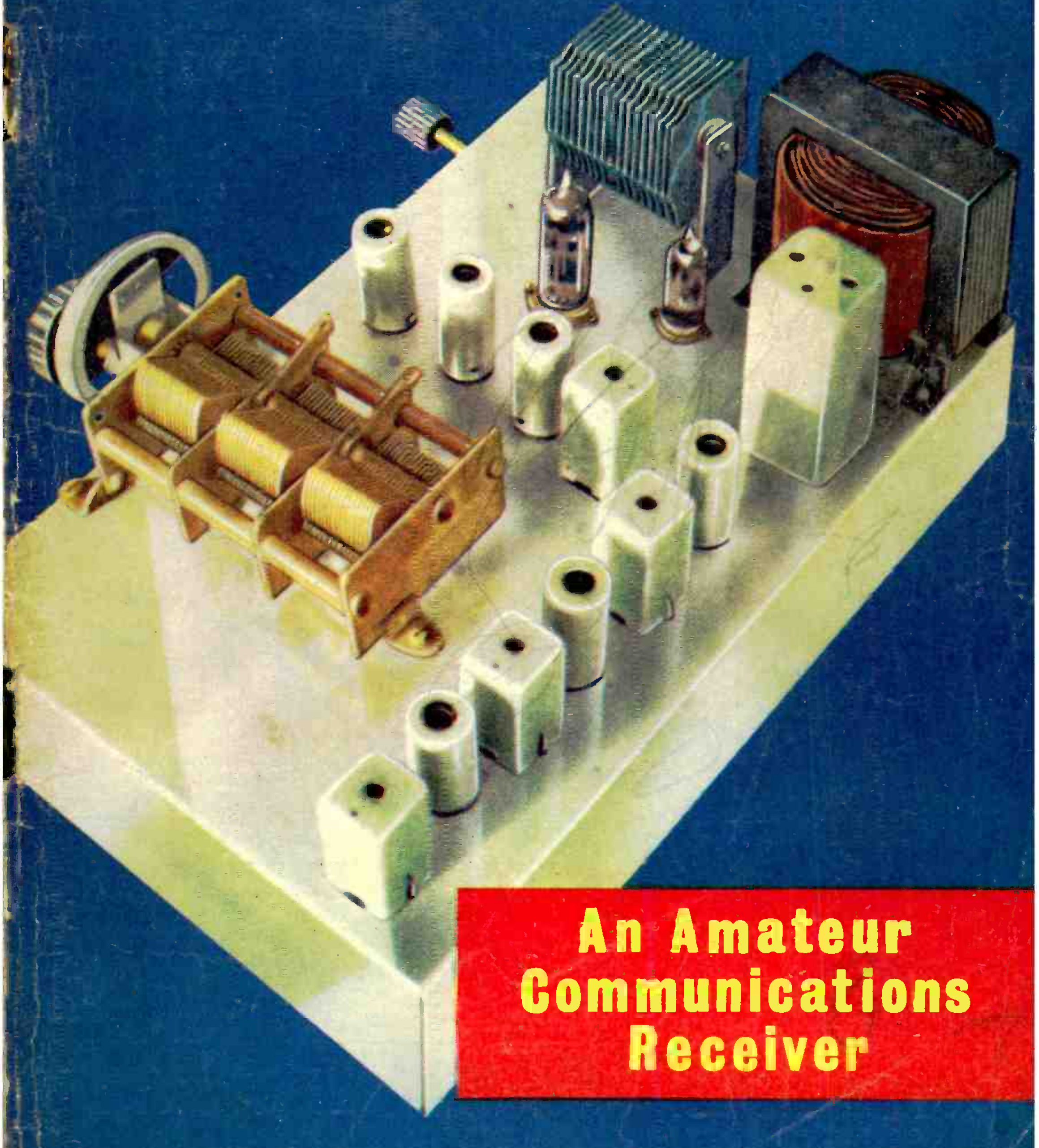
JULY 1961

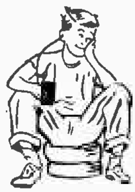
Practical WIRELESS

1/6



An Amateur Communications Receiver

THE SOLDERLESS TRANSISTOR "3"



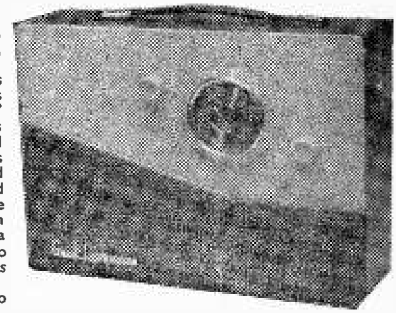
Ideal for Camping and Holidays as no Aerial or Earth Needed

You can easily make this set without any soldering, our special solderless terminals ensure perfect connection also remove risk of damage to transistors. This pocket set is a real radio in a proper plastic cabinet, uses proper tuning condenser, first grade transistors and other parts, it will receive Luxembourg and local stations on the Broadcast Band.

Add on units are available to increase volume and to bring in long waves, if required.

Price of the basic set, as illustrated, 37/6. Post and insurance 2/6. More details S.A.E.

NOW THE "GOOD COMPANION" CAR RADIO AND PORTABLE



Largely due to the helpful criticisms and suggestions received from purchasers of our previous set "The Real Companion" we have improved and now supersede this with a new set which we call "The Good Companion". We feel confident that this new set is one of the finest of its kind available. The design is the combined efforts of our own technicians and of those of several of the leading manufacturers in the country, and the resulting set has a performance as good as if not superior to those selling at £20 and more. *It has the eight transistor set performance.*

Features include American Philco R.F. transistors and Mullard A.F. transistors—Q.P.P. output giving 750 mW—full coverage on Medium and Long—very fine tuning arrangement—excellent reception of difficult stations like 208—variable feed-back control—full tonal qualities—really superior looking cabinet size 11 x 8 x 3in. approximately—car aerial attachment—several months operation from battery costing only 3/6.

Circuit employs six transistors and two diodes, it incorporates all latest refinements, and oscillator I.F. Transformer are pre-aligned so no instruments are necessary. Anyone who can solder competently can make this set. The instructions are fully comprehensive with plenty of illustrations. Service is available in the unlikely event of your getting into difficulties. All components fully guaranteed.

Price of all components and cabinet to make set as illustrated **£9.19.6.** Post and insurance **5/-.** Battery **3/6** extra.

AGENTS REQUIRED
to make up this receiver

SUB MINIATURE COMPONENTS FOR TRANSISTOR SETS

- ★ Push-pull o.p.t. and driver **17/9** pair (500 milliwatt). **12/6** pair (300 milliwatt).
- ★ Push-pull driver with Sep. Secondaries for transformerless output **6/6.**
- ★ 3 IF transformers and oscillator and circuit **23/6.**
- ★ Ferrite aerial with coils for medium and long wave with circuit for pocket sets **7/6.**
- ★ Smallest possible electrolytics **1/9** each. 1 mfd., 2 mfd., 8 mfd., 10 mfd., 20 mfd., 30 mfd., 50 mfd., 100 mfd., 200 mfd.
- ★ Smallest ¼ watt resistors **5d.** each all popular values.
- ★ Miniature 0.1 mfd., **1/-**. 0.05, 0.01 **8d.** values up to 0.005 **6d.** each.
- ★ Miniature slide switch **2/6.**
- ★ Edgewise Volume controls, 2K., 5K., 10K., 20K., all **2/6** each.
- ★ Set of 6 transistors for superhet in original packets guaranteed. Mullard OC44., OC45., OC71 matched pair OC72 **£2.0.0** the set.
- ★ 3in. Speakers 3 ohm **18/6.**
- ★ 3in. Speakers 80 ohm **18/6.**
- ★ 2½in. Speakers 3 ohm **19/6.**
- ★ Elliptical Speaker, 7" x 4", 3 ohm or 35 ohm **19/6.**

POCKET LOUDSPEAKER TRANSISTOR RADIO

Available Again at 42/6

Read these Testimonials

D. A. Hilton, Leigh, Lancs.
"I received 'Pocket 4' on Christmas Day. I made it up on Boxing Day and I am very pleased with the results. It brings in local stations and many foreign stations including Luxembourg at good strength. I am 13 years old".

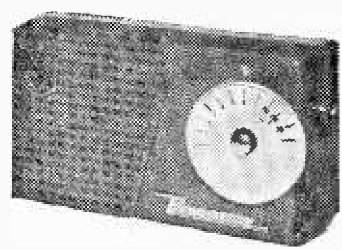
Mr. J. Bell, Wolverhampton.
"I am writing to express my satisfaction at the standard of your kit for your Pocket 4 Transistor set and also to state that it has come up to my expectations in regard to performance".

Mr. R. Belt, Newcastle-on-Tyne.
"I have built your Pocket 5 Transistor set. I am very pleased with it".

Mr. F. Jackson, Ickenham, Middx.
"I have built the Pocket 4 and am more than pleased with the results".

Mr. G. Bamford, Ramsgate.
"I find this set even better than you claim it to be and most certainly up to your usual standard of quality. I feel that nobody could fail to build it and get results. Even the first-time-ever novice, as your circuit diagrams and instructions are so clear and precise".

Mr. A. J. Simmonds, Welling, Kent.
"I purchased from you a week ago the Pocket 4 Transistor Kit. I put it together last night in 1½ hours, on switching on the set I was right on Radio Luxembourg. I must say thank you because not only has the set a very attractive appearance, it also behaves fantastically".



Circuit comprises 2 HF transistors reflexed to equal 4 stages. Permanent germanium diode and high gain AF output stage, fitted with miniature speaker, proper tuning condenser, volume control and in case with handle as illustrated (less monogram), completely portable. No **aerial or earth required.** Pocket 4 uses 3 transistors and 1 diode, price **42/6**, plus 2/6 post and insurance. Pocket 5 uses 4 transistors and 1 diode and has feedback control, price 55/-, plus 2/6 post and insurance. Prices are for medium wave models, long or medium versions **8/6** extra.

GOOD RESULTS EVERYWHERE

Nothing can be more disappointing than to find that despite care in making up, your radio just will not work or needs a long high aerial and water pipe earth. We can prove good results in all areas and we guarantee all components for 12 months. Read just a few of the hundreds of testimonials we have received from constructors who have made these sets. Send in confidence. Money refunded if not up to your expectations. Plans free with parts, or separately **1/6.** More details S.A.E.

ELECTRONIC PRECISION EQUIPMENT LTD.

post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66 Grove Road, Eastbourne, marked Department 7. Callers may use any one of the Companies below.

266 London Road, Croydon. Phone: CRO 6558 Half day Wednesday	**29 Stroud Green Rd., Finsbury Park, N.4.** Phone: ARChway 1049 Half day Thursday	**520 High Street North, Manor Park, E.12.** Phone: ILFord 1011 Half day Thursday	**42-46 Windmill Hill, Ruislip, Middx.** Phone: RUIslip 5780 Half day Wednesday	**246 High Street, Harlesden, N.W.10.** Phone: ELGar 4444 Half day Thursday

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1. Telephone: PRIMROSE 9090

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OB2	17/6	6F11	17/3	10F1	26/6	35Z3	10/6	DK91	6/6	EF50(E)	5/-	KL35	8/6	PM84	17/3	UABC80	9/-	XFY34	17/6
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1A5	6/-	6F13	11/6	10LD3	8/6	35Z5GT	9/-	DK96	8/6	EF73	10/6	KT2	5/-	PY31	16/7	UB41	12/-	XSG(1.5)	6/6
1A7GT	12/-	6F15	15/3	10LD11		43	10/-	DL33	9/6	EF80	6/-	KT33C	10/-	PY32	12/6	UBC41	8/6	Y63	7/6
1C5	12/6	6F23	10/6		15/11	50C5	10/-	DL66	17/6	EF85	6/-	KT36	29/10	PY80	7/6	UBC81	11/4	Z63	7/6
1D6	10/6	6F32	10/6	10P13	15/-	50CD6G		DL68	15/-	EF86	10/6	KT41	23/3	PY81	8/6	UBF80	9/-	Z66	17/6
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1LD5	5/-	6J5	5/-	12AD6	17/3	77	8/-	DL96	8/6	EF97	13/3	KT66	15/-	PZ30	19/11	UCC85	9/-	*Transistors*	
1LN5	5/-	6J6	5/6	12AE6	13/11	78	6/6	DM70	7/6	EF98	13/3	KT88	24/-	QP21	7/-	UCF80	16/7	*and diodes*	
1N5GT	10/6	6J7G	6/-	12AH7	8/-	80	9/-	E80F	20/-	EF183	18/7	KTW61	6/6	QP25	14/6	UCH21	23/3	CG1C	7/6
1R5	6/6	6J7GT	10/6	12AH8	12/6	83	15/-	E83F	37/6	EF184	18/7	KTW62	7/6	QS150/15		UCH42	9/6	CG4E	7/6
1S4	9/-	6K7G	5/-	12AT6	7/6	85A2	25/-	EA50	2/-	EK32	8/6	KTW63	6/6		10/6	UCH81	9/6	CG6E	7/6
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2P	26/6	6K25	19/11	12AV6	12/8	304	10/6	EAF42	9/-	EL38	26/6	MHL4	7/6	RG1/240A		UF42	12/6	GD3, 4, 5,	
2X2	4/6	6L1	23/3	12AX7	7/6	305	10/6	EB34	2/6	EL41	9/-	MHLD6	12/6		45/-	UF80	10/6	6, 8	4/-
3A4	6/-	6L6G	8/-	12BA6	8/-	807	7/6	EB41	8/6	EL42	10/6	ML4	8/6	RK34	7/6	UF85	9/-	OA70	4/-
3A5	10/6	6L6M	9/6	12BE6	9/-	956	3/-	EB91	4/-	EL81	16/7	MS4B	23/3	S130	22/6	UF86	17/11	OA73	4/-
3B7	12/6	6L7GT	7/6	12BH7	21/3	1821	16/7	EBC3	23/3	EL83	19/11	MU12/14	8/-	SP4(7)	14/6	UF89	9/-	OA79	4/-
3D6	5/-	6L18	13/-	12E1	30/-	4033L	12/6	EBC33	5/-	EL84	7/6	N37	23/3	SP41	3/6	UL41	9/-	OA81	4/-
3Q4	7/6	6L19	23/3	12J5GT	4/6	S763	12/6	EBC41	8/6	EL85	13/11	N78	19/11	SP42	12/6	UL44	26/6	OA86	6/-
3Q5GT	9/6	6LD3	8/6	12J7GT	9/6	7193	5/-	EBC81	8/-	EL86	17/3	N108	23/3	SP61	3/6	UL46	14/6	OA91	5/-
3S4	7/-	6LD20	15/11	12K5	17/11	7475	7/6	EBF80	9/-	EL91	5/-	N308	20/7	SU25	26/6	UL84	8/6	OA95	5/-
3V4	7/6	6N7	8/-	12K7GT	5/6	9002	5/6	EBF83	13/11	EL95	10/6	N339	15/-	SU61	9/-	UM4	17/3	OA210	25/-
5R4GY	17/6	6P25	12/6	12K8GT	14/-	AC/PEN		EBF89	9/6	EL820	18/7	P61	3/6	T41	9/-	UM34	17/3	OA211	40/-
5U4G	6/6	6P26	19/11	12Q7GT	5/-	5-pin	23/3	EBL21	23/3	EL822	25/-	PABC80		TDD4	12/6	UM80	15/3	OC16	54/-
5V4G	10/-	6P28	26/6	12SA7	8/6	7-pin	15/-	EBL31	23/3	EM34	9/6		13/11	TH41	26/6	URIC	18/7	OC19	54/-
5Y3	6/6	6Q7G	6/6	12SC7	8/6	AC2PEN/		EC52	5/6	EM71	23/3	PCC84	8/-	TH233	33/2	UU6	19/11	OC23	87/-
5Z3	12/6	6Q7GT	11/-	12SG7	7/-	DD	12/6	EC54	6/-	EM80	9/-	PCC85	9/6	TH2321	20/-	UU7	16/7	OC26	44/-
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6A7	10/6	6SA7GT	8/6	12SJ7	8/6	AC/TP	33/2	EC92	13/3	EM84	10/6	PCC89	11/6	TP25	15/-	UU9	7/6	OC35	48/-
6A8	9/-	6SC7	7/6	12SK7	6/-	ATP4	5/-	ECC32	5/6	EM85	17/3	PCF80	8/-	TP2620	33/2	UY1N	18/7	OC44	26/-
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6AG5	5/6	6SH7GT	8/-	12SR7	8/6	AZ31	10/-	ECC34	24/7	EY51	9/-	PCF84	16/7	U12/14	8/6	UY41	7/6	OC65	22/6
6AG7	7/6	6SJ7GT	8/-	12Y4	10/6	AZ41	13/11	ECC35	8/6	EY83	16/7	PCF86	15/-	U16	10/-	UY85	7/-	OC66	25/-
6AK5	8/-	6SK7GT	6/-	14S7	27/10	B36	15/-	ECC40	23/3	EY84	14/-	PCL82	10/-	U18/20	8/6	VMP4G	15/-	OC70	14/-
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6AM6	4/6	6SN7GT	5/6	19H1	10/-	C1	12/6	ECC82	6/6	EZ35	6/-	PCL84	12/6	U22	8/-	VP2	12/6	OC72	17/-
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6BH6	8/-	6X5GT	6/-	25L6GT	10/-	CY31	11/-	ECH3	26/6	GZ30	9/-	PEN44	26/6	U45	9/-	VT61A	5/-	TJ1	40/-
6BJ6	6/-	6/30L2	10/-	25Y5G	10/-	D1	3/-	ECH21	23/3	GZ32	10/-	PEN45	19/6	U50	6/6	VT501	5/-	TJ2	45/-
6BQ7A	15/-	7A7	12/6	25Z4G	9/6	D15	10/6	ECH35	6/6	GZ33	19/11	PEN45DD		U52	6/6	W76	5/6	TJ3	50/-
6BR7	23/3	7B6	21/3	25Z5	9/6	D63	5/-	ECH42	9/-	GZ34	14/-		26/6	U54	19/11	W81M	6/-	TP1	40/-
6BS7	25/-	7B7	8/6	25Z6G	10/-	D77	4/-	ECH81	9/-	GZ37	19/11	PEN46	7/6	U76	6/-	W107	18/7	TP2	40/-
6BW6	8/6	7C5	8/-	27SU	19/11	DAC32	10/6	ECH83	13/11	H63	12/6	PEN383	23/3	U78	5/-	W729	19/11	TS1	10/-
6BW7	6/-	7C6	8/-	28D7	7/-	DAF91	6/-	ECL80	9/-	HABC80		PEN453DD		U107	16/7	X24M	24/7	TS2	12/6
6BX6	6/-	7H7	6/-	30C1	8/-	DAF96	8/6	ECL82	10/6		13/6		33/2	U191	16/7	X41	15/-	TS3	15/-
6C4	5/-	7R7	12/6	30F5	6/-	DD41	13/11	ECL83	19/3	HL2	7/6	PEN/DD		U201	16/7	X61(C)	12/6	TS4	24/-
6C5	6/6	7S7	9/6	30FL1	10/-	DET25	7/6	ECL86	16/7	HL23	15/3	4020	33/2	U251	14/-	X63	9/-	V30/10P	28/6
6C6	6/6	7V7	8/6	30L1	8/-	DF33	10/6	EF9	23/3	HL23DD	7/6	PL33	19/3	U281	19/11	X65	12/6	XA101	23/-
6C9	13/6	7Y4	7/6	30L15	11/6	DF66	15/-	EF22	14/-	HL41DD		PL36	12/-	U282	22/7	X66	12/6	XA102	26/-
6C10	9/-	8D2	3/6	30P4	12/-	DF91	3/6	EF36	4/-		19/3	PL38	26/6	U301	23/3	X76M	14/-	XA103	15/-
6CD6G	36/6	8D3	4/6	30P12	7/6	DF96	8/6	EF37A	8/-	HL42DD		PL81	10/6	U329	14/-	X78	23/3	XA104	18/-
6CH6	9/-	9BW6	15/3	30PL1	10/6	DF97	9/-	EF39	5/6		19/3	PL82	7/6	U339	16/7	X79	23/3	XB102	10/-
6D6	6/6	9D2	4/-	30PL13	16/6	DH63	6/6	EF40	15/-	HN309	24/7	PL83	9/-	U403	16/7	X109	17/3	XB103	14/-
6E5	12/6	10C1	13/-	35A5	21/3	DH76	5/-	EF41	9/-	HVR2	20/-	PL84	12/8	U404	8/6	XD(1.5)	6/6	XB104	10/-
6F1	26/6	10C2	26/6	35L6GT	9/6	DH77	7/-	EF42	10/6	HVR2A	6/-	PL820	18/7	U801	29/10	XFG1	18/-	XC101	16/-

RADIO BOOKS. MULLARD AMPLIFIER MANUAL 9/6d. MULLARD TRANSISTOR MANUAL 13/6d. BRIMAR VALVE MANUAL 7/-. ALL POST FREE.

