are many members in other parts of the world, Singapore, Trinidad, Nigeria are again but examples, to say nothing of the members in H.M. Forces scattered abroad both within and outside this island.

However, for all its other facets the hub of a radio club is its station and the impression which it portrays to other amateurs over the air. At one time a "defunct" CR100 and a two-valve 160m transmitter were its sole contents. However, when the long-awaited call (G3PRC for Plymouth Radio Club) was issued in 1962 then began the rapid transformation from our humble beginnings of a station to the somewhat different picture given by the photograph. Basically the receiving side comprises a "hotted-up" CR100 running from a KW/Geloso converter at 4·6Mc/s and the trans-

A recent quiz between Torbay A.R.S. and Plymouth R.C.

mitting side a KW Vanguard. However, a great deal of work has been put into designing the station to our exact specifications. The console operating position was built with ease of operating over long periods in mind and all operations can be performed by using the fingertip controls immediately in front of the operator. The transmitter/receiver set-up has been modified for full break on c.w., with switching handled by "Londex" relays, and for single switch control on 'phone—sidetone is, of course, incorporated for the former mode. The "Skywire" arrangements comprise a G5RV fed with open wire tuned feeder for the "34' down-lead" section and then with low loss coaxial cable. For the h.f. bands there is a G4ZU beam fixed on the east.

Operations are roughly half 'phone and half c.w. and there is a great deal of activity on all bands, especially in contests during the winter DX season. The R.S.G.B. National Field Day is a must every year and a highlight in the Club calendar. A certain amount of other portable activity is indulged in—the station is operated at the aforementioned annual picnic and also from specially selected sites high up on Dartmoor during a few weekends.

The clubroom itself is situated in Virginia House Settlement, where we have our own accommodation. The meeting room holds a coffee bar and the shack is partitioned off. All the work, console, station, Clubroom, shack, etc., has been done by members in their spare time. Situated only a few hundred yards from the Mayflower steps whence sailed the "Pilgrim Fathers" when they left to found the United States in 1620 the clubroom is in a part of old Plymouth near the famous Barbican and, indeed, inside the original walls of the old "Sudtone" which appears in the "Domesday Book" (a little before radio!) and within easy walking distance of the "Hoe" and we often go up to see Drake playing bowls when operating /m!

So much for the past and present but what of the future? Plans have been drawn up for a new building with a radio shack and station drawn up by the architects to our specifications. A lattice tower will be built into the roof, an earth mat into the floor and the shack will be separated from a laboratory by a glass partition through which measurements and readings can be made on the test equipment on the laboratory bench. The present station will be used to train novices, whilst the new equipment will probably be on the lines of a Collins "S" line or its equivalent in about five years' time, when we can reasonably expect these plans to materialise!

In the meantime we intend to fit s.s.b. to the existing station by purchasing an SB10U which will be built by our technical committee and will enable the call-sign "G3PRC" to be broadcast even further than the five continents and some 80 countries which have already been contacted. ■

A Transistorised S.W. Converter—continued from page 689

core of L2 will be different for the two bands (although this was not the case in the prototype), but a suitable compromise can usually be found with a little patience. When a setting has been found for L2 core it should be set in place by means of wax. The final adjustment to L3 is made next, peaking up for maximum response with a smooth coverage and the core then set in place.

It must be emphasised that the converter is only suitable for use with a set which does not employ a ferrite-rod aerial, and is reasonably insensitive without an aerial as, of course, interference will occur between the converter output and the M.W. signals. In the original it was found necessary to provide a little screening for the aerial coils of the receiver to prevent breakthrough. However, with a little care and attention to adequate screening where required will ensure that breakthrough at "I.F." will be no problem.

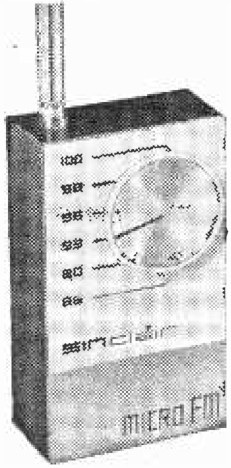
All is not completely black for the ferrite aerial set if one is prepared to go to drastic lengths. The writer has found that the converter will work very satisfactorily into the car aerial socket of his transistor radio which is screened by placing it inside a biscuit tin! ■

Coils	L1	L2	L3	L4	L5	L6
Turns	60t tap 13t from earth	8t	50t	5t	150t	10t
Wire gauge (enam) s.w.g.	34	34	34	34	42	34
		Wound over L1		Wound over L3		Wound over L5
	7/16 dia iron cored coil				7/16 dia air cored coil	

All coils close wound

Fig. 4: Coil winding data.

ANOTHER SINCLAIR



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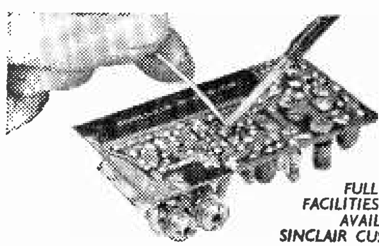