VOLUME CONTROLS

All with Long Spindle and Double-pole Switch, 4/6 each.

10 K 25 K 50 K 100 K

¼ mg. ½ mg. 1 meg. 2 meg.

METAL RECTIFIERS *Full List with ratings free for S.A.E.*

DRM1B	13/-	RM-1	5/3	14A86	17/6	14B130	35/-	14RA 1-2-8-3 (FC31)	21/-	18RA 1-1-16-1 (FC116)	6/6
DRM2B	15/6	RM-2	7/6	14A97	25/-	14B261	11/6	16RD 2-2-8-1	12/-	18RA 1-2-8-1	11/-
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RM-0	7/11	RM-5	19/6	14A163	38/-						

JUST OUT. MIDGET SILICON RECTIFIERS. OUTPUT 120 VOLTS AT ½ AMP. TWO IN SERIES GIVE 240 VOLTS AT ½ AMP. NO LARGER THAN A RESISTOR. 10/6 EACH.

ELECTROLYTIC CONDENSERS

Standard Can						Wire-ended tubular			
16 x 8 x 8 mfd., 500 v.	4/-	60 x 250 mfd., 275 v.	9/6	200 mfd., 275 v.	4/-	8 mfd., 450 v.	1/9	8 x 8 mfd., 450 v.	3/-
32 x 32 mfd., 450 v.	5/9	100x400 mfd., 275 v.	12/6			16 mfd., 450 v.	2/9	16 x 16 mfd., 450 v.	4/-
64 x 120 mfd., 350 v.	8/3	100 mfd., 275 v.	3/-	100x200 mfd., 275 v.	9/6	32 mfd., 450 v.	3/9	32 x 32 mfd., 350 v.	4/-
								8 x 16 mfd., 450 v.	3/9

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83 HIGH STREET, MERTON,

GRAM AND TAPE EQUIPMENT BARGAINS

MONAURAL AMPLIFIER KIT
This comprises a complete kit of parts (including UCL82 valve) to build a quality 3W amplifier, size 7 x 3¼ x 6½in. Efficient Circuit with volume and tone controls. Everything supplied including mains and O.P. transformers, metal rect., knobs, etc. and comprehensive instructions.
ONLY **39/6** Post and packing 4/6 extra.
5in. loudspeaker (3Ω) to suit, 14/6 extra.
All parts sold separately.

A.M. RADIOGRAM CHASSIS
A modern chassis by a famous maker. Size 15½ x 7 x 6½in. high, incorporating fully delayed AVC and neg-feed back. Valves ECH81, EF89, EBC81, EL84, EZ81. Attractive brown and gold dial with matching knobs. Controls—w/change (L.M.S. and gram), tone, tuning and vol. on/off. Complete with O.P. trans, valves, knobs, etc. **£9.19.6** plus 4/6 P. & P.

F.M. TUNER HEAD
Made by famous manufacturer. 88-100 Mc/s. Non-drift. Uses ECC85 valve (PRICE) (less valve) **14/6** plus 1 6 P. & P.
ECC85 valve 8/6 extra.

RECORD CHANGERS
Write for our new super list of Tape Decks and Changers.

B.S.R.

Monarch UA8 4-spd. a/changer	£6.19. 6
TU8 4-spd. single player less P.U.	£2.10. 0
UA14 Stereo Changer	£9. 5. 0

NOTE; Any of our Mono Players with Stereo Cartridge and Fittings, 16/- extra. Carriage and ins. on each of above 5/- extra.

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LATEST B.S.R. MONARDECK (single speed) 3¾in. per sec., simple control, uses 5¾in. spools .... £7. 5. 0 plus 5/6 carr. and ins. (tapes extra).
TRUVOX MARK III TAPE DECK. New and Boxed .... £10.6. 6 Plus 6/- carr. and ins. (tapes extra).

HI/FI STEREO/MONAURAL AMPLIFIER
A 5 valve HI/FI amplifier with switched stereo/monaural operation. Output 3 watts per channel, provision for bass and treble speakers on each. Volume and tone controls fitted both channels. All housed in stylish blue/grey metal case, with gold finished knobs and trimmings. **£9.19.6** plus 4/6 P. & P.

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A 3-valve amplifier (ex-relay unit). Comprising 10F3 RF amp, 10P14 Audio amp (3W) and U404 rect. Inputs for AC/DC mains, 6 preset channels and crystal P.U. Complete in attractive brown and cream bakelite case, with 8in. 15Ω speaker fitted. Ideal gram, guitar, amplifier, etc. ONLY **21/-** Plus 6/6 P. & P.

THE WORLD FAMOUS E.M.I ANGEL TRANSCRIPTION P.U. (Model 17A)
A Pick-up for the connoisseur originally priced at £17.10.0. The last remaining few offered at **£4.10.0** Plus 5/- P. & P.

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Heavy 8¾in. metal turntable. Low flutter performance, 200/250 v. shaded motor with tap at 80 v. for amplifier valve filament if required. Turnover LP/78 head.
89/6 COMPLETE Plus 4/6 P. & P.

E.M.I 4-SPEED STEREO PLAYER
To suit our stereo amplifiers Plus 5/- carr. **£6.12.6**

SWITCHED ATTENUATOR
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A kit of ready-built units only requiring interconnection. Comprising two midget 3W amplifiers, push button switch, transformer, control unit (bass, treble and vol.), power pack, one speaker (second speaker 14/6 extra), indicator light, valves (ECL82, EZ80 range), and comprehensive instructions. **59/6** plus 6/6 P. & P.

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A compact amplifier embodying the latest features, giving good reproduction and ample volume. Complete with valves (ECL82, ECL82, EZ80), panel, knobs, etc., and two 3Ω matched speakers. **£5.10.0** Plus 4/6 P. & P.

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U17	11/9
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UCL82	15/6
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UF41	8/6
UF85	8/6
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1N5	9/9
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1S4	9/9
1S5	6/-
1T4	5/6
2C26	1/3
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6BR7	11/9
6BW6	8/6
6BW7	8/-
6C4	3/9
6C5GT	6/-
6C6	4/6
6C31	7/-
6CD6G	28/-
6D6	4/6
6CH6	9/9
6F6G	7/-
6F6M	7/-
6F1	13/-
6F13	13/-
6F15	13/-
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6F33	16/6
6H6	2/3
6H6GT	2/3
6J5GT	4/6
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6J7G	6/-
6J7M	8/6
6K7G	3/9
6K7M	6/3
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6X5GT	6/6
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7C5	7/6
7C6	7/6
7D6	12/6
7H7	8/6
7Q7	8/6
7S7	9/-
7Y4	8/-
8D2	2/6
9D2	3/3
10C1	11/9
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12AX7	7/6
12BA6	8/6
12BE6	8/6
12C8	8/6
12E1	32/6
12H6	3/3
12J5GT	2/9
12J7GT	10/-
12K7GT	7/-
12K8GT	13/-
12Q7GT	7/-
12SG7	7/-
12SH7	5/6
12SJ7	5/6
12SK7	5/6
12SN7	7/6
12SL7GT	14/-
12SQ7	8/-
14S7	15/9
15D2	7/3
19AQ5	9/-
19BG6G	3/-
20D1	5/-
20F2	25/-
20L1	25/-
20P1	25/-
20P3	22/-
20P4	25/-
20P5	22/-
25A6G	9/9
25L6GT	9/6
25Z4	9/-
25Z5	7/6
25Z6	9/6
27SU	18/6
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30L1	18/6
30P4	19/-
30P12	11/9
30P16	9/-
30PL1	11/9
35L6GT	9/3
25Y5	9/3
35W4	7/-
35Z4GT	7/6
42	7/6
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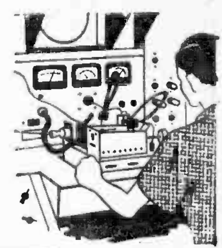

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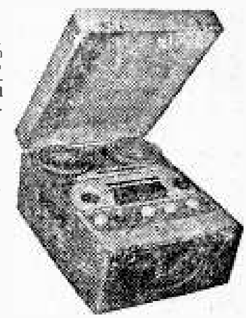
The Recorder incorporates the Latest Collaro Studio Tape Transcriptor. The Linear L45X High Quality Tape Amplifier listed £12.12.0 High Flux P.M. Speaker listed 30/-, empty Tape Spool, a Reel of Best quality Tape listed 22/6, and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 18 x 13 x 9in. high, listed £4.10.0, and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflet.

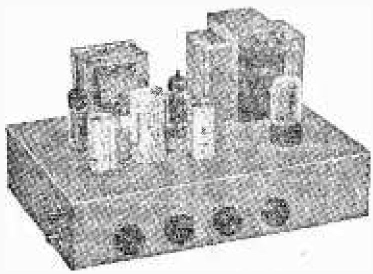


25½ GNS. Carr. 17/6

H.P. TERMS. Deposit £5.7.6 and 12 monthly payments of 2 gns. Cash price if settled in 3 months.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

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



Two input sockets with associated controls allow mixing of "mike" and gram, as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For **STANDARD or LONG PLAYING RECORDS** For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS,** etc. **OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/- (Or factory built 45/- extra).

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

A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts, suitable for all crystal stereo heads. Ganged Bass and Treble Controls give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. **8 Gns.** Full constructional details and price list 2/6 Carr. 10/-

TELEVISION RECTIFIERS 250 v. 200 mA. small size. Only **6/9** each.

COLLARO CONQUEST 4-SPEED AUTO-CHANGER with high fidelity Studio pick-up. Latest model. For 200-250 v. 50 c.p.s. A.C. mains. Our price **£6.19.6.** Carr. 5/6.

COLLARO RC 457 4 SPEED MIXER AUTO-CHANGERS. Turnover Studio Pick-up head, for 200-250 v. A.C. **£7.19.6.** Carr. 4/6.

THE SKYFOUR T.R.F. RECEIVER A design of a 3-valve Long and Medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion detector. Valve line-up 6K7, SP61, 6V6G. Selectivity and quality excellent. Simple to construct. Point-to Point wiring diagrams, instructions and parts list, 1/9, maximum building costs **£4.19.6.** inc. attractive Walnut veneered wood cabinet 12 x 6½ x 5½in.

D.C. SUPPLY KIT. 12 v. 1 a. consisting of a partially drilled metal case, mains trans., F.W. Bridge Rectifier, 2 fuseholders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable for Electric Trains. Limited number available at **33/9.**

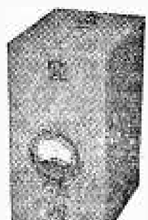
R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250 v., 50 ccs. Guaranteed 12 months.

HEAVY DUTY CHARGER KIT 6/12 v. 6 amps. variable output. Consisting of Mains Transformer 0-200-230-250 v.; F.W. (Bridge) Selenium Rectifier; Ammeter, Variable Charge Rate Selector Panels, Plugs, Fuses, Fuseholder and circuit, 59/9. Carr. 4/6.

DEAF AID EARPIECES. Low Impedance with lead, 8/9. High Impedance Crystal 8/9.

MICROPHONE INSERTS. Crystal type. 6/9.



Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finished. Fused and ready for use with mains and output leads. **69/9** Carr. 5/- Terms: Deposit **13/3** and 5 monthly payments 13/3.

ASSEMBLED CHARGER 6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Ready for use With mains and output leads. Double Fused. Only **49/9** Carr. 3/9.

BATTERY CHARGER KITS Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 3/6 extra.

6 v. or 12 v. 1 amp	24/9
As above, with Ammeter	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. inclusive of Ammeter	42/9
6 v. or 12 v. 4 amps.	53/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector	59/9

CHARGER AMMETERS. 0-1.5 a., 0-3 a., 0-4 a., 0-7 a., 0-25 a., 0-60 a. 8/9.

R.S.C. MAINS TRANSFORMERS (FULLY GUARANTEED)

Interleaved and Impregnated. Primaries 200-230-250 v. 50 c/s. Screened

TOP SHROUDED DROP THROUGH

250-0-250 v. 70 mA. 6.3 v. 2 a, 5 v. 2 a	17/9
350-0-350 v. 80 mA. 6.3 v. 2 a, 5 v. 2 a	18/9
250-0-250 v. 100 mA, 6.3 v. 2 a, 6.3 v. 1 a	19/9
250-0-250 v 100 mA, 6.3 v. 3.5 a, C.T.	19/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	25/9
300-0-300 v. 130 mA. 6.3 v. 4 a, 6.3 v. 1 a, for Mullard 510 Amplifier	29/9
300-0-300 v. 100 mA, 6.3 v 4 a, 5 v. 3 a	26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	26/9
350-0-350 v. 100 mA, 6.3 v. 4 v. 4 a, C.T. 0-4-5 v. 3 a	26/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a	29/9

FULLY SHROUDED UPRIGHT

250-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in.	17/11
250-0-250 v. 100 mA. 6.3 v. 4 a, 5 v. 3 a	27/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	27/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a	27/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a	35/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a C.T., 5 v. 3 a	49/9

FILAMENT TRANSFORMERS All with 200-250 v. 50 c/s, primaries 6.3 v. 1.5 a. 5/9; 6.3 v. 2 a. 7/6; 0-4-6.3 v. 2 a. 7/9; 12 v. 1 a. 7/11; 6.3 v. 3 a. 8/11; 6.3 v. 6 a. 17/6; 12 v. 1.5 a twice, 17/6.

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	3/9
Small Pentode, 5000 Ω to 3 Ω	3/9
Small Pentode 7/8,000 Ω to 3 Ω	3/9
Standard Pentode 5,000 Ω to 3 Ω	5/6
Standard Pentode 7/8,000 Ω to 3 Ω	5/6
10,000 Ω to 3 Ω	5/6
Push-Pull 10-12 watts 6V6 to 3 Ω or 15 Ω	18/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω	19/[illegible]
Push-Pull EL84 to 3 or 15 Ω	3/[illegible]
Push-Pull 15-18 watts, 6L6, KT66	22/9
Push-Pull for Mullard 510 Ultra Linear	29/9
Push-Pull 20 watts, sectionally wound 6L6, KT66 etc., to 3 to 15 Ω	47/9

ELIMINATOR TRANSFORMERS Primaries 200-250 v. 50 c/s.

120 v 40 mA, 5-0-5 v. 1 a.	15/9
90 v. 15 mA, 4-0-4 v. 500 mA	9/9

SMOOTHING CHOKES

150 mA. 7-10 H 250 ohms.	11/9
100 mA, 10 H 200 ohms	8/9
80 mA, 10 H 350 ohms	5/9
60 mA. 10 H 400 ohms	4/11

CHARGER TRANSFORMERS All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a. **11/9**; 0-9-15 v. 2 a., **14/9**; 0-9-15 v. 3 a. **16/9**; 0-9-15 v. 5 a. **19/9**; 0-9-15 v. 6 a. **23/9**; 0-9-15 v. 8 a. **28/9.**

AUTO (Step up/Step down) TRANS. 0-110/120-200/230/250 v. 50-80 watts **13/9**; 0-110/120-200/230/250 v. 150 watts, **£7/9.**

MICROPHONE TRANSFORMERS 120:1 high grade, clamped, **6/9**; 120:1 Potted. Mu-metal screened, **9/9.**

R.S.C. (Manchester) Ltd. LIVERPOOL, LEEDS, BRADFORD, MANCHESTER

R.S.C. A12 STEREOPHONIC AMPLIFIER KIT

A complete set of parts to construct a Stereo amplifier with an undistorted output total 6 watts. For A.C. mains input of 200-250 v. Outputs for matched 2-3 ohm speakers. Sensitivity 130 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and point-to-point wiring diagrams supplied. Only good quality components and latest high grade valves used. Exceptionally realistic reproduction can be obtained at ample volume for the home, as can be demonstrated in typical surroundings at our County Arcade premises. A really sensational offer.

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STEREO EQUIPMENT OFFER. Comprising A12 Kit, 2 matched 8in. L/Speakers, and Acos T/O Stereo head suitable most pick-ups. **£6.19.6** Carr. 7/6

PICK-UP ARMS complete with Hi-Fi turnover crystal head. Acos GP54. Limited number brand new, perfect at approx. half price. Only 35/9.

ACOS CRYSTAL MICROPHONES. Mic40 stand or desk. Listed 45/-. Only 27/9. 39-1 Stick type. Listed 5 gns. Only 39/6.

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

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response—3 db. 30-30,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used EF86, EF86, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE.** The unit is designed for **CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS,** etc. For use with Electronic **ORGAN, GUITAR, STRING BASS,** etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for a **RADIO FEEDER UNIT** An extra input with associated vol. control is provided so that two separate inputs such as Gram. and 'Mike' can be mixed. Amplifier operates on 200-250 v. 50 c/cs. A.C. Mains and has output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required cover as for A11 can be supplied for 18/9. The amplifier can be supplied, factory built with EL34 output valves and 12 months' guarantee, for 14 Gns.

11 Gns. Carr. 10/-

TERMS: DEPOSIT 33/9 and 9 monthly payments of 33/9.

FULL RANGE OF LINEAR AMPLIFIERS ALWAYS IN STOCK.

COLLARO JUNIOR 4-speed single player units and Hi-Fi crystal pick-up with turn-over head. £3.19.6.

B.S.R. UA8 4-SPEED AUTO-CHANGERS with Hi-fi turnover pick-up head. £6.19.6. Carr. 5/-.

LINEAR L45 MINIATURE 4/5 WATT QUALITY AMPLIFIER. Suitable for use with any record playing unit, and most microphones. Negative feed-back 12db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c/cs. Output for 2-3 ohm speaker. Three miniature Mullard valves used. Size of unit only 7-5-5½in. high. Guaranteed for 12 months. Only £5.19.6. Send S.A.E. for illustrated leaflet. Terms: Deposit 22/6 and 5 monthly payments of 22/6.

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A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads, in addition to all other types of pick-ups and practically all 'mikes'. Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71db. down. 15db. of Negative feedback is used. H.T. or 300 v. 25 mA, and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape-Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4.15.0, or assembled ready for use 25/- extra, plus 3/6 carr.; or Deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

R.S.C. PORTABLE GUITAR AMPLIFIERS

Junior 5 watts High Quality output. Separate Bass and Treble "Cut" and "Boost" controls. Sensitivity 15 m.v.. Twin inputs. High Flux 8in. Loudspeaker "built-in". Handsome, strongly made Cabinet (size approx. 14 x 14 x 7in.) finished in attractive and durable policrome, and fitted carrying handle. H.P. Terms. Deposit £1 and 9 monthly payments of £1. **£8.19.6** Carr. 7/6

Senior 10 watts High Fidelity output. Separate Bass and Treble "Cut" and "Boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two loudspeakers are incorporated, a high Flux 12in. for Bass notes and a 7 x 4 in. elliptical for Treble. Cabinet is well made and finished as Junior model. Size approx. 18 x 18 x 18in. H.P. Terms. Deposit 34/9 and 9 monthly payments of 34/9. **15 Gns.** Both models for 200-250 v. Carr. 10/- A.C. mains. Above model fitted Linear Tremolo Unit 5 gns. extra. Or Deposit 11/6 and 9 monthly payments 11/6.

R.S.C. BASS REFLEX CABINETS. JUNIOR MODEL. Specially designed for W.B. HF1012 Speaker, but suitable for any good quality 10in. speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18 x 12 x 10in. Handsome appearance. Ensure superb reproduction for only £3.19.6.

STANDARD MODEL. As above but for 12in. speakers. Size 20 x 15 x 13in. Especially recommended for Plessey Dual Concentric Speaker. £5.19.6. Suitable legs with brass ferrules, 25/- per set of 4.

PLESSEY DUAL CONCENTRIC 12in. 15 ohms HIGH FIDELITY SPEAKER (12,000 lines) with built-in tweeter (completely separate elliptical speaker with choke, condensers, etc.) providing extraordinarily realistic reproduction when used with our A11 or similar amplifier. Rated 10 watts. Price only £5.19.6.

P.M. SPEAKERS. 2-3 ohm. 2½in. Perdio 21/9. 5in., 17/9. 6½in. 16/9. 8in., 19/9. 8 x 5in. 25/9. 10in. 26/9. 10 x 6in. 29/9. 12in. 29/11. 10in. W.B. "Stentorian" 3 or 15 ohms type HF1012 10 watts, hi-fidelity type. Recommended for use with our A11 Amplifier. £5.10.9. 1 2in. R.A. 3 ohms 10 watts (12,000 lines). 59/6.

TWEETERS. Plessey 3Ω 19/9. 15Ω 25/9.

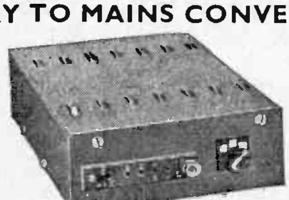
HI-FI CRYSTAL PICK-UP HEADS. (Turnover type with sapphire stylus.) Acos. Standard replacement for Garrard and B.S.R. B.S.R. Ful-fi. Garrard GC2. 19/9. B.S.R. Stereo-Monaural 39/11.

GL3A MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with any single or auto-change unit. Output for 2-3 ohm speaker. For 200-250 v. A.C mains. Size 11½ x 2½ x 2½in. Controls: Vol. and Tone with switch. Only 59/6.

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). Delayed A.V/C. Controls are Tuning, W/Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Simple alignment procedure. Point-to-Point wiring diagrams, instructions and priced parts list with illustration. 2/6. Total building cost £4.15.0. For leaflet send S.A.E.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces battery supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types.



Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v. 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed. **Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators when connected to** A.C. mains supply 200-250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit of parts with diagrams and instructions. 49/9, or ready for use, 59/6.

Complete kit with diagrams. 39/9, or ready to use, 46/9.

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6J5	3/6
6J5G	3/-
6J6	4/3
6J7	7/6
6J7G	5/-
6K6GT	6/6
6K7G	2/3
6K7GT	4/9
6K8G	5/9
6K8GT	8/9
6K8M	8/3
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FREQUENCY METER BC221 TECHNICAL MANUAL 22/6.

Field Telephone Type "L" Excellent guaranteed condition, £5.5.0 per pair, carriage paid.

Telephone Handset. Standard G.P.O. type, new, £1. P. & P. 1/6.

Transmitter/Receiver No. 22. 2 Mc/s to 8 Mc/s. Built almost exactly as No. 19 set but much more economical in battery consumption. Complete in fully working condition with power pack for 12 v., Headgear and Microphone assembly and Key, £9.19.6. Carriage 15/-.

Marconi SIGNAL GENERATOR. TF144G. 85 kc/s. 25 Mc/s. Made up to new standard. £70 delivered free.

U.H.F. SIGNAL GENERATOR TYPE T.S.14. 3,200–3,370 Mc/s, power measuring range 20–200 mW, R.F. output power —20 to —100 dbm below 1 mW. Power supply 115 w A.C. Price £15. Carriage 15/-.

S.C.R. 522 Receivers (BC624) 100–156 Mc/s, without valves, 7/6. P. & P. 5/-.

H.T. Chokes made by Bendix Radio (U.S.A.), 3 Henry's 0.600A D.C. 25 ohms D.C. resistance 18,000 v. R.M.S. 60 cycle test, £1.12.6. P. & P. 6/-. Ditto 10 Henry's 250A D.C. 90 ohms resistance 1,500 v. R.M.S. 60 cycle test, 16/6. P. & P. 3/6.

Carbon Inset Microphone, G.P.O. Type 2/6. P. & P. 1/-.

Miniature Relays. Changeover 12–30 v. D.C. supply, 5 amps contacts, 5/-. P. & P. 2/-.

Pre-set Double Potentiometers. 2 x 3,000 ohms linear 4 w, 5/-. P. & P. 1/6.

R109 Receivers. 1.8–8.5 Mc/s working from 6 v. D.C. Complete with all valves and built-in speaker. In excellent, guaranteed working condition. £5.5.0. Carriage and packing 15/-.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS

I.F. Transformers. 1st, 2nd, 3rd, 4th (for type D), 12/6 each or complete set of 6, 60/-.

I.F. Transformers. Crystal Load, 12/6 each

Plates escutcheons (for D and LF), 15/- each.

Dials (for type D), 10/- each.

Logging Dial (for D and LF), 10/- each.

Filter Chokes (for D and LF), 22/6 each.

Output Transformers (for LF), 30/- each.

Antenna Trimmers (LF and D), 2/6 each.

Filter Condenser 3 x 4μF, £2.10.0

Condensers:
3 x .25μF (D and LF), 2/6 each.
3 x .01μF (D and LF), 2/6 each.

RF Antenna Inductors (D and LF), 7/6 each.

Mains Transformers (LF), £3 each.

Small Mica Condensers, various values, 1/6 each.

Instruction Manual for AR88D, £1.

Specially Built Power Pack for TCS Receiver. 230 v. A.C. mains, including 6X5GT valve, £3.10.0. Carriage 5/-.

Marconi CR-100 Communications Receiver. 60 kc/s–30 Mc/s with noise limiter. Completely reconditioned, £25. Carriage 25/-.

T.C.S. Receivers. Made by Collins of U.S.A. In fully guaranteed working condition. 1.5–12 Mc/s. Line up: 12SA7 (1) 12SQ7 (1). 12A6 (2). 12SK7 (3). Power requirements 12 v. L.T., 225 v. H.T. £11.10.0. Carriage 12/6.

P. C. RADIO LTD.
170 GOLDHAWK RD., W.12
Shepherds Bush 4946

R209 Reception Set. A 10-valve High-Grade Super Heterodyne Receiver with facilities for receiving R/T (A.M. or F.M.) and C.W. Frequency 1–20 Mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2-point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loud-speaker or phone output. Overall measurements: Length 12in., width 8in., depth 9in. Weight 23 lbs. In as new, tested and guaranteed condition £23.10.0, including special headphone and supply leads. Carriage £1.

Supply Unit Rectifier No. 21. Fully sealed enabling all sets built for 6 v. (R209, R109, etc.) to work from A.C. mains. Input 90–260 v. A.C. (Taps at 10 v. intervals). Output excellently smoothed up to 10 amps with meter indicating exact output voltage. Measurements: 12 x 9 x 10in. Price £8. Carraige and packing 15/-.

19 Set Owners. To increase output of your set 6 to 10 times use **RF Amplifier No. 2** with built-in rotary converte for 12 v. input. Four 807 valves output. Simple connection with transmitter. Fully tested condition, £9.15.0, including necessary connectors and instructions. Carriage and packing 15/-.

Laboratory Precision Variable Condenser. Manufactured by General Radio Co., U.S.A. 50–1,500pF with micrometric drive and calibration chart. Overall dimensions of case 9 x 8 x 7in. Price £15. Carriage 15/-.

Vacuum Condenser. 32,000 v, 50pF, 12/6. P. & P. 3/-.

AR 88's. Completely rebuilt with new PVC wiring. Type "D" £75; Type "LF" £70.

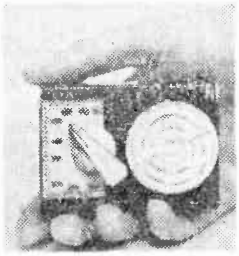
SENSATIONAL NEW 1961 DESIGNS—*BY CONCORD*

LOW PRICES ★ PICTORIAL STEP-BY-STEP PLANS ★ EASY AS A.B.C.

THE NEW "LISBON" TRANSISTOR SET

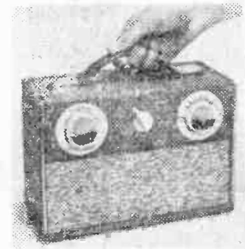
19/6

Build the miniature, highly sensitive **"LISBON"** design. This is a pocket 2-stage transistor set not much larger than a matchbox. Excellent clear reception covering all medium waves and working for months and months off a tiny 1½ or 3 volt battery costing only 3½d. A very simple set to build and an excellent introduction to transistor circuitry. Everything can be supplied down to the last nut and bolt including **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS FOR ONLY 19/6**, plus post and packing 1/6. (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



"MAJORCA" 7 TRANSISTOR RADIO

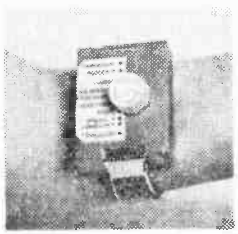
Build this 7-TRANSISTOR **£10.19.6** "MAJORCA" superhet portable with Car Radio aerial attachment. An exceptional high quality design giving remarkable tone with push-pull output. Can be built for **ONLY £10.19.6**, including everything down to the last nut and bolt and **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS.** Post and packing 3/6 (C.O.D. 3/- extra). Parts sold separately.



OUR NOVEL WRIST RADIO

22/6

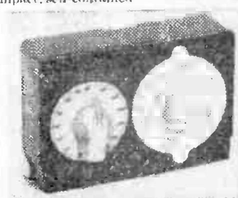
Our engineers have designed this novel Wrist Radio using latest transistor techniques. Size only 1½ x 1 x ½in. "Featherweight" yet gives clear, crisp reception over all medium waves. Tiny battery lasts months and months costing only 4d. No snags—anyone can build it in an hour or two using our **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS.** All parts can be supplied including case and strap **FOR ONLY 22/6**, plus post and packing 1/6 (C.O.D. 2/- extra.) Parts sold separately, priced parts list 1/-.



THE NEW "FLORIDA" VALVE RADIO

27/6

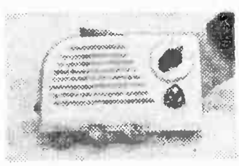
This sensational "FLORIDA" model is one of our most sensitive valve radios. It is a highly compact, self-contained miniature push button base, valve pocket radio at absolutely rock bottom building cost. Covers all medium waves with very latest circuitry bringing in stations from all over Europe without fuss. Size only 4½ x 2¾ x 1¼in. A fascinating pocket radio. We can supply all the parts including beautiful 2-tone case and **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**, screws, wire, etc. Can be built for the exceptionally **LOW PRICE OF 27/6**, plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



OUR NEW 4 STAGE "MINUETTE"

39/6

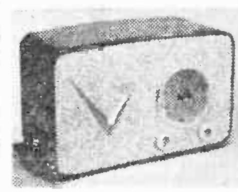
Build this newly-designed **"MINUETTE" 4-STAGE** transistor set in very strong ready drilled **ULTRA-MODERN CASE**, size only 6 x 3½ x 1in. Uses three transistors and diode and **SELF-CONTAINED LOUD SPEAKER.** Very sensitive, ideal for office, bedroom, holidays, etc. Months and months of listening off an 8d. battery. Can be built **FOR ONLY 39/6**, including **PROPER CASE**, miniature speaker, etc. **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**, etc., plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



THE NEW "MONTE-CARLO" RADIO

£5.15.0

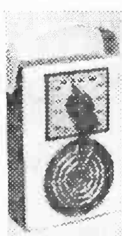
One of our new, exciting designs, the "MONTE CARLO" is a powerful, all mains, miniature table radio with the latest trimmings, gold insert knobs, special unmarkable plastic veneer, etc. The amazing circuit covers all medium and long waves with good selectivity, fantastic tone and output. Includes ready drilled and punched chassis, standard octal base valves, etc. All the parts can be supplied including **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS.** Everything down to the last nut and bolt **FOR ONLY £5.15.0**, plus post and packing 3/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



THE NEW 3-STAGE "RIO"

29/6

Our fabulous new **3-STAGE MINIATURE LOUDSPEAKER DESIGN THE "RIO"** covers all medium waves including Home, Light, etc. Very reliable and lightweight. Works for months and months off an 8d. battery. Can be assembled in an hour or two. All parts can be supplied including miniature speaker and everything down to the last nut and bolt with **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS** for **ONLY 29/6**, plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



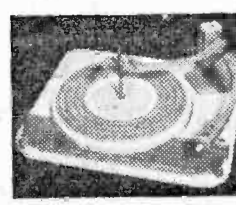
BRAND NEW RECORD CHANGERS

ONLY £8.15.0 BRAND NEW! the latest 4-speed Autochanger, B.S.R. UA14, as illustrated, few only **OUR PRICE £8.15.0. P.P. 3/6.**

BRAND NEW! the B.S.R. 4-speed Autochanger, UA8, few only left. **OUR PRICE £[illegible].15.0. P. & P. 3/6.**

BRAND NEW! the **COLLARO** Junior 4-speed record player. **OUR PRICE 75/-. P. & P. 3/6.**

BRAND NEW! COLLARO "Conquest", 4-speed Autochanger. **OUR PRICE £7.15.0 P. & P. 3/6.**



CONCORD ELECTRONICS Dept. PW32

210, Church Road, Hove, Sussex

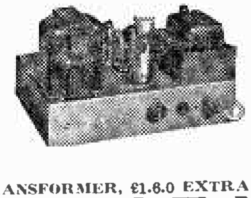
Cheques accepted. Cash on delivery 2/- extra. Please print name and address in block letters. Suppliers to Schools, Universities, Government and Research Establishments. Complete range of components and valves stocked. *Regret no C.O.D. abroad.*

DEMONSTRATIONS DAILY AT WORKS

STERN'S MULLARD DESIGNS

Designed by MULLARD—presented by STERN'S strictly to specification

COMPLETE KIT OF PARTS— MULLARD "5-10" MAIN AMPLIFIER



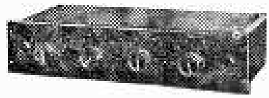
For use with the MULLARD 2-valve pre-amplifier with which undistorted power output of up to 10 watts is obtained. We supply **SPECIFIED COMPONENTS AND NEW MULLARD VALVES**, including **PARMEKO MAINS TRANSFORMER** and choice of the latest Ultra-Linear **PARMEKO** or the **PARTRIDGE** Output Transformer.

PRICE COMPLETE KIT (**PARMEKO** Output Trans.). **£10.0.0**

Alternatively we supply **ASSEMBLED and TESTED**. **£11.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER, £1.6.0 EXTRA

MULLARD'S PRE-AMPLIFIER TONE CONTROL UNIT



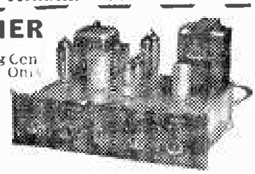
Employing two EF86 valves, and designed to operate with the MULLARD **MAIN AMPLIFIERS**, but also perfectly suitable for other makes.

PRICE COMPLETE KITS OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

Supplied strictly to **MULLARD'S SPECIFICATION** and incorporating:

- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups, and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-amplifier.
- Sensitive Microphone Channel.
- Wide range **BASS** and **TREBLE** Controls.

COMPLETE MULLARD "5-10" AMPLIFIER



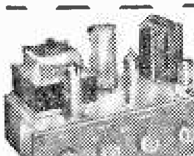
The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Only Specified Components and new **MULLARD VALVES** are supplied including **PARMEKO MAINS TRANSFORMERS** and choice of the latest **PARMEKO** or **PARTRIDGE** ULTRA-Linear Output Transformers.

KIT OF PARTS **£11.10.0** OR ASSEMBLED and TESTED **£13.10.0**

HIRE PURCHASE (Assembled Amp. only). DEPOSIT £2.14.0 12 months at 19/10.

ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.

COMPLETE MULLARD "3-3"



THE IDEAL AMPLIFIER FOR A SMALL HIGH QUALITY INSTALLATION PROVIDING EXCELLENT REPRODUCTION OF UP TO 3 WATTS OUTPUT

COMPLETE KIT OF PARTS **£7.10.0** OR ASSEMBLED and TESTED **£8.19.6**

(plus 6/6 carriage and insurance) H.P. Terms: Deposit 32.0.0 and 8 Months at £1.0.0. Complete to MULLARD'S SPECIFICATION including Mullard valves and a **PARMEKO OUTPUT TRANSFORMER.**

THE "ADD-A-DECK"

Incorporating GARRARD "MAGAZINE" TAPE and the MATCHED MODEL HF/G2P PRE-AMPLIFIER

Supplied on ONE CHASSIS (as illustrated) READY FOR USE **18 Gns.**

(Carr. & Ins. 10/- extra).

Price includes Garrard Magazine and a 4in. Spool Double Play Tape

H.P. Deposit £2.16.0, and 12 months of £1.7.8.

Provides complete tape recording facilities and designed to operate through the pick-up sockets of the standard type of RADIO RECEIVER, or an AMPLIFIER, from which really first class reproduction is obtained. It consists of a Twin Track Deck connected to the Pre-amplifier and operates at 3¾in/sec. speed providing up to 1 hr. 10 mins. playing time.

RECORD PLAYERS

THE LATEST MODELS ARE IN STOCK, MANY AT REDUCED PRICES

SEND S.A.E. FOR ILLUSTRATED LEAFLET

B.S.R. MONARCH UA8 4-speed mixer Autochanger with Crystal Pick-up.	**£6.19.6**
The **NEW COLLARO MODEL RP594** 4-speed Single Record Player. Studio Cartridge.	**£9.18.9**
The **NEW COLLARO C60** 4-speed Autochanger unit with Studio "O" Pick-up.	**£7.19.6**
The **E.M.I.** 4-speed Single Record Player with crystal Pick-up.	**£6.9.6**
B.S.R. MODELS UA12 and UA14. Each a 4-speed mixer autochanger with Crystal Pick-up.	**£7.19.6**
Both available incorporating the **B.S.R. STEREO Pick-up**, plays L.P. and 78 Records.	**£10.10.0**
GARRARD MODEL TA/MkII 4-speed Player fitted high output Crystal Pick-up.	**£8.10.0**
GARRARD MODEL RC/209. Autochanger 4-speeds. High output. Crystal Pick-up.	**£8.19.6**

Carriage and Insurance on each above. 5/- extra.

Dept. P.W. 109 FLEET ST., LONDON, E.C.4

Telephone: FLEET STREET 5812/3/4

PRICE REDUCTIONS

(a) The KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-valve PRE-AMP CONTROL UNIT............. **£15.15.0**

(b) The "5-10" and the 2-stage PRE-AMP both ASSEMBLED and TESTED H.P. Dep. £3.16.0 and 12 months of £1.7.8......... **£18.18.0**

(c) The KIT OF PARTS to build the DUAL-CHANNEL "3-3" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT............. **£21.10.0**

(d) The DUAL-CHANNEL "3-3" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT BOTH ASSEMBLED and TESTED **£25.0.0**
H.P. Terms: Deposit £5 and 12 months of £1.16.8.

(e) THE KIT OF PARTS to build one "5-10" MAIN CHANNEL, and the DUAL-CHANNEL PRE-AMP CONTROL UNIT **£21.10.0**

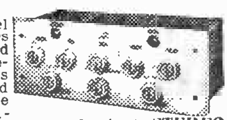
(f) ONE "5-10" AMPLIFIER and the DUAL-CHANNEL PRE-AMPLIFIER both ASSEMBLED and TESTED **£25.0.0**
H.P. Terms: Deposit £5, 12 months of £1.16.8.

(g) KIT OF PARTS to build Two "5-10" MAIN AMPLIFIERS (incorporating Parmeko Output Transformers) and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT............... **£31.0.0**

(h) TWO "5-10" AMPLIFIERS and the DUAL-CHANNEL PRE-AMPLIFIER CONTROL UNIT BOTH ASSEMBLED & TESTED **£36.0.0**
H.P. Terms: Deposit £7.4.0, 12 months £2.12.0.

Carriage and Insurance 7/6 extra. Prices quoted are subject to £1.6.0 extra for Partridge Transformer.

STEREO PRE-AMPLIFIER



This model incorporates two Mullard 2-valve Pre-Amplifiers combined into a Single unit enabling it to be used for both **STEREO PHONIC** or **MONAURAL** operation. It is designed primarily to operate with our range of **MULLARD MAIN AMPLIFIERS** but will also operate equally well with any make of Amplifiers requiring an input of 250 m/volts.

COMPLETE KIT OF PARTS **£12.10.0** ASSEMBLED AND TESTED **£15.0.0**

H.P. £3 Dep. and 12 mths. at £1.2.0

MULLARD FOUR CHANNEL MIXER UNIT

Self powered with Cathode follower output. Incorporates Two inputs for MICROPHONES One for CRYSTAL PICK UP and a fourth for RADIO or TAPE

Complete Kit of Parts **£8.8.0**

Assembled and Tested **£10.0.0**

TERMS: Deposit £2 and 12 months at 15/-.