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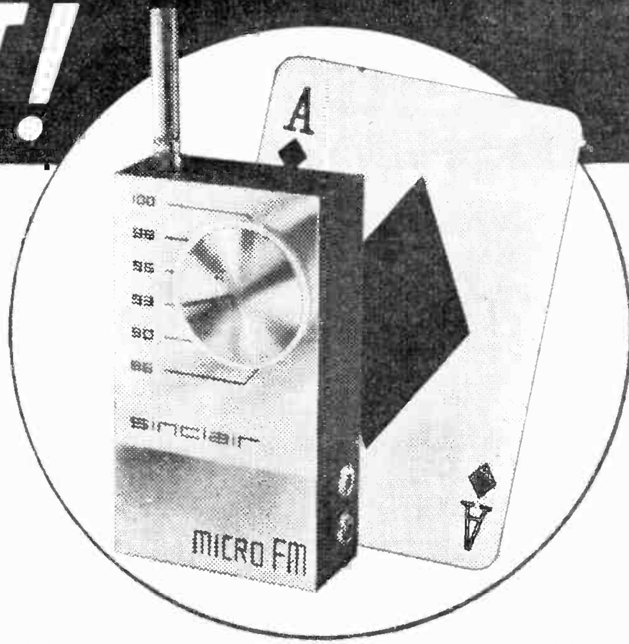

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- **CONSUMPTION**—5mA
- **SENSITIVITY**—Typically 3 microvolts
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- **HIGH LEVEL AUDIO OUTPUT**—9V peak to peak
- **TUNING RANGE**—87.5 to 108 Mc/s
- **SIGNAL TO NOISE RATIO**—30dB at 30 microvolts
- **AUDIO FREQUENCY RESPONSE**—10 to 20,000 c/s ± 1dB

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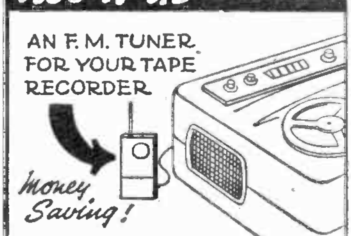

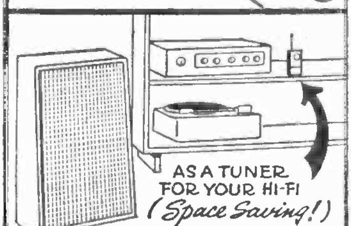

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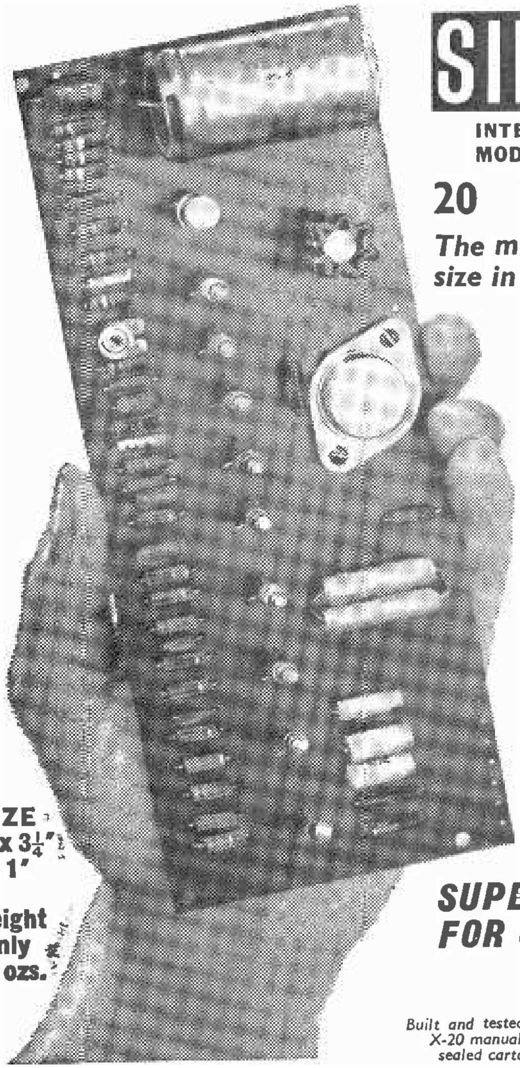

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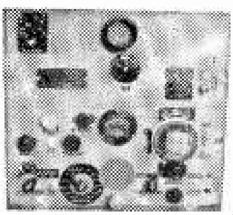

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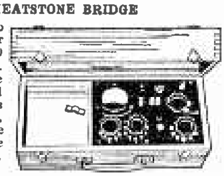

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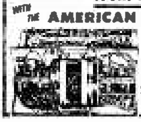

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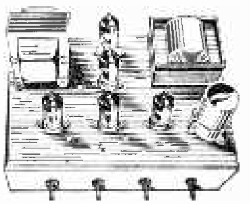

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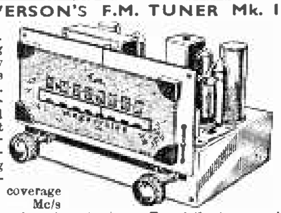

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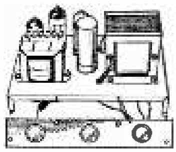

A really excellent all purpose A.C. mains 200/240v. **AMPLIFIER KIT TYPE HSL 'FOUR' 3 VALVE 4 WATT USING ECC83 EL84, EZ80 VALVES**

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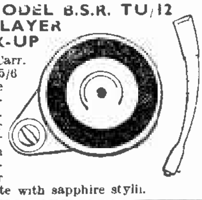

ONLY **69/6** Carr. 5/6

7in. metal turntable Low flutter performance. 200/250 v. shaded pole motor with 90 v. tap for valve heaters. High gain crystal pick-up with turnover LP/78 head complete with sapphire stylii.

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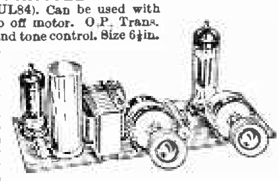

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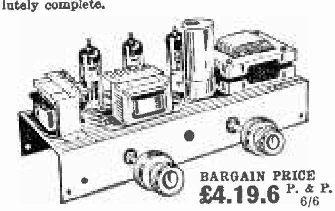

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PRACTICAL WIRELESS, DECEMBER, 1965

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