MODEL I.L. one microphone Input matched for moving coil or Ribbon Mike. £1.17.0 extra.

Mk.11 "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line up. FOR THE CONSTRUCTOR **£10.10.0** ASSEMBLED **£14.5.0**

A SPECIAL CASH OFFER!!

This very attractive **PORTABLE AMPLIFIER CASE** together with a good quality **GRAM AMPLIFIER** and a matched **P.M. SPEAKER**. For ONLY **£8.7.6** (Plus 7/6 Carr. & Ins.)

The amplifier consists of a 2-stage design incorporating 3 modern B.V.A. valves and has separate BASS and TREBLE CONTROLS.

The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Mushroom Grey Rexine.

WE ALSO SUPPLY SEPARATELY—
(a) The 2-stage (plus Rectifier) **AMPLIFIER** **£4.2.6**
(b) The **PORTABLE CARRYING CASE** **£3.17.6**
(c) **6½in. P.M. SPEAKER 18/9** Carriage and Insurance 4/- extra.

Easy - to - build kit - sets of **Heathkit** DAYSTROM ***highest quality at lower cost***

AMATEUR TRANSMITTER Model DX-100U
Covers all amateur bands from 160-10 metres. 150 watts D.C. input. Self contained including Power Supply Modulator V.F.O. £81.10.0

AMATEUR TRANSMITTER Model DX-40U
From 80-10 m. Power input 75 w. C.W., 60 w. peak C.C. phone. Output 40 w. to aerial. Compact and self-contained. Prov. for V.F.O. £32.10.0

VAR. FREQ. OSCILLATOR VF-1U
From 160-10 m. Ideal for our DX-40U and similar transmitters. Price less valves £8.19.6 £11.2.0

R.F. SIGNAL GENERATOR Model RF-1U
Up to 100 Mc/s. fundamental and 200 Mc/s. on harmonics and up to 100mV. output on all bands. £11.18.0

AUDIO SIGNAL GENERATOR Model AG-9U
10 c/s to 100 kc/s. switch selected. Distortion less than 0.1% 10 v. sine wave output metered in volts and dB's. £19.19.6

VALVE VOLTMETER Model V-7A
Measures volts to 1,500 (D.C. and R.M.S.) and 4,000 pk. to pk. Res. 0.1 Ω to 1,000 MΩ. D.C. input imped. 11M Ω. Complete with test prods leads and standardising battery. £13.0.0

Portable 2¾ in. SERVICE 'Scope Model OS-1
Compact portable scope ideal for servicing and general work. Y amplifier sensitivity 10 mV/cm; response ±3 dB 10 c/s-2.5 Mc/s. Time base 15 c/s-150 kc/s. Printed circuit. Case 7⅜ × 4⅞ × 12½in. long. Wt. only 10½lb. £19.10.0

5 in. OSCILLOSCOPE Model O-12U
Has wide-band amplifiers, essential for TV servicing. F.M. alignment, etc. Vertical freq. response 3 c/s to over 5 Mc/s. without extra switching. T/B covers 10 c/s to 500 kc/s. in 5 ranges. £36.10.0

RES.-CAP. BRIDGE Model C-3U
Measures capacity 10pF to 1,000µF resistance 100 Ω to 5 M Ω and power factor 5-450 v. test voltages. With safety switch. £8.6.6

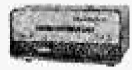
SINGLE CHANNEL AMPLIFIER, MA-12
10-12 watt Hi-Fi amplifier. Extremely low distortion and wide frequency range. £10.19.6

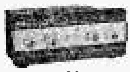
HI-FI EQUIPMENT CABINETS
Range of cabinets available with at least one to suit your particular needs. From small to large, housing Tape Deck, Record Player and full equipment. In the white for finishing to personal taste.
From £11.5.6 to £17.18.6

GRID DIP METER Model GD-1U
Coverage from 2 Mc/s. to 250 Mc/s. Complete set of plug-in coils provided £10.9.6

TAPE RECORDING/PLAYBACK AMPLIFIER Model TA-1
Monaural (TA-IM) £18.2.6. Conversion unit to Stereo £6.10.0. Stereo (TA-IS). £23.6.0

'PACKAGED DEALS' of Hi-Fi Equipment including **TAPE DECKS RECORD PLAYERS** and **DECCA ffss PICK-UPS.**
Write in to see how these deals save you further money:


F.M. TUNER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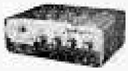
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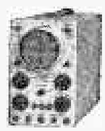
DX-40


UXR-1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Practical Wireless

VOL. XXXVII No. 653 JULY, 1961

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Contents

The Editor will be pleased to consider articles of a practical nature. Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Owing to the rapid progress in the designs of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Modern Communications

ONE of the first uses for radio was the establishment of reliable communications between countries and continents. Now, submarine cables are used increasingly for the transmission of messages and information, but even so, electronic research is facilitating the introduction of new telephone circuits operating over larger distances than before. The main problem in installing telephone cables of great length is in finding a way of preserving the strength of the signals—the resistance of the conductor used cannot be reduced indefinitely since the weight and cost of the cable rises as well. The solution is to employ amplifiers at regular intervals along the cable, but it is only recently that this has become possible. Electronic research has permitted the introduction of reliable valves which have an extremely long life and the characteristics of which remain almost constant during their life. Amplifiers using these valves are spliced into the submarine cables in the factory and can thus be made an integral part of the cable.

At present, the conventional type of cable predominates, but cables using integral repeaters—as the submerged amplifiers are termed—will soon become much more numerous. Communications will thus become increasingly more reliable. However, one of the factors which cause interruption of messages is the breakage of cables caused by trawl fishing. In such fishing, the boat drags behind it a trawl or net and in order to hold the net open, two weighted boards are used. Although these boards will generally ride over any cables on the bed of the ocean, where there is a trough for example, it is possible for them to foul the cable and break or damage it. It is obvious that such damage will be very serious where repeater cables are concerned—these may carry as many as 80 conversations in each direction simultaneously. The interruption to services will have much more effect than if a telegraph cable were broken or damaged.

Much of the damage occurs in European coastal waters, or in the North-West Atlantic, off the Newfoundland coast, in depths of about 500 fathoms, and recently practical steps have been taken to minimise the damage. Following two years' work by an internationally constituted Cable Damage Committee, with headquarters in London, charts are to be issued to trawler owners in an effort to reduce the number of cable interruptions caused by trawlers. The charts will plot the positions of every cable in water up to 500 fathoms in depth in the North-East and North-West Atlantic.

The introduction of these charts should be an important factor in the establishment of reliable communications over long distances and should materially affect the cost of using and installing the necessary equipment. Further research—both into cables and the associated electronic components—should reduce the cost of communications still further in the future.

Our next issue, dated August, will be published on July 7th.

Round the World of Wireless

POTENTIAL AND CURRENT NEWS

Broadcast Receiving Licences

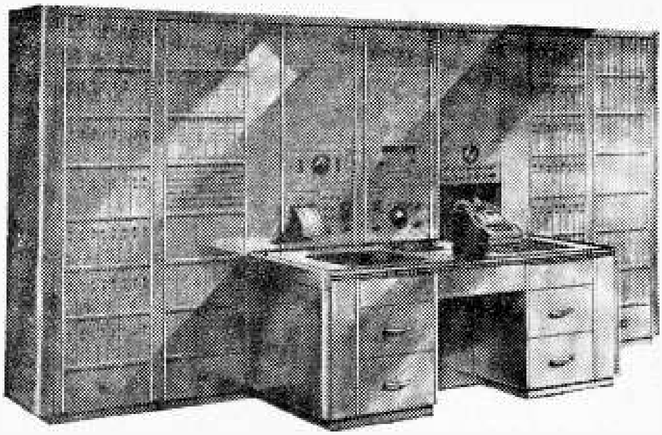
THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of March, 1961, in respect of wireless receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region	*Total*
London Postal	692,282
Home Counties	652,845
Midland	473,911
North Eastern	518,782
North Western	448,390
South Western	391,932
Wales and Border Counties ..	230,117
Total England and Wales	3,408,259
Scotland	383,379
Northern Ireland	117,346
Grand Total	3,908,984

Simlac Analogue Computer

THIS computer, made by Short Brothers and Harland Ltd., was featured in Round the World of Wireless of the May issue of PRACTICAL WIRELESS. However, the illustration accompanying its description was not of the Simlac analogue computer, as stated in the caption, but was a photograph of the Short Educational Computer.

This month an artist's impression of the Simlac analogue computer is illustrated. Printed circuit detachable patch panels, push button selection of co-efficients and fault detection are all features of the Simlac computer which employs components of 0·01per cent accuracy. Design and circuiting have already been established and a prototype is being built. Production models are scheduled for next year.



A Simlac analogue computer made by Short Brothers and Harland Ltd.

German Radio, Television, and Phono Exhibition Berlin 1961.

THE German Radio, Television and Phono Exhibition Berlin 1961, to be held from 25th August to 3rd September at the Berlin radio tower, is to be the biggest exhibition event of the year. It is the first such exhibition held in Berlin for 22 years. It was first held here in 1924 and then regularly until 1939. Since the end of the second world war it was three times held in Düsseldorf and twice in Frankfurt.

This year there will be 150 exhibitors in 13 halls and the Philips pavilion will be on West Berlin's exhibition grounds at the radio tower. German radio stations are to set up studios in two halls from which live broadcasts and television programmes can be transmitted with exhibition reports, giving visitors a view behind the scenes of radio and TV work.

R.E.C.M.F. Exhibition

FOUR types of rectifier units and diodes, namely copper-oxide, selenium, germanium and silicon, were shown on the Westinghouse stand at the Radio and Electronic Component Manufacturers' Exhibition in a variety of power, miniature and sub-miniature assemblies to meet all the requirements of the electronic industry.

Of special interest were ranges of crystal aligned selenium rectifiers in various types of assembly, capable of working at much higher current densities and giving greater service life expectancy than normal processed selenium units.

The copper-oxide display showed units specially designed for telecommunication applications together with bridge connected instrument type rectifiers in both standard and potted assemblies.

Applications of silicon controlled rectifiers included single- and three-phase A.C. power regulators, motor control and regenerative braking, and a power inverter.

C.E.G.B's Biggest Transformers

THE Central Electricity Generating Board Midlands Project group has placed an order with Associated Electrical Industries Limited for two 400MVA generator transformers for connection to the supergrid at the Drakelow "C" Power Station near Burton-on-Trent.

These generator transformers are the largest so far ordered by C.E.G.B. and they will connect two 375MW super critical turbine-generators to the grid system. AEI is manufacturing one of these 375MW turbine-generators.

When fully assembled each transformer will weigh 270 tons and be 38ft long, by 13ft wide, by 30ft high.

The transformers will step up the generator voltage from 90kV to 300kV at no-load. Tappings will provide voltage adjustments of plus or minus 10per cent in eighteen equal steps arranged for local and remote electrical control.

Radar for Brussels National Airport

WITH the installation of the new 500kW Marconi 50cm surveillance radar nearing completion, a new order has been placed with Marconi's/S.A.I.T. Electronics for the delivery and installation of 18 fixed coil radar display units, to be manufactured by the Chelmsford works of Marconi's Wireless Telegraph Co. Ltd. With this installation the Air Traffic Control at Brussels National Airport will be provided with extensive display facilities. In this way a complete coverage of a territory extending considerably beyond the frontiers of Belgium has been obtained.

The fixed coil display units, type SD 1010, to be installed in the control tower have been designed to handle and display large quantities of ancillary information between timebase sweeps. Up to 20 inter-trace markers will be employed at the Brussels Air Traffic Control Centre with joystick control to place them on any part of the display. Some of the inter-trace marks will be of the track-while-scan type; these, when positioned alongside aircraft responses, follow them automatically for permanent and positive identification. Facilities are also included for repeating the strobe information from one display to another. Superimposition of automatic direction finding traces will also be incorporated. Facilities for data handling of radar information will be progressively incorporated.

British Electronics Exhibition in Sweden

THE British Radio and Electronic Component Manufacturers' Federation is to hold an exhibition in the Marmorhallar, Stockholm, from 9th to 13th October, 1961.

This will be the fourth exhibition held in Stockholm by the British electronic component manufacturing industry, previous ones having been in 1948, 1953 and 1958. Previously timed for every five years, representations have been made from the Scandinavian countries that the exhibition should be held more frequently.

The exhibition follows the Federation's exhibition at Olympia, London, from 30th May to 2nd June. It is expected to include components for the latest electronic applications, including computers, machine tool control, communications and other satellites, missiles and nuclear engineering.

Exports of British components last year increased by 36per cent compared with 1959.

Trans-Atlantic Talk

A TRANS-ATLANTIC meeting of audio engineers took place recently over the intercontinental broadcast telephone lines.

The conference was between the Association of Public Address Engineers at the Kings Head Hotel, Harrow-on-the-Hill, in England, and representatives of the U.S. Audio Engineers' Society in New York.

Audiences assembled in both places to hear the conversation over loudspeakers. The U.S. panel used a three-pick-up system employing Shure Brothers Inc's newest 545 Unidyne III dynamic microphones in desk stands.

Topics ranged broadly over the entire audio field, including transistorised power supplies and amplifiers, ribbon versus dynamic microphone, proper output and placement of speakers at public events, theatre sound systems, stereo pick-up of musical presentations, etc.

On both sides of the Atlantic, participating engineers pronounced the experiment a success. Sound fidelity was of the highest quality, with good frequency response and complete freedom from fading.

Service Depot moves to New Premises

THE address of the Mullard Birmingham Service Depot is now 2,219 Coventry Road, Birmingham. These new premises will give better facilities both to dealers and to service depot staff.

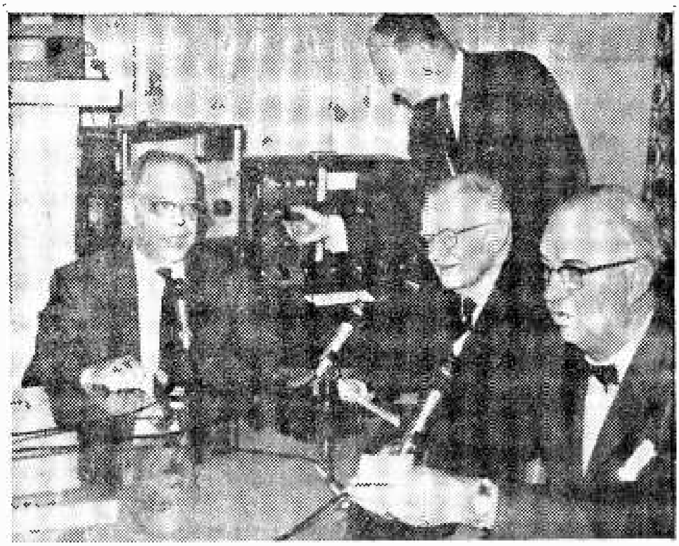
It has modern equipment for handling and testing valves and picture tubes, and an improved valve tester service section.

One of the greatest benefits of the new depot is that it is sited well away from the traffic congestion of the City centre.

R.E.C.M.F. Elections

MR. ARTHUR BULGIN (A. F. Bulgin and Co. Ltd.) has been elected president of the Radio and Electronic Component Manufacturers' Federation, in succession to Mr. E. M. Lee (Belling and Lee Ltd.). Mr. Bulgin was one of the six manufacturers who met in 1932 to form the Federation.

Dr. G. A. V. Sowter (Telcon Metals Ltd.) succeeds Mr. Hector V. Slade (Garrard Engineering and Manufacturing Co. Ltd.) as chairman.



Audio engineers in England and the United States confer over inter-continental broadcast telephone lines to compare latest advances in techniques.

QUALITY reproduction is commonly associated with large power valves, expensive transformers, etc., but if fundamental principles are observed, excellent results can be obtained with simple circuits and inexpensive components. The amplifier described here was designed for use with a VHF tuner; it has a frequency range which is more than adequate for the purpose and a silent background which does justice to the quality of the transmissions.

An Inexpensive Amplifier

By V. E. Holley

Circuit

As will be seen from Fig. 1, the output stage employs two pentodes, EL42, which in class AB1 push-pull operation will produce 7W. This is more than enough for the average listener and is unlikely to be required in full. The valves have been selected because, although they are slightly more expensive than some alternatives, they have a comparatively small current requirement which enables the power supply to be reduced in bulk, weight and cost. They are operated with 250V on anodes and screens and share a common bias resistor. This does not have to be bypassed, since the signal currents cancel out at the cathodes if the valves are reasonably well matched. A word of warning here—the amplifier must not be switched on unless *both* output valves are in place.

Output Stage

The output transformer should have a reasonably high primary inductance and, to match the anode-to-anode load, which is 15k, should provide a ratio of about 70 to 1 for a 3Ω speaker or 35 to 1 for a 15Ω type. The primary inductance of the transformer used in the prototype is 45H with no D.C. An expensive component is not necessary; indeed the extended frequency response obtained from it may introduce phase shift leading to instability when negative feedback is applied. The circuit relies on negative feedback to make good the shortcomings of the cheaper transformer.

Inverter

The output stage requires a signal of about 35V peak grid-to-grid for full power, and this is provided by one half of the double triode valve, 12AU7, connected as a phase inverter. The circuit shown is simple but linear in the extreme, owing to heavy negative current feedback in the cathode load resistor. This feedback raises the input impedance of the stage to about ten times the value of the grid leak, i.e. 10M. Quite a small coupling capacitor from the previous stage would therefore be adequate for low frequency

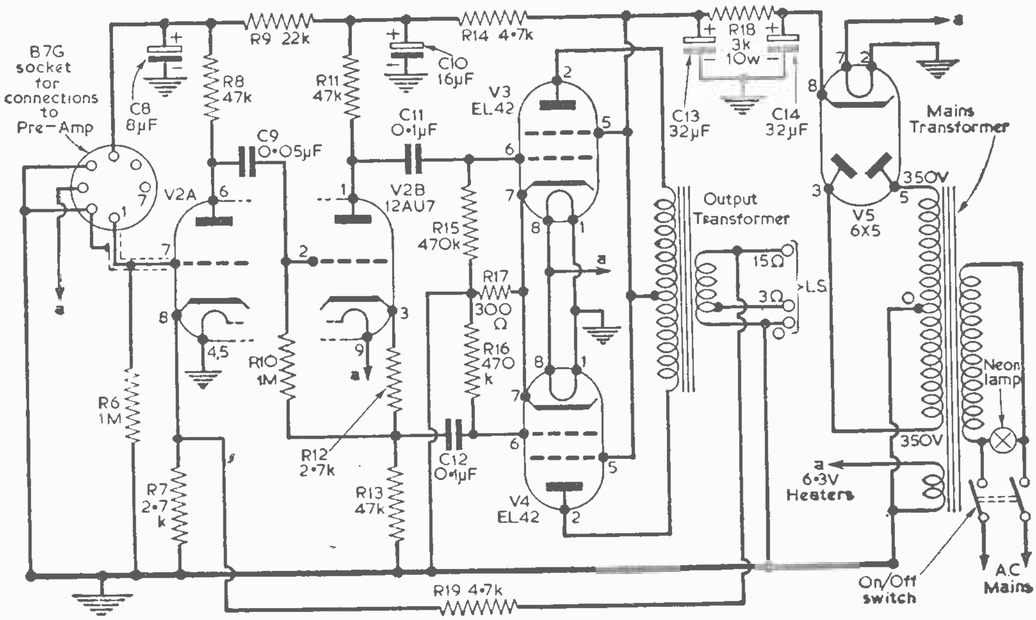


Fig. 1.—The circuit of the main amplifier.

response, but it is not advisable to reduce it below 0·05µF or the high impedance from the grid of V2B to earth will make the grid unduly susceptible to electrostatic hum pick-up. For the same reason, the anode load in the preceding stage should not be too high. The cathode bias resistor, R12 is small in relation to R13, so that there is no point in bypassing it.

A.F. Stage

The phase inverter is fed from the other half of the 12AU7, arranged as a conventional resistance coupled amplifier with an anode load of 47k. Decoupling and additional smoothing are provided bv C8 and R9 and the linearity of the stage is improved by omitting the usual bypass capacitor from the cathode circuit. This omission also provides a suitable point for the injection of negative voltage feedback from the output transformer and of course, saves the cost of the capacitor. The resistors R7 and R19 are selected for two purposes; their value in parallel provides the correct bias for V2A and their relative values determine the proportion of the output voltage to be fed back to the valve cathode. The valve, of course, operates with both current and voltage feedback.

Tone Controls

Tone controls are not strictly necessary for reproduction of VHF programmes, but comprehensive controls have been provided so that the response can be adjusted for individual taste. The gain from the grid of V2A onwards is quite low and the controls are inserted at this point, so that they shall not be sensitive to hum. The values of the capacitors can be varied to taste; those shown gave a wide range of control in the prototype and should be generally satisfactory. No special screening is necessary.

Pre-Amplifier

The pre-amplifier stage employs a resistance-coupled pentode, 6AM6 (Fig. 2). This gives the amplifier more overall gain than is necessary for radio reproduction, but makes it suitable for use

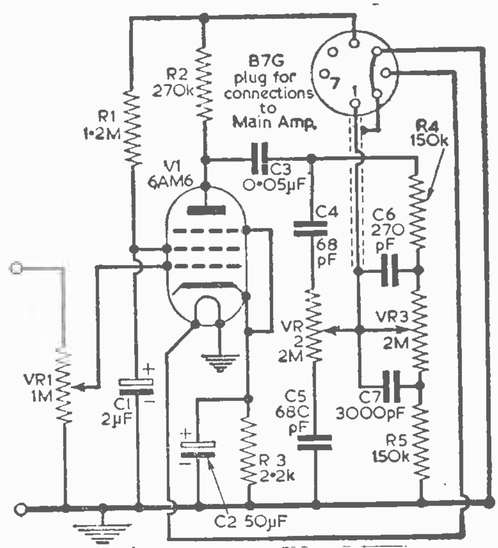


Fig. 2.—The pre-amplifier circuit.

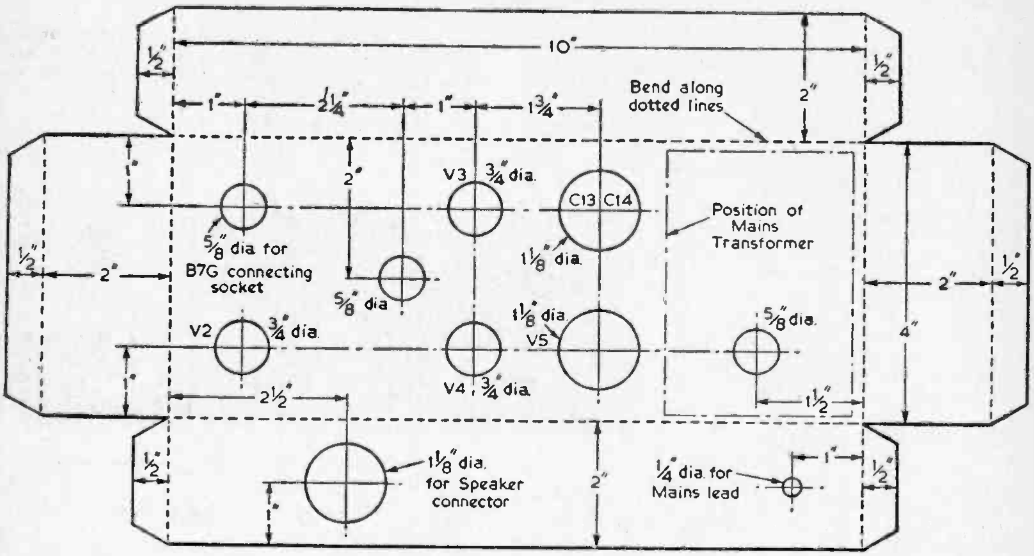


Fig. 3.—Details of the main chassis.

with other lower level inputs. The screen of this valve requires to be decoupled by not less than 0·5μF, and as a paper capacitor of this value is rather bulky, a 2μF electrolytic is used. The

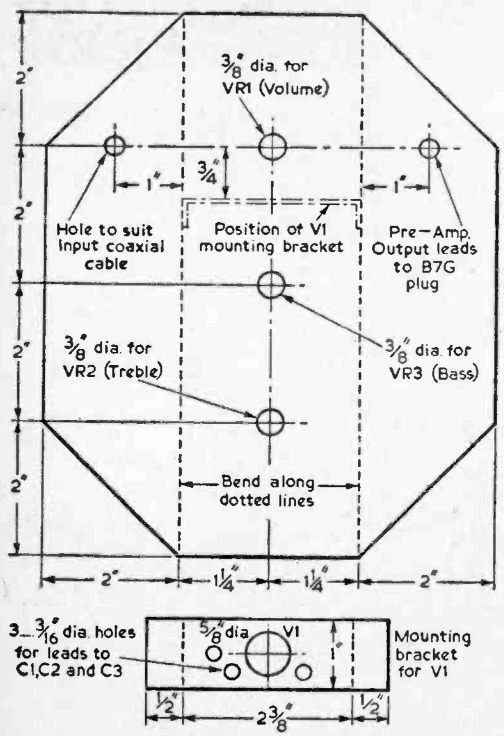


Fig. 4.—Constructional details of the pre-amplifier chassis.

COMPONENTS LIST

Resistors:
(½W unless otherwise stated)
- R1 1·2M
- R2 270k
- R3 2·2k
- R4 150k
- R5 150k
- R6 1M
- R7 2·7k
- R8 47k
- R9 22k
- R10 1M
- R11 47k
- R12 2·7k
- R13 47k
- R14 4·7k
- R15 470k
- R16 470k
- R17 300Ω, 1W
- R18 3k, 10W
- R19 4·7k

Capacitors
(500VW unless otherwise stated)
- C1 2μF electrolytic
- C2 50μF 25VW electrolytic
- C3 0·05μF
- C4 68pF
- C5 680pF
- C6 270pF
- C7 3000pF
- C8 8μF electrolytic
- C9 0·05μF
- C10 16μF electrolytic
- C11 0·1μF
- C12 0·1μF
- C13 32μF electrolytic
- C14 32μF electrolytic

Valves:
- V1—6AM6, B7G base and screen
- V2—12AU7, B9A base
- V3—, V4— EL42, B8A base
- V5—6X5, octal base

Potentiometers:
VR1 1M log. VR2 2M log. VR3 2M log.

Mains transformer:
350-0-350V, 60mA, 6·3V, 2A

Output transformer:
Push-pull ratio 70 to 1 for 3Ω speaker, 35 to 1 for 15Ω

1 B7G base and plug to suit
1 Octal base and plug to suit

cathode resistor in this stage must be bypassed, not to avoid degeneration but to remove hum caused by the heater-cathode capacitance of the valve. The volume control is incorporated in the grid circuit. No decoupling is necessary between V1 and V2.

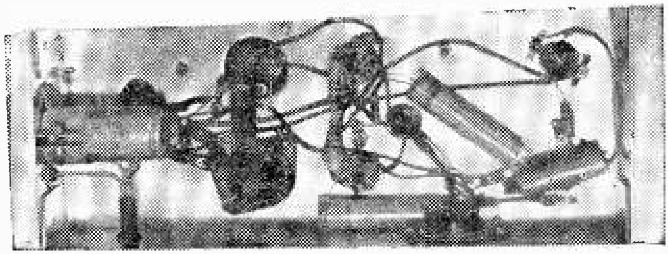
If the expense of an additional 1M potentiometer is no objection, one may be fitted in the grid circuit of V2 as the main volume control in place of R6, so that any noise voltages originating in the first stage will be reduced along with the signal. It will be necessary, however, to retain the control in the grid circuit of V1 to prevent overloading with high level inputs, but a cheaper pre-set type is suitable for this.

Power Supply

The mains transformer must have an output of 350V at 60mA and 6·3 at 2A, and the clamping must be adequate to prevent any audible buzz from the stampings. Ex-Government transformers, impregnated for tropical use, are excellent and one was used in the prototype. A 6X5 rectifier is shown in Fig. 1, but any type to suit the transformer will be satisfactory. Mains smoothing is provided by R18 in conjunction with C13 and C14; the resistor value may need slight adjustment to produce the right voltages at the valve electrodes. Generous smoothing almost completely eliminates hum and it is very difficult indeed to discover by ear whether the amplifier is switched on.

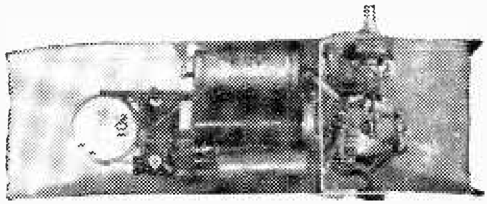
Construction

The construction is quite straightforward and the layout is in no way critical. The prototype was built in two sections so that the main amplifier could, for physical stability, be fitted at the bottom of a floor-standing cabinet, to be described, and the pre-amplifier and controls higher up in a convenient operating position. A plan of the main chassis, which is of 16s.w.g. aluminium sheet, is given in Fig. 3 Power supplies for the pre-



Above.—The component layout of the amplifier.

Below.—An underchassis view of the pre-amplifier.



amplifier are taken from the B7G socket by way of a suitable plug and cables.

(To be continued)

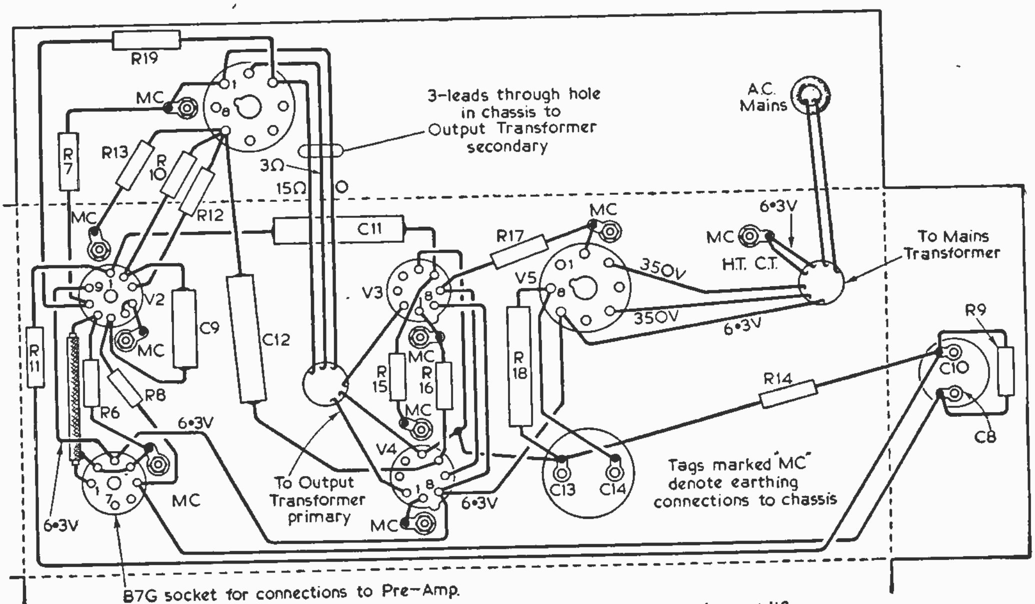


Fig. 5.—The component layout and wiring diagram for the amplifier.

Radio Construction for the Beginner

By D. B. Kidd

ALTHOUGH No. 5 in the series practically exhausted the possibilities of construction from photographs reproduced in half-tone, so many readers requested further circuitry on the same lines that this article has been written to round off the series.

This has been made possible by employing line-drawings only as illustrations, and it is hoped that these will enable the reader to construct quite a complicated receiver without assuming much previous knowledge.

The receiver last described (in the January and February 1961 issues) was a two-transistor regenerative set, and although many beginners have expressed pleasure at its performance (especially as a "Top Band" receiver) help has been asked for in almost every case to obtain additional volume or "output".

It will be assumed that the reader has built the set and that its appearance is roughly as shown in the half-tone illustration, which appeared on page 777 of the January issue. It will be found extremely helpful to compare this, and the theoretical diagram at the foot of page 776, with the illustrations in the present article.

The circuitry to be described consists of modifications and additions to the previous receiver, and a little time spent in comparing the two will save a good deal of work later, as there is no point in moving components about the board unnecessarily.

Greater volume can be obtained from the receiver in two ways. The first is to add another amplifying stage—that is, to use a third transistor. (Two methods of doing this will be described.) The other method is by using a trick known as "reflexing", which readers have probably read about already in the pages of this magazine at some time or other.

It was pointed out in the January article (No. 4) that "ordinary" or audio-type transistors will not magnify the sort of signals (called "radio-frequency") which are emitted by the transmitter and appear at the aerial of the set. For this, a special sort of transistor (R.F. type) had to be used. Now, an R.F. transistor will amplify the "audio" (sound frequency) signals produced by the crystal detector perfectly well. For this reason, it is possible, provided certain precautions are taken, to make the R.F. transistor (T1 in the two-transistor set) carry out both functions at the same time. It thus takes over the work of T2, leaving the second transistor in the position of a third amplifier.

This means that a two-transistor set can be made to work as though it were a three-transistor receiver, thus obtaining greater volume.

To see how this is done, it is only necessary to compare Fig. 1 (below) with the theoretical circuit on page 776 of the January issue. The audio feedback loop at the foot of the new diagram is very obvious and the three extra components needed appear near the top. They are R2 (2·2k), C4 (8μF), and R3 (100k).

The total cost of these components is less than half that of a good audio transistor, so there is some saving in cost when reflexing is used.

The reader should now compare Fig. 2 (page 209) with the layout photograph in the January issue. Eighteen woodscrews and washers are required for the new circuit, not counting those of the ferrite aerial and battery assemblies, which, together with the tuning condenser, headphone sockets, and on/off switch, need not be disturbed at all. In Fig. 2 (page 209) the on/off switch has been shown as though placed on one side, but this is simply to make the illustration easier to follow.

It will also be noticed that nearly all the components near the positive line, including the two transistors, can remain where they are, though as

ADDITIONAL COMPONENTS REQUIRED FOR Fig. 1 (below)

R2 2·2k ½W	R3 100k ½W	C4 8μF 6VW

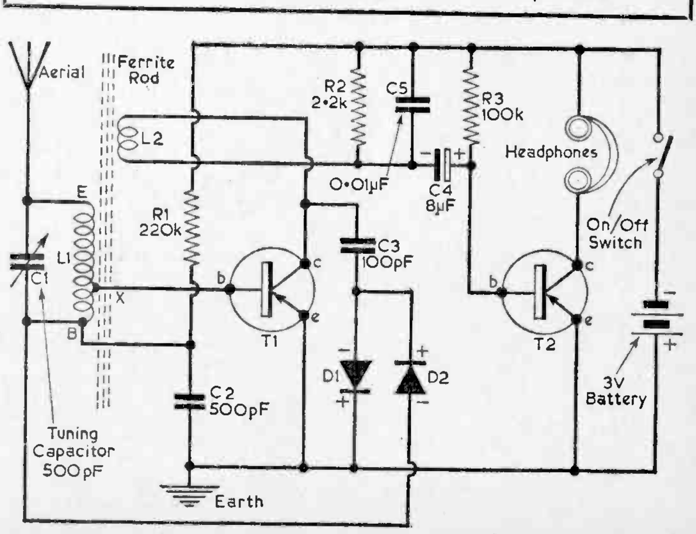


Fig. 1.—The modified circuit to give reflexed operation.

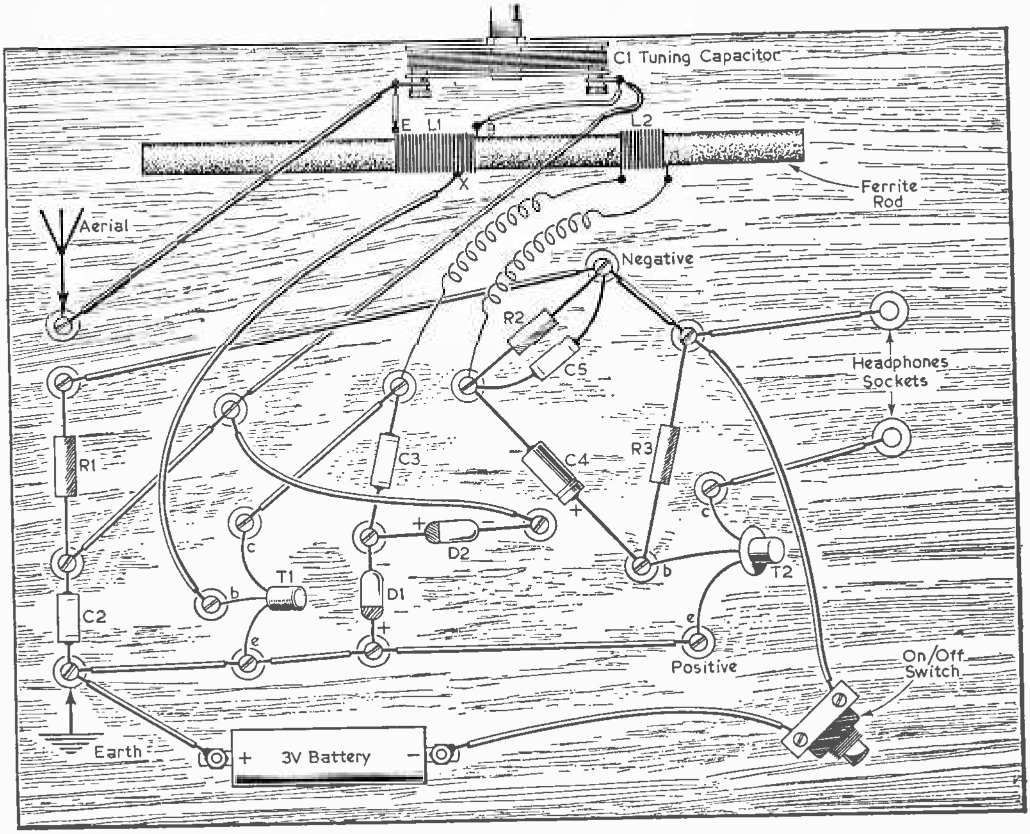


Fig. 2.—The practical layout of the new circuit.

a precaution the battery should be removed from its clips while the various changes are made.

When the new circuit pattern has been completed, the battery can be replaced and the set switched on. If the wiring has been carried out correctly, the increased volume should be apparent immediately. If not, the set should be switched off and the circuit rechecked, making sure that all connections are correct, clean, and tightly screwed up.

It is most important that the diodes should be fixed as shown. If either diode is reversed, the receiver will fail to operate. If they have been left undisturbed, this, of course, cannot happen. Although the added impedance of R2 and C5 may make an extra turn or two on L2 an advantage, the difference is most likely to be too small to matter.

The beginning and end of the tuning coil have been marked B and E on both Figs. 1 and 2, and the tapping marked X.

This modification has, incidentally, introduced a new component to the beginner. This is the electrolytic condenser, C4, and a few words about this will therefore not be out of place.

Electrolytic condensers contain a liquid or moist element. They are less robust than other types of condenser and should be handled. The wire leads, especially the positive one, must not be bent too near to the body of the condenser, otherwise they may snap off. This is particularly true of the very small condensers.

They must always be connected **the right way round in the circuit;** reversing the polarity may damage the condenser. They must not be submitted to a voltage strain greater than that printed on them.

All this may make the beginner feel that it is best not to touch them at all in case of damage! In practice, all that is necessary is to make sure that the wire leads are treated reasonably gently and that the end marked negative on the diagram is the lead going directly to the aluminium casing. (If both ends are insulated, they will have different colours: black for negative; red for positive.)

As our battery supply is 3V, the condenser should be marked "3 volts working" (3VW). Any larger figure would do perfectly well, but a smaller figure would denote an unsuitable type. The value of electrolytics is usually very broadly assessed. For instance, C4 is quoted as 8μF when, in practice, any value between, say, 6μF and 15μF would do just as well.

The reflexed receiver works as follows. The audio (sound frequency) output, instead of passing directly to the base of T2, as previously, is led.

back to the base of T1, the condenser C2 ensuring that any radio frequencies left after detection flow to earth and do not reach T1. The audio signal, after being amplified by T1, is reflected by the resistance R2 through C4 to the base of T2 for further amplification. The purpose of condenser C5 is to provide an easy path for radio frequency currents in L2. Without it, L2 would be damped too much to provide any useful amount of reaction, and the set would lose sensitivity.

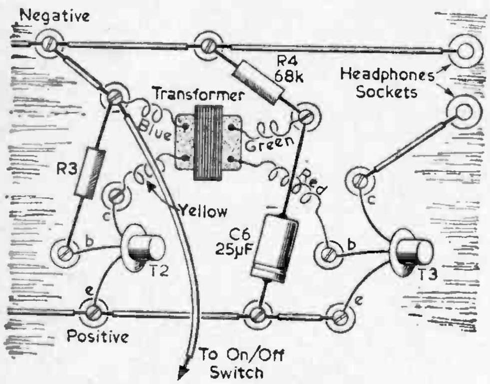
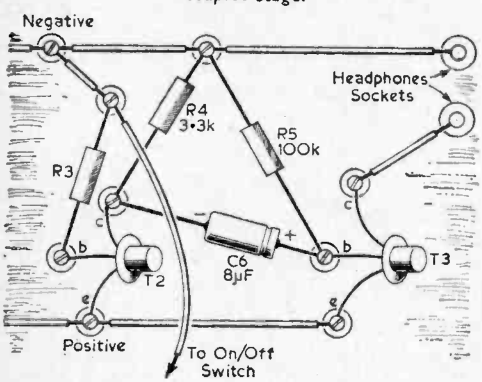


Fig. 3 (above).—An additional transformer-coupled stage.

Fig. 4 (below).—An additional resistance-capacitance coupled stage.



A Further Stage

A further stage may be added instead of, or in addition to, reflexing. This will be a matter of personal preference for most readers, but it should be pointed out, that if a local station is very near (within a few miles) reflexing could overload T1 on this station.

A further stage using a third audio transistor can be achieved in several ways, of which the following two are the most commonly used. The first uses transformer coupling to the extra stage, and the second what is called "Resistance-Capacitance" (R/C) coupling. The first gives greater volume at the cost of one rather expensive component, the transformer. The second gives somewhat better tone, and is cheaper.

Figs. 3 and 4 give all the details necessary to connect the extra stage. The colours of the wires in Fig. 3 are the standard ones used by most manufacturers of transformers. If the wire-colours of the transformer used are different, the correct connections can be found by experiment; connecting them wrongly will do no harm but simply reduce the output.

The terminals "Negative" and "Positive" are repeated in Figs. 2, 3 and 4 to provide clear reference points.

The precautions already given regarding electrolytic condensers should be taken with C6 in both cases.

COMPONENTS LIST (Figs. 3 and 4)

Transformer-coupled stage (Fig. 3)
- *1 audio transistor (T3)*
- *1 4½:1 transistor interstage transformer*
- *1 resistor 68k (R4)*
- *1 electrolytic condenser, 25μF 3VW (C6)*

RC coupled stage (Fig. 4)
- *1 audio transistor (T3)*
- *1 resistor, 3·3k (R4)*
- *1 resistor, 100k (R5)*
- *1 electrolytic condenser, 8μF 3VW (C6)*

Conclusion

It is possible that the reader may wish to preserve the receiver more or less permanently, with the additional stage and perhaps an output transformer and speaker as previously described.

In this event, soldered connections may be substituted in the following simple way:—

A supply of solder tags is purchased and the "tag" of each one bent at right-angles to the "washer" portion. These are then substituted for the brass washers, one by one, the wires being soldered to the upright "tag" portion.

If the diodes and transistors are soldered into circuit, the job should be done as quickly as possible so as not to damage these components by heat conducted along the leads from the soldering-iron. A pair of pliers gripping each lead whilst soldering will help by acting as a heat-shunt, but if in doubt, it is best to avoid soldering these components at all.

When replacing the battery, care should always be taken to place it back in position the correct way round. While making any modification to the circuit, the battery should always be removed as a safety measure.

Regeneration

Those readers who experience difficulty in obtaining regeneration when using a "surplus" R.F. transistor may care to increase the supply voltage from 3V to 4½V, which is the *maximum* value permitted.

An Introduction to Stereo

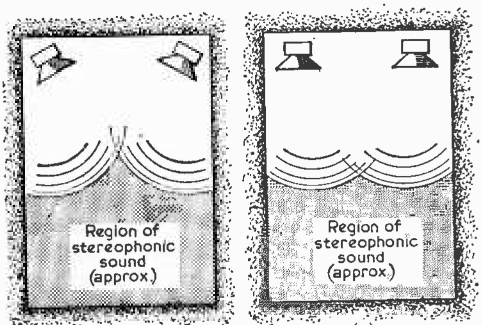
THE LOUDSPEAKER SYSTEM AND POWER SUPPLY

By N. A. Walter

(Continued from page 124 of the June issue)

MOST constructors have their own ideas of what is the best arrangement of the loudspeaker system. However, it is useless to build an amplifier with low distortion and then use it on ordinary small speakers built into a small radiogram cabinet. The choice of speaker will depend upon space and finance available and it is suggested that one of two systems be used.

With a small reflex enclosure a good single full range high fidelity loudspeaker is suitable. A frequency range of 40 to 15,000c/s, 6W handling capacity and a fundamental resonance of 65c/s is typical of such a speaker.



(a) (b)

Fig. 9.—The regions of stereophonic effect obtained with different loudspeaker positions.

With a larger reflex enclosure, starting perhaps with one loudspeaker, provision for the addition later on of a mid-range and tweeter speaker is advisable.

Placing of the Loudspeakers

As a general rule the aim should be to keep the loudspeakers separate from the radiogram itself for the following reasons: (a) acoustic feedback can be very difficult to eliminate; (b) unless the radiogram cabinet is very large, and solidly built, good bass response cannot be obtained; (c) positioning of the loudspeakers for best results would be impossible.

Each room behaves differently and, in order to find the best position for maximum stereo effect, some experimenting will be necessary. As a guide. start with the loudspeakers as shown in Fig. 9(a); then try Fig. 9(b). Other positions can be tried, but the loudspeakers should be kept between 4 and 8ft. apart.

The Power Supply

Most enthusiasts will have various components available, and provided that the H.T. voltages given are fed to the various units, satisfactory operation will be ensured. It is essential that the H.T. fed to the units has some degree of smoothing such as choke and condenser, and that the 6·3V heater supply is centre-tapped to earth. However, for those wishing to build a new power supply, a suitable design is given in Fig. 10. Remember, always feed the unit from a 3-pin plug/socket arrangement and ensure that earthing is efficient.

A few fundamental precautions are worth listing:

(1) all electrolytic capacitors should be adequately rated, e.g., a 325-0-325 secondary will produce a peak voltage on load of 450 volts, and without a load may well be over 500V;

(2) an indirectly heated rectifier is better for capacitors that a directly heated rectifier;

(3) make sure the chassis is earthed;

(4) fit a fuse in the leads of the mains input and another in the lead from the centre-tap of the secondary H.T. winding to earth;

(5) bleed resistors of 470k should be fitted across each electrolytic capacitor in the H.T. smoothing circuit;

(6) keep the power supply well away from the pick-up and pre-amplifier unit;

(7) if possible, use a separate heater winding for the rectifier valve.

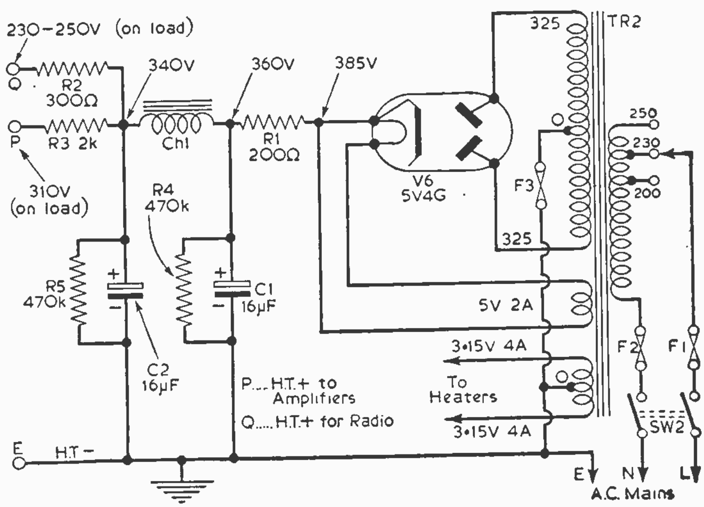


Fig. 10.—The circuit of the power supply.

Power Supply Requirements

Pre-amplifier and tone control unit
H.T. = 230 to 250V at 10mA
L.T. = 6·3V at 0·4A
Main amplifiers
H.T. = 310V at 95mA
L.T. = 6·3V at 2·0A
Radio feeder
H.T. = 230 to 280V at 40mA
L.T. = 6·3V at 2·0A (too allow for dial lamps).

The total H.T. current consumption can be taken to be about 150mA, and the L.T. as 6·3V at 4A together with a winding to suit the rectifier; e.g., 5V 2A, for a 5V4G rectifier.

Setting up the Completed Unit

Having checked the wiring, a few preliminary adjustments are necessary:

(a) Pre-amplifier

Apart from H.T. and L.T. voltage, the only precaution is to ensure that the right-hand channel lead from the pick-up goes to its appropriate grid input and that the audio output from the pre-amplifier is connected into the right-hand channel main amplifier. The same check should be made on the left-hand channel.

(b) Main Amplifiers

The only checks needed here are:—

(i) To obtain correct phasing of the feedback. This is achieved by connecting the main amplifiers, but first disconnecting the feedback lead in, say, the left hand channel. If possible use an old loudspeaker and connect it across the loudspeaker output leads of the right hand channel. Load the loudspeaker output of the left hand channel with a 3Ω 1W resistor. Switch on H.T. and L.T., and if violent oscillation occurs, switch off. Reverse the secondary connections to the output transformer of the right hand channel, when all should be well. Switch off, remove the loudspeaker from the right hand channel output sockets to the left hand output sockets and load the right hand output sockets with the resistor. Reconnect the feedback in the left hand channel. If violent oscillations occur on switching on, reverse the secondary connections to the left hand output transformer, when again all should be well.

(ii) Switch off and connect up the correct loudspeakers to their respective channels.

(c) Loudspeaker phasing

It is essential that the loudspeakers are correctly phased, and this can be arranged as follows:

If each loudspeaker system consists of more than one loudspeaker, each loudspeaker in that system must be correctly phased. Take each loudspeaker separately and apply a 1½V battery across the speech coil, and note which way the cone moves on connecting the battery. It is worth using a convention here, and the following is suggested. If the cone moves inwards, reverse the connection to the battery so that the cone now moves outwards when the battery is connected. Mark the speech coil solder tag connected to the positive of the battery with a +. Repeat this for each loudspeaker in the system.

Correct phasing will be obtained when all + signs are connected to the same lead. Also, code the lead connecting these + signs with a red sleeve, so that it can be connected to the loudspeaker output sockets on the main amplifier in the correct way.

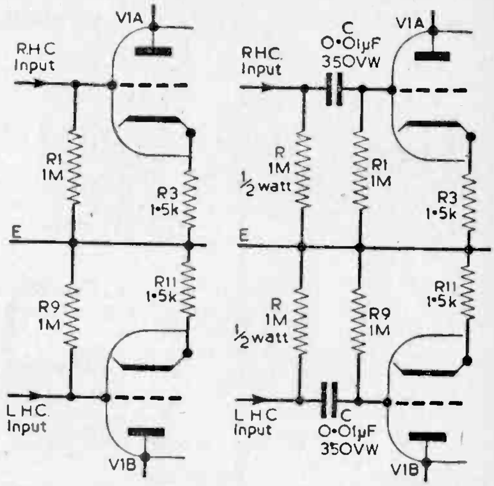


Fig. 11. (left).—The original circuit of the pre-amplifier and (right) a modified circuit to remove "rumble".

Repeat the above for the other channel loudspeaker system.

If turntable rumble is pronounced or noticeable when playing quiet passages, the input circuit of the pre-amplifier may be modified as shown in Fig. 11.

FOR POWER PACK

COMPONENTS LIST

TR2	Mains Transformer— Primary: 0-200, 230, 250V; Secondary: 325-0-325V at 150mA; 5V 2A; 3·15-0-3·15V at 4A
SW2	Mains on-off switch (can be fitted on volume control RV3/RV7, but a separate control on the control panel is recommended)
F1, F2	2A fuses and holders
F3	250mA fuse with holder
CL1	10H 150mA choke
C1, C2	16μF (or 32μF) 500VW electrolytic capacitors
R1	200Ω 10W w.w.
R2	300Ω 6W w.w.
R3	2000Ω 10W w.w.
R4, R5	500k 2W
V6	5V4G

Note: R2 and R3 can be adjusted on load to provide correct H.T.

TEST VOLTAGES
(using high resistance voltmeter)

H.T. 310V at 48mA		
at C2	285V	
at C1	210V	
V3	anode voltage	290
	screen voltage	285 (approximate)
	cathode voltage	28
V2	anode voltage	20
	screen voltage	28

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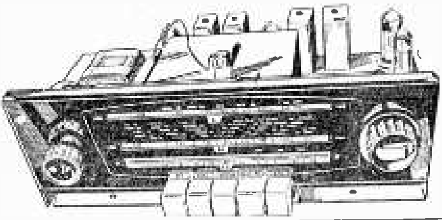

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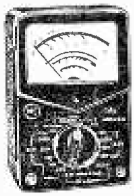

Prices include Test Prods, Batteries, Instruction Book. Also measure dB. Accuracy: A.C., 3 per cent, D.C., 2 per cent.

A-10 **£4.17.6** B-20 **£6.10.0**

A.10—2K ohms/v. on A.C. and D.C. volts (10, 50, 250, 500 and 1000 v); 10K and 1M ohms; ½ mA, 25 mA and 250 mA. D.C. Size: 5½ x 3½ x 1½in. Weight 17 oz.

B-20—10K ohms/v. on 0.5 v. and 2.5 v.; 4K ohms/v. on 10, 50, 250, 500 and 1000 v., A.C. and D.C. Resistance, 2K, 200K, 2 M and 20M ohms; D.C. current, 100 microA, 2.5 mA, 25 mA, 250 mA. Size: 5½ x 3½ x 2½in. Weight, 24 oz.

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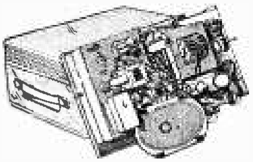

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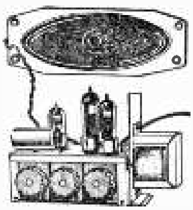

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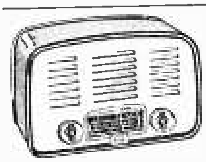

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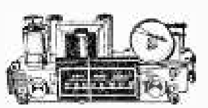

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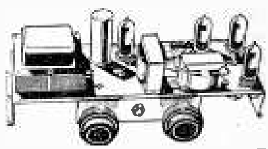

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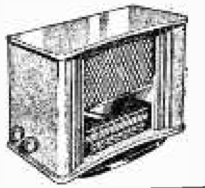

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ADDING COMMUNICATIONS FEATURES

TUNING INDICATOR CIRCUITS

(Continued from page 132 of the June issue)

By F. G. Rayer

THE circuit of the BFO stage was given last month. The frequency of oscillation may be varied by means of a 25pF variable condenser. Modification to the value of C1 may be tried if results seem unsatisfactory. The BFO signal at the diode must not be too strong, or weak C.W. signals may be lost.

When interference is troublesome, the BFO may be tuned above or below the I.F., as necessary, for best reception. For SSB reception, adjust the BFO frequency for maximum intelligibility. If the speech sounds "inverted", the BFO signal is on the wrong side of the SSB signal, so the 25pF condenser must be readjusted. It is also necessary to secure a correct balance between the strength of the SSB signal and the BFO signal. The 50k potentiometer in Fig. 3 will aid in this direction. If no means of adjusting the BFO output is provided, a somewhat similar effect can be achieved by turning back the R.F. gain control. Such a control can be fitted and will be described later.

For battery operated receivers, a similar circuit may be used. The BFO valve filament is switched, to conserve battery supplies. A 1S5, 1T4, or similar valve will be suitable. An anode coupling winding or reaction circuit can be used to obtain oscillation, as a separate cathode will not be available.

When other additions are to be made, it will be convenient to fit a 5-way rotary switch, to control the BFO. Other switch positions can then furnish standby and AVC in/out operation.

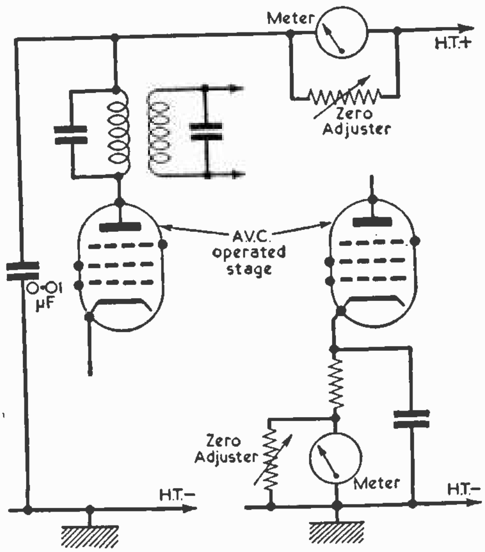


Fig. 4.—Two simple tuning indicator circuits.

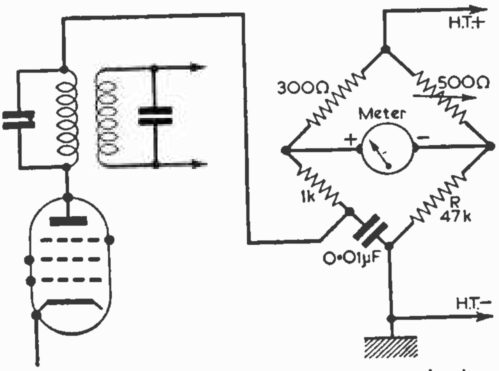


Fig. 5.—A bridge signal strength meter circuit.

Tuning Indicators

A signal strength or tuning indicator is extremely useful. In addition to performing its usual function of showing the signal strength of a station, it also allows receiver adjustments to be made more easily. The meter type of indicator is particularly sensitive, and is usually preferable.

If a station is tuned in, and trimming or alignment of R.F., F.C. or I.F. stages is adjusted, the meter will show if results are being improved. This is an extremely useful function. In addition, if changes to the aerial or earth improve signal strength, this will immediately be shown by the meter. It is thus easy to compare one aerial with another or to test the effect of directional aerials.

Meter indicators are frequently controlled by an I.F. stage. The anode current of such a stage is at maximum with no signal, and falls by several milliamperes when a signal is tuned in, owing to the AVC action. Two simple ways of connecting the meter are shown in Fig. 4.

The meter may be included in the anode circuit, as indicated, with a bypass condenser to chassis, or it may be included in series with the usual fixed cathode bias resistor. The current drawn by the valve passes through the meter, which is equipped with a variable shunt. This forms the zero adjuster, and its value is modified until the meter reads full scale, with no station tuned in. The correct tuning point for a station, and the strength of the signal, will then be indicated by the extent to which the meter pointer falls back.

A 1mA, 2mA or 5mA instrument will be satisfactory with most mains valves, with a low value wire-wound shunt of such resistance that the meter reads full scale with normal anode or cathode current (about 7mA to 10mA). If the meter pointer tends to go off the scale, the zero adjuster resistance is simply reduced in value, until the proper full-scale reading is achieved.

Circuits like those in Fig. 4 are particularly suitable for a receiver with a strong AVC action. With the usual type of meter, the pointer will move towards the left, as signal strength increases. If a movement from left to right is preferred, with these circuits, the meter may be mounted upside down, and the scale drawn to suit.

A further signal strength and tuning meter circuit is shown in Fig. 5. With no signal, the bridge is so balanced that no current passes through the meter. When the AVC voltage is applied to the I.F. stage, its anode current falls. This unbalances the bridge, so that the pointer moves in proportion to the signal strength.

The 1k resistor and 0·01μF condenser merely serve to keep I.F. currents out of the meter circuit. The values of the 300Ω and 500Ω resistors are not at all critical, provided the bridge can be balanced (zero current through the meter) with no signal tuned in. If balance cannot be achieved, the resistor, R, should be changed in value. If the meter is too sensitive, it can be so shunted that it reads full scale only with an S9-plus signal.

Such circuits may be employed in battery operated receivers, provided the meter is of fairly sensitive type. A 1mA or 2mA instrument will usually be satisfactory, though this depends on the valve types and battery voltage.

Magic Eye

A magic eye may be used as a tuning indicator, though it is less exact in its indications than a meter, and is not very suitable for signal strength readings. It does, however, require only a small panel area.

A suitable circuit is shown in Fig. 6. and may be used with a 6U5G or similar valve. With this indicator, sensitivity can be adjusted to some extent by modifying the target voltage. With the values shown and a 250V supply, a grid voltage of about −22V will be required for zero shadow angle. If the AVC circuit does not provide this, with a strong signal, the sensitivity of the eye can be increased by reducing the supply voltage. This can be achieved with a resistor dropping network. With a 100V supply, and the 1M resistor reduced to 500k, zero shadow angle will be reached with about −8V.

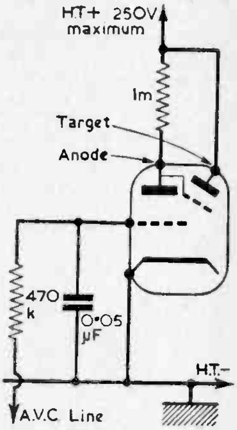


Fig. 6.—A circuit for a "magic eye" tuning indicator.

Adding Extra Bands

When improving an ordinary set so that it can be used as a communications receiver, it will almost certainly be necessary to add other wavebands. Many ordinary receivers have only one S.W. range, in addition to L.W. and M.W. coverage. The S.W. band will often cover about 19m to 50m. Even if two S.W. bands are provided, it is not likely these will include the 80m and 160m Amateur frequencies. Some surplus receivers also have a rather restricted frequency coverage.

When modifying the set it is a good plan to provide continuous coverage from about 200m to 10m if possible. The usual M.W. band of about 550m to 200m can prove useful occasionally, but it may be decided to omit the L.W. band.

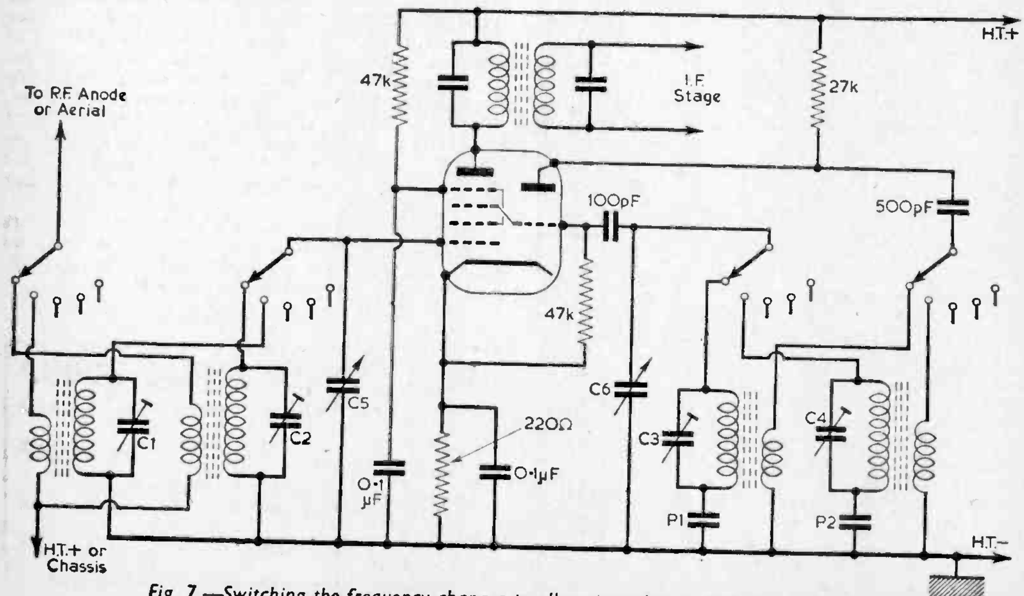


Fig. 7.—Switching the frequency-changer to allow reception on several wavebands.

Switching Circuit

An efficient and convenient way of obtaining the required wave-bands is to use a separate set of coils for each band, as in Fig. 7. This has the advantage that each set of coils is independent of the others. The switch should be a long type with separate wafers, and have as many positions as there will be wavebands. It is wise to use a switch with a fairly large number of positions, as it will then be easy to add further coils later.

In Fig. 7, only two bands are shown. C1 and C2 are trimmers for the signal frequency coils, and C3 and C4 are oscillator coil trimmers. Small 50pF or similar trimmers will be satisfactory. Each set of coils has its own trimmers, so that each band can be adjusted individually.

P1 and P2 are the oscillator coil padders. Unit coils of this type can be obtained from many manufacturers, and each oscillator coil must have the padder capacity specified for it. C5 and C6 are sections of the usual gang tuning condenser.

The values given in Fig. 7 are average for many popular valves, and can be followed when constructing such a receiver. But when an existing receiver is to be adapted, resistors and condensers already present can usually be retained. The tuning coils may also be returned to the AVC line, though results will generally be better on the S.W. bands with no AVC bias applied to the frequency changer.

If a tuning indicator has been provided, as described earlier, this will greatly simplify accurate alignment. Each band is dealt with separately. The appropriate trimmers are adjusted at a fairly low wavelength in the band, and the coil cores are adjusted at a high wavelength. Adjustment will be for maximum reading on the tuning indicator, which will reveal changes indistinguishable to the ear.

Image Frequencies

When reception will be on high frequencies, the effect of image frequency interference must be kept in mind. This is likely to be troublesome on short wave bands, but not on higher wavelengths. Fig. 8 shows how image frequency reception arises, with a typical M.W. and S.W. set. It is assumed that the receiver has an intermediate frequency of 465kc/s. If the receiver is tuned to 500m or 600kc/s, the oscillator will be operating at 1065kc/s. Stations 465kc/s higher in frequency than the oscillator frequency would also be converted to intermediate frequency in the F.C. stage. That is, a station at 1530kc/s (approximately 200m) might be heard together with the station at 600kc/s. However, even a single tuned circuit of average efficiency can distinguish sufficiently between the 500m and 200m signals to reject the latter. Because of this, image frequency reception is unlikely on the M.W. band.

On the S.W. band it is assumed that a station is tuned in at 20m or 15Mc/s. This is 15,000kc/s, and the oscillator will be operating at 15,465kc/s. The image frequency thus falls at 15,930kc/s or approximately 19m. A single tuned circuit will not distinguish strongly between signals so near in wavelength, and thus a station near 19m may easily come in on top of the required 20m signal.

Image frequency reception is at twice the receiver intermediate frequency, e.g., 930kc/s higher in frequency than the desired station, throughout all bands (with an I.F. of 465kc/s).

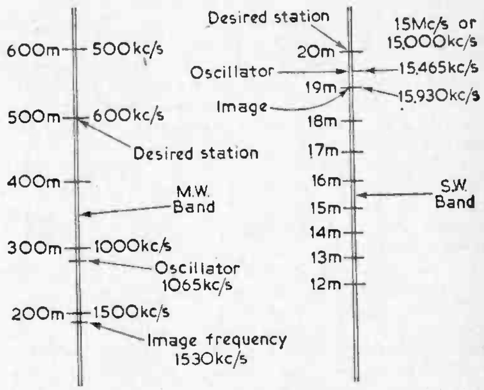


Fig. 8.—Image frequency reception.

One way of avoiding such interference is to have sufficient selectivity *before* the frequency changer. For this reason, a communications receiver with a 465kc/s I.F. may have two R.F. stages. Two such stages prove a little difficult for home construction, but a single selective R.F. stage will be helpful, and can be provided fairly easily. It is, in fact, possible to obtain quite reasonable results with no R.F. stage, if most interest lies in the lower frequency bands. But for most purposes it is wise to plan with the R.F. stage in view.

Increased I.F.

Another method of reducing image frequency interference is to use a higher intermediate frequency, such as 1·6Mc/s. Image interference is then twice this, or 3·2Mc/s (3,200kc/s) away, through all bands. The tuned circuits ahead of the frequency-changer then need to reject signals 3·2Mc/s away from the desired station, instead of 930kc/s away, and are more easily able to do so.

Unfortunately, a high intermediate frequency does not give good adjacent channel selectivity. For this reason, it is quite usual to employ about 1·6Mc/s in an early stage, followed by 465kc/s or a similar lower frequency in later stages. This results in the double superhet, which will be dealt with later.

Some commercial communications receivers are single superhets, with an I.F. of around 465kc/s. Others are double superhets, a high I.F. being followed by a much lower I.F.

(To be continued)

THE P.W. SIGNAL

CHASSIS No. 3

VARIABLE FREQUENCY AUDIO OSCILLATOR SECTION

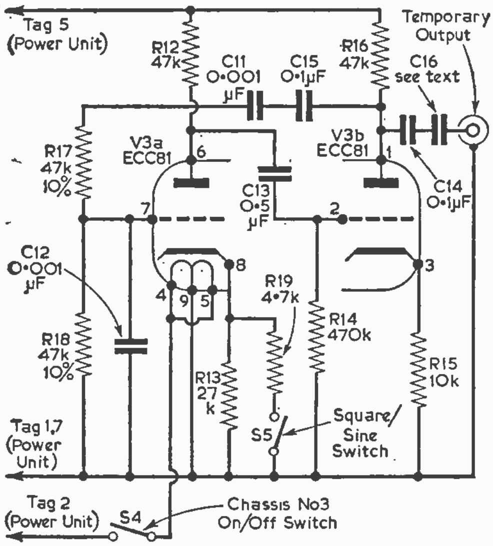


Fig. 16.—The theoretical circuit of the audio oscillator. There are no variable components and the circuit given above produces a single fixed note.

GOOD variable frequency audio oscillators are not cheap to purchase or easy to make and although the one to be described has limitations it will fulfil nearly every requirement of the beginner, and will be an asset in every amateur radio laboratory. (The author wishes to thank Mullard Ltd. for permission to use information from their Educational Pamphlet describing a simple Wien Bridge Oscillator.)

Chassis Number 3 will consist, finally, of a variable frequency oscillator, a triode amplifier and a cathode follower output stage and will incorporate a coarse frequency change switch, fine frequency adjustment by ganged potentiometers, a on/off heater switch and a switch giving sine or square waves. The range will be approximately from 15c/s to 33kc/s (which is beyond the range of normal human hearing). The output voltage being, if required, over 100.

This chassis will be wired in stages:—

1. a simple Wien Bridge oscillator.
2. addition of triode stage.
3. addition of the cathode follower stage.
4. addition of variable frequency components.

The Oscillator

The circuit is shown in Fig. 16 and reference to Fig. 17 will show the positions of the main components for the first part of the oscillator. This will work on a single, fixed, frequency.

Verify that the centre post of the coaxial output socket is not shorted to chassis and also that the tags of the tag strip (except the two at the ends) are not earthed. Check that the valveholders are fitted exactly as shown or the wiring in Fig. 17 will not hold good.

In order that connections to the power unit may be made easily, a small tag strip (tag strip A) should be mounted at the rear of this chassis in the same position as that on Chassis Number 2—see Fig. 5 on page 1106 of the April issue. This

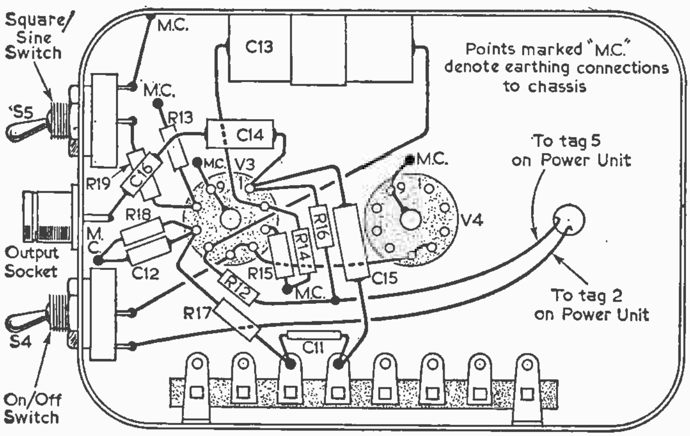


Fig. 17.—The wiring of the fixed frequency audio oscillator.

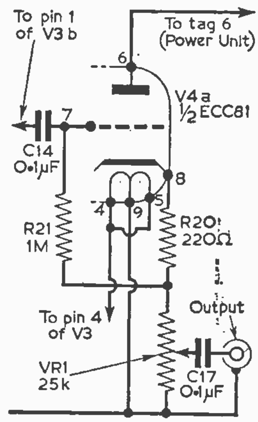


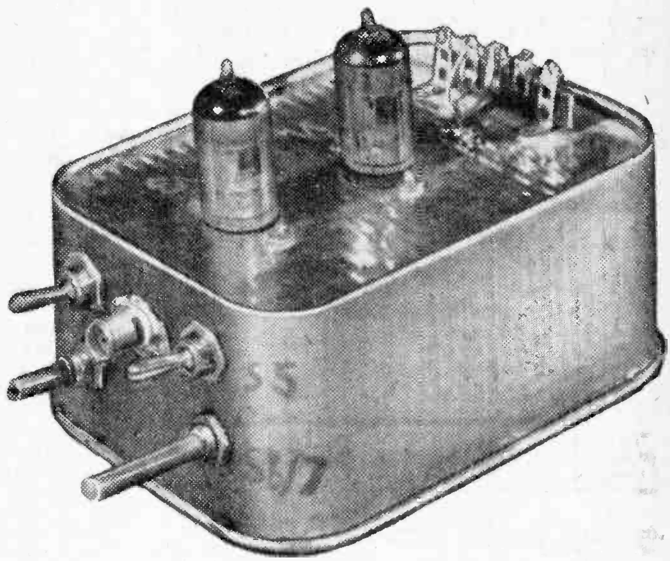
Fig. 18.—The circuit of the cathode follower stage.

GENERATOR

By
E. V. King

tag strip should have three insulated and either one or two earthed tags: the insulated tags are used for H.T. positive connections and for the heater wiring and one of the earthed tags is used for the other heater connection and H.T. negative. Wire one of the insulated, unearthed, tags of this tag strip to one tag of S4. This will be the connection for the heater supply. Wire the other tag of S4 to pin 5 of V3 and continue the wire to pin 4 (Fig. 17). Earth the centre spigot of V3 valveholder via pin 9, to the chassis. Now, connect tag strip A to the heater supply from the power unit (Chassis Number 1) and check that the heater of V3 heats up when S4 is switched on.

Continue the wire from pins 4 and 5 of V3 to pins 4 and 5 of V4; earth pin 9 of V4 and the centre spigot. Check that the heaters of V3 and V4 heat up when S4 is switched on.



The completed unit

Wiring of V3b

Next attach R16 to pin 1 (we are dealing only with V3) and connect a red wire to it and take this through a grommet to an insulated tag on tag strip A (which will later be connected to tag 5 on the power unit to supply H.T. to V3). Also connect C14 to pin 1, and its other end to condenser C16 (100pF). The other side of C16 connect to the centre of the coaxial output socket (C14 and C16 are in series). Connect pin 3 to earth via R15 and pin 2 to earth via R14. Connect the H.T. positive from the power unit (tag 5) to the V3 H.T. tag on tag strip A and plug in to the mains. Connect phones to the output socket. Touch pin 2 with a metal object held in the hand (beware of touching pin 1 in error or you may get a shock). Buzzing or humming should be heard in the phones. Switch off the unit.

Connect C13 to pin 2 and the other side of C13 to tag 6. Make sure C13 is securely fixed with a clip and that it cannot slide about. Repeat the phones tests above, but this time touch pin 6 with an insulated screwdriver. Humming or at least

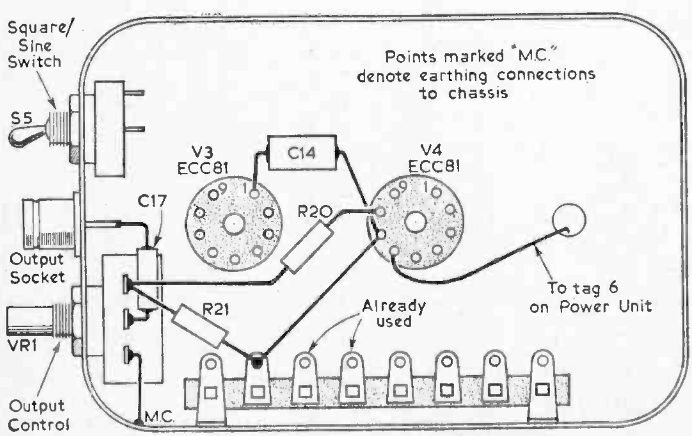


Fig. 19.—The wiring of the cathode follower stage—only wiring additional to Fig. 17 is shown.

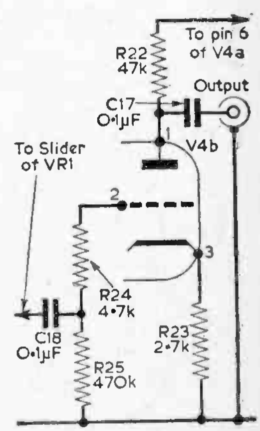


Fig. 20.—The circuit of the triode amplifier.

COMPONENTS LIST

For Figs. 16 and 17

R12	47k	R16	47k
R13	27k (see text)	R17	47k 10per cent
R14	470k	R18	47k 10per cent
R15	10k	R19	4·7k
C11	0·001 μF	C14	0·1 μF 350VW
C12	0·001 μF	C15	0·1 μF 350VW
C13	0·5 μF 350VW	C16	100pF

Chassis as for the Power Unit
S4 and S5 Two toggle switches—any single pole switch is suitable
Coaxial output socket
V3a and b ECC81

For Figs. 18 to 21

R20	220Ω ¼W	R23	2·7k ¼W
R21	1M ¼W	R24	4·7k
R22	47k ¼W	R25	470k

VR1 25k pot; small type—linear
C16 no longer used
C17 0·1 μF 350VW
C18 0·1 μF 350VW
V4a and b ECC81

crackles should be heard as the screwdriver is moved about on pin 6.

Wiring of V3a

Attach R12 to pin 6 and by suitable bending join the other end of R12 to the H.T. end of R16. Take pin 8 to earth via R13. Join pin 7 to earth via R18.

Plug in to the mains and switch on. Repeat the phones test, but touch pin 7 with the metal object and take care not to touch pins 1 and 6. The humming should now be much louder.

Now attach C12 between pin 7 and earth, and repeat the above test. The tone may be somewhat different but hum should still be heard.

Attach R17 to pin 7 and take it to the second unearthed tag of the internal tag strip (the third tag usually, as the first one is earthed)—see Fig. 17. Bend the wire of C11 suitably so that it may be soldered between the third and fourth unearthed tags (see Fig. 17). Connect C15 between the third unearthed tag and pin 1. The feedback path is now complete.

Attach the phones as before and switch on. A strong musical note of somewhere about 3kc/s will be heard. If the note is not heard, check all the parts added since the last test. If necessary, but only as a last resort, reduce the value of R13.

The Value of R13

The value given will suit almost every case. Where second-hand valves, or other, faulty, components are used it may be necessary to reduce R13 gradually until oscillation is obtained. Where it is possible to make it of higher value than 27k and still maintain oscillation this should be done. The author found all valves will work with 27k and many with 33k, and a few with even higher values. The higher the value of R13, the more likely is the wave produced to be pure.

Wiring in the "Square Wave" Components

When the value of R13 is reduced greatly, the biasing of the valve is small and considerable distortion produces waves which approximate to square waves. This type of waveform is useful for amplifier testing. Beginners may not have an immediate use for this type of wave and they may, if they wish, omit R19 and S5. If this facility is required, wire R19 to one side of S5 and the other side of the switch to earth. The complete wiring is shown in Fig. 17. The output is now available for limited use. If it is applied to the pick-up terminals of a radio, the note will be reproduced loudly in the speaker. An amplifier section of a radio may be checked by touching each valve grid (or transistor base) with the output lead, the two chassis being joined together. The note should be amplified each time, and some idea of stage gain can be obtained by the volume levels.

Adding the Cathode Follower Stage (V4a)

The output from V3a and V3b is to be fed into V4a which does not amplify, but serves to isolate the oscillator from the external connections.

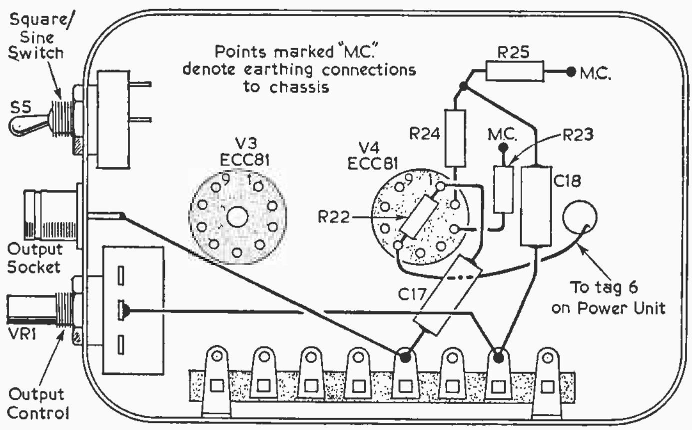


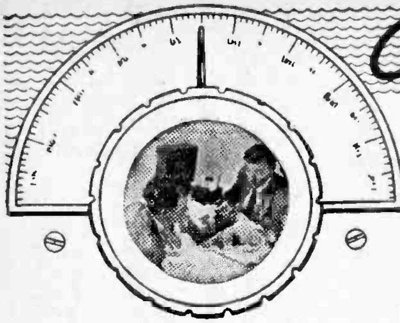
Fig. 21.—The wiring added to that of Figs. 17 and 19 to complete the triode amplifier stage.

Readers may have noted that if various phones (or amplifiers) are connected in circuit the note is different. The stage using V4a will prevent this from happening. It also allows a convenient and simple control of volume.

The circuit for V4a is given in Fig. 18 and the *additional* wiring in Fig. 19.

Unsolder the junction of C14 and C16, take C16 out of circuit, and wire C14 to pin 7 of the valve being wired (V4a). Connect R21 between pin 7 and one end of VR1 (see Fig. 19), and from this connection wire in R20, taking the other end to

(Continued on page 257)



On Your Wavelength

BY THERMION

Communication Receiver Design

MOST readers will be familiar with the older type of American communication receiver in which the coil unit was built as a large inset, pushed in from the front of the receiver, and carrying on the face-plate two large scales showing all the tuning ranges and the *exact* dial settings. Making one of the latter types of scale is one of the main difficulties encountered by the home-constructor, as no matter how accurately the coils are made and the wiring is carried out, without the aid of a really good signal generator one is faced with the difficulty of locating a wanted station, or ascertaining the wavelength of a station which one picks up. Nowadays it appears that there is no coil unit available which is supplied with a suitable tuning scale. Not only in the field of short-wave working, but also on the normal broadcast bands, complete coil units with their accompanying tuning scales, many of them carrying station names, were at one time readily available, and I look for the day when the amateur will again be able to purchase a ready lined-up coil pack, with a really reliable tuning dial. This not only gives the finished set a commercial appearance, but greatly simplifies its use and gives one a greater interest in station searching. The rather large type of plug-in coil which was at one time so popular has now apparently ceased to have any interest, probably owing to the difficulty of winding coils for modern circuits.

Mains Unit

Whilst dealing with some of the older types of equipment I am reminded that the power pack or power-unit of today is a very much simplified version of the older units, but is it so useful or, what is more important, so safe? The earlier idea was to use a really well-made transformer delivering adequate output, and with a really good choke, with plenty of iron in it, and adequate reservoir and smoothing capacities. Besides providing a really smooth and steady D.C. output, this also had the merit of isolating from the mains any apparatus which it fed.

The arrangement of a resistance wound integrally with the mains leads and known as "line cord" does not seem ever to have really caught on in this country, although at one time it was extremely popular, especially in the U.S.A. Today the transformer appears conspicuous by its absence, and tiny little resistors, sometimes as low as one watt, and no greater in value than 1,000 ohms, provide all the smoothing; but I do not like this arrangement, and I still prefer a good transformer and choke, and I am glad to note that the Editorial policy of this paper is now to avoid the "live chassis" type of receiver wherever possible.

The Transistor Controversy

As a result of my notes in the April issue concerning the popularity among service engineers of transistor receivers, I have received a considerable number of letters both for and against these sets. It seems from the remarks made by my correspondents, that the main complaint is from the servicing angle. The transistor is usually well placed to permit heat dissipation, but the three leads are generally tucked away very close together, and the serviceman resents the time which he has to spend tracing the position of these leads—unfortunately they are not generally placed in the same order as on the base of the transistor. With a valve base, all that is necessary is to look for the spigot or the wide space between two of the pins, and then one knows from the valve type number exactly which pin is which. There are three leads to the transistor, but from the back of the panel one cannot see easily which is the emitter, which the base and which the collector. It is necessary first to find from the circuit the value of the resistors feeding these points and then trace the appropriate lead.

Delivery Delays

Although not my province, I receive a large number of letters from readers asking me to use my influence to try and ginger up some firms whom they accuse of slackness in delivering components. Whilst I am at all times only too willing to do what I can to help readers, I am afraid that I cannot do much in such instances, other than to pass the request or complaint to our advertising section, as very often these complaints are accompanied by the most drastic accusations. In the few cases which I have investigated, I have found that the readers themselves are to blame. The most common fault is the failure to send a stamp or stamped addressed envelope with their request for information concerning goods. It must be realised that in many business establishments the post is very extensive, and all letters asking for information are put to one side whilst orders are dealt with separately. The cost to a firm of postage on letters can be very large, and as you know it is usual in quoting the cost of goods to include a percentage for postage. The second and most glaring fault is failure to enclose your name and address. This is avoided, of course, if you enclose a stamped and addressed envelope, but if you merely send a postal order for, "the following goods . . ." and fail to give your name and address, you obviously will not hear from the firm, and until you lodge a complaint they will not have the faintest idea who you are.

A Top-Band Transistor Tx

Note: To operate this unit, the operator must own a transmitting licence.

A POCKET-SIZED INSTRUMENT FOR SHORT RANGE COMMUNICATIONS

By A. E. Watson

THE following article describes a pocket transmitter which is suitable for short range car communications. It has been found useful at a sports meeting for relaying the various results of the field events, as well as for testing the sensitivity and selectivity of a top-band receiver.

The Circuit

The modulator consists of a one-transistor amplifier, using an audio transistor such as an OC71 or any surplus red-spots. The A.F. output of this is developed across R1 and is fed via C2 to the base of the transistor oscillator Tr2 (which is a transistorised version of the Hartley oscillator). Note: Poor stability will develop if R2 is omitted, and it is therefore advisable that this be included.

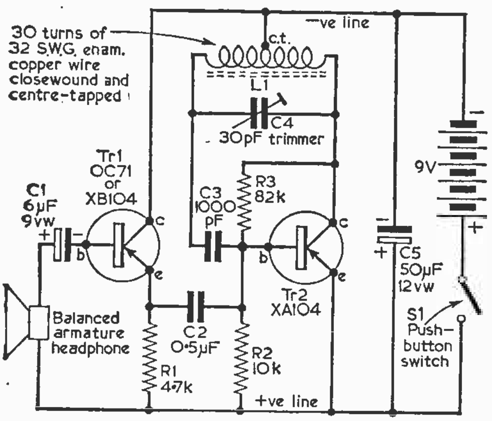


Fig. 1.—The circuit diagram.

COMPONENTS LIST					
Condensers					
C1	6μF 9VW				
C2	0·5μF				
C3	1000pF				
C4	30pF beehive trimmer				
C5	50μF 12VW				
Resistors (All ¼W)					
R1	4·7k	R2	10k	R3	82k
Transistors					
Tr1	OC71 or red spot, or XB104				
Tr2	XA104 or red/yellow spot				
2 Transistor holders					
9V battery PP3					
Low impedance balanced armature headphone (surplus)					
Push button on-off switch					
5/16in. x 4in. ferrite rod (broken in half)					
4ft. 8 B.A. threaded rod (aerial)					

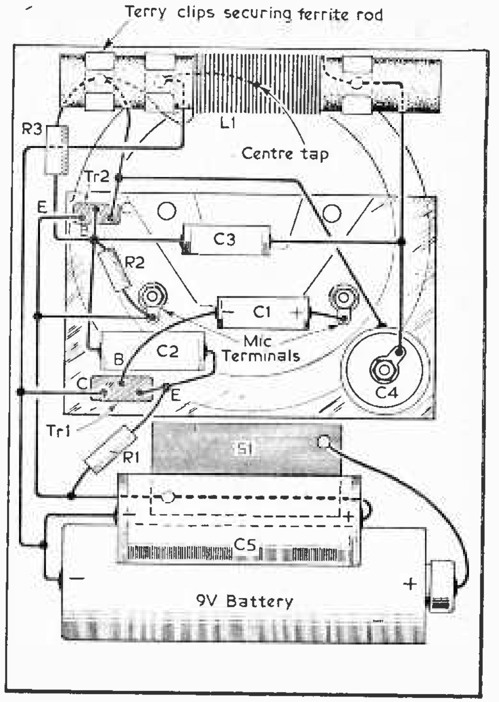


Fig. 2.—The internal wiring diagram.

Components

The voltage across Tr2 may seem rather high, but the maximum Vc-e (in volts) for this transistor is (—12), and therefore this transistor is not overloaded. and as can be seen from Fig. 2 any heat dissipated will be carried away by the metal ring on the balanced 'phone. The coil consists of 30 turns of 32s.w.g. enamelled copper wire, close wound on a double length of 5/16in. diameter ferrite rod.

Construction

The ferrite rod is mounted behind the balanced headphone (the hole for mounting the Terry Clip is

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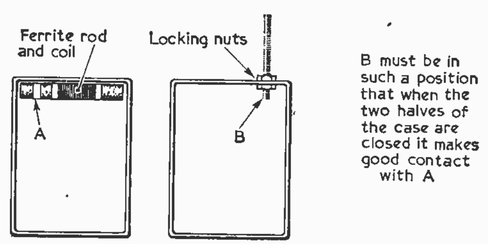


Fig. 3.—The position of the ferrite rod.

A Valve/Transistor Short Waver

AN EASILY MADE RECEIVER FOR THE NEWCOMER TO SHORT WAVE LISTENING

By P. K. Cripps

THIS receiver is highly sensitive and selective, and, although it cannot equal the performance of the more expensive commercial sets, it will provide a useful introduction to the short-wave, amateur, and broadcast bands.

Specifications

The coverage is from about 18m (16·66Mc/s) to 60m (5Mc/s), and from 150m (2Mc/s) to 300m (1Mc/s) in another band. This covers the 20, 40, and 160m amateur bands and the 19, 25, 31, 41, and 49m broadcast bands. The 15 and 10m bands have been omitted, but, owing to the 11-year sunspot cycle, 10 and 15m will open up very rarely for some years. In any case, the condition of these bands nowadays is rather poor owing to the large numbers of stations operating.

The output from the receiver will be from 250mW to 600mW according to the transistors used. As might be expected, selectivity is excellent owing to the well-designed coils, and no difficulty will be experienced in separating stations, even on the crowded amateur bands. Sensitivity is sufficient to allow Dx reception on phones, and loudspeaker reception of the stronger broadcast stations.

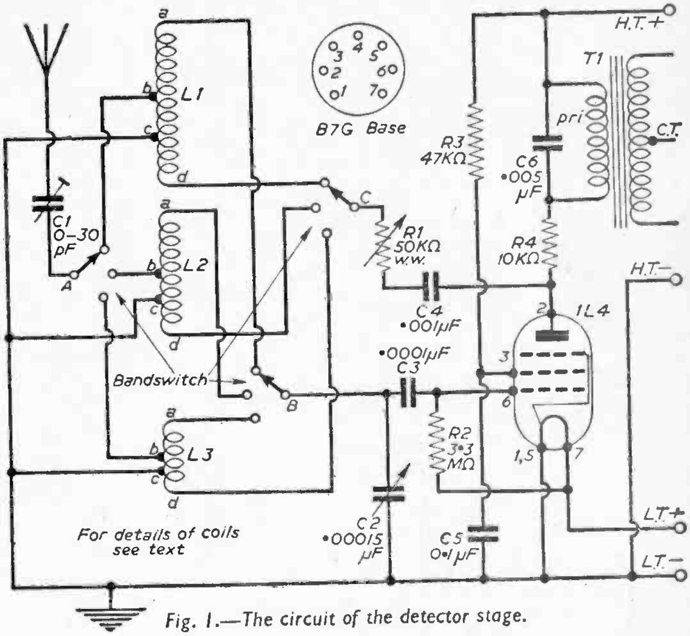


Fig. 1.—The circuit of the detector stage.

Circuit Details

The detector circuit is unusual as only a single tapped coil is used (for each band) with anode reaction. The detector is of the leaky grid type, chosen for its high sensitivity and simplicity.

COMPONENTS LIST FOR THE DETECTOR STAGE

L1, L2, L3—see text and Table II
C1 0-30pF trimmer
C2 0·00015µF S.W. variable capacitor
C3 0·0001µF silver mica capacitor
C4 0·001µF silver mica capacitor
C5 0·1µF paper 150VW
C6 0·005µF paper 150VW
R1 50k variable w.w.
R2 3·3M ¼W
R3 47k ¼W
R4 10k ¼W
Slow motion drive
Switch 3-pole, 3-way

However, if carelessly constructed, with poor quality components, it will prove very unstable with the type of reaction used. Transistors have been used in the output stage owing to their low current requirements and high efficiency. These components have a reputation of an extremely high noise level, and, although this is true, in some circuits using cheap transistors, the noise in this circuit is very low and will not prove troublesome even where faint signals are concerned.

The valve for the detector stage is the 1L4. Its current requirements are 0·1A at 1·4V, and 2mA at 90V. Other types which may be used are the 1AE4, 1AF4, 1AJ4, 1F2, 1F3, 1AF5, ZD17, 1AH5, 1FD9, 1S5, 1T4, 1U4, DAF91, DAF96, DF91, DF92, DF96 and DF904. The base connection details of all these valves, together with their approximate filament voltage and current requirements are given in Table 1.

Table 1

Valve	Filament Voltage (V)	Filament Current (A)	Valve-holder type
1L4	1·4	0·1	1
1AE4	1·25	0·1	1
1AF4	1·4	0·025	1
1AJ4	1·4	0·025	1
1F2	1·4	0·05	1
1F3	1·4	0·05	1

Table I (continued)

Valve	Filament Voltage (V)	Filament Current (A)	Valve-holder type
1T4	1·4	0·05	1
1U4	1·4	0·05	1
DF91	1·4	0·05	1
DF92	1·4	0·05	1
DF96	1·4	0·025	1
DF904	1·4	0·05	1
DAF91	1·4	0·05	2
1AF5	1·4	0·025	2
1AH5	1·4	0·025	2
1FD9	1·4	0·1	2
1S5	1·4	0·05	2

The pin connections of these are as follows:—

Pin Connections — VALVE GROUP 1

1—negative filament and suppressor grid
2—anode
3—screen grid
4—no connection
5—negative filament, suppressor grid
6—control grid
7—positive filament

Pin Connections — VALVE GROUP 2

1—negative filament, suppressor grid
2—no connection
3—diode anode (wire to earth)
4—screen grid
5—anode
6—control grid
7—positive filament

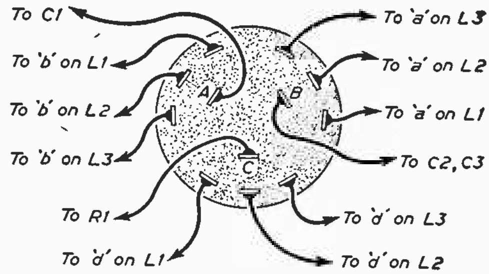


Fig. 3 (above).—The connections for the bandswitch.

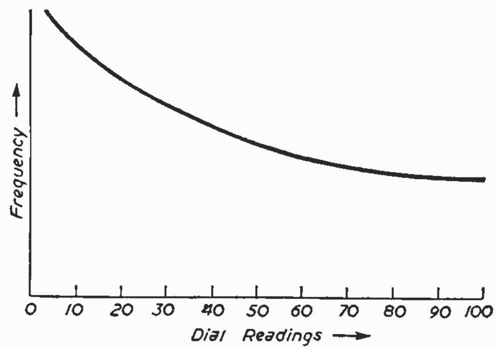


Fig. 4 (above).—A calibration graph.

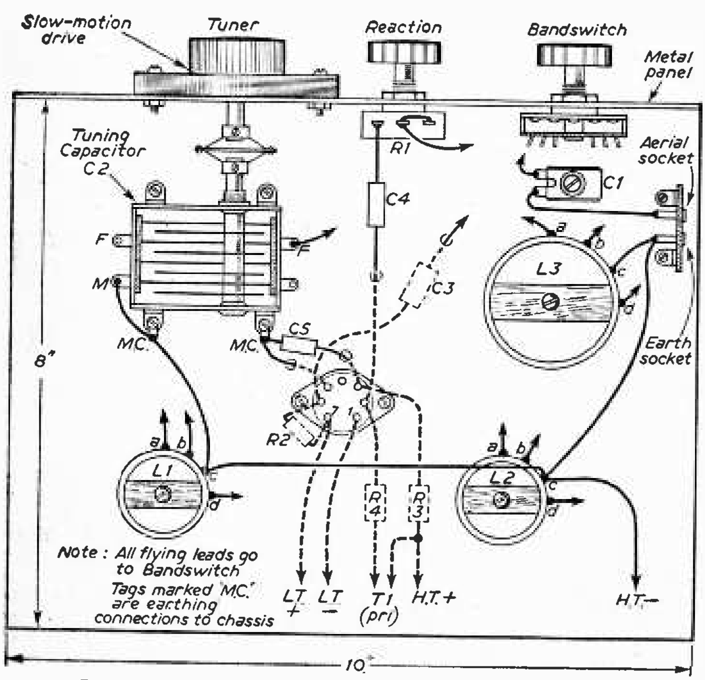


Fig. 2.—The component-layout diagram of the detector stage.

Constructional Details of Detector

The wiring diagram of this stage is given in Fig. 2. It may be constructed on a metal or wooden chassis, metal being better than wood on account of its superior screening properties. In either case a metal panel is essential to screen the controls from the operator to prevent hand-capacity effects. At all times, short, direct, wiring is extremely important. The layout diagram is given for guidance, but it should not be adhered to rigidly; i.e., if you can make a wire shorter than is shown, do so. Any long leads should be of coaxial or screened cable.

The Coils

These coils are home-wound, their winding details being given in Table II. For L1 and L2, the turns should be of enamelled copper wire of the gauge recommended. The turns should start and finish securely, and the taps can be made by twisting the wire and scraping the enamel insulation at the positions given.

Table II

Coil	No. of turns		s.w.g.
L1	100		28
L2	30		22
L3	10 spaced over 2in.		18
Coil	**Tappings b**	**c**	**Diameter of former**
L1	50	75	1¼in.
L2	15	20	1¼in.
L3	5	2½	2in.

COMPONENTS LIST FOR THE OUTPUT STAGE

R1 2·2k ¼W R2 220Ω ¼W R3 33Ω ¼W
C1 200μF 3VW electrolytic
C2 0·05μF
T1 Push-pull input transistor transformer
T2 Push-pull output transistor transformer
T3 Standard pentode output transformer
Tr1, 2 OC71 or any other small power output transistors not requiring a heat sink

The slow motion drive deserves mention: any type will serve. It should be possible to obtain one of Admiralty pattern fairly cheaply from ex-Service stores. The prototype used one of 200 : 1 ratio of this type, which is excellent.

A type marked in frequencies will not be suitable in view of the home-wound coils used. A 1-100 scale will allow stations to be logged with reasonable accuracy, and a graph may be drawn up for a more accurate determination of frequency. The procedure is as follows:—

First, a station is accurately tuned in and its frequency noted. The dial reading is also taken and the procedure repeated until a number of stations at different frequencies are logged. Then, a graph is drawn up of dial reading against frequency. This is shown in Fig. 3. The curve obtained may or may not be a straight line according to the type of tuning condenser used, but it should be regular. Any points well away from the main curve should be disregarded—they are either from faults in reading the tuning dial, or harmonics of a strong station.

Operation of the Detector

If desired, 4000Ω headphones may be connected to the output, instead of the primary of T1, to test the detector. First, check the wiring to ensure that the H.T. voltage cannot reach the filament of the valve, and then connect the batteries: 90-120V H.T. and 1½V L.T. Without an aerial, advance the 50k potentiometer. There should be no crackling or other noises. Somewhere between the middle and end of the travel of the control, there should be a faint "plop" and the set will break into an oscillation howl.

Now that it is proved that reaction is functioning satisfactorily, an aerial may be plugged in and the set tested on all bands. The reaction control should be adjusted to be just below the point of oscillation.

The Output Stage

The circuit of this is shown in Fig. 5. It is constructed on a "breadboard" which can be mounted in the loudspeaker cabinet. The loudspeaker is best a 5in. or larger unit, although smaller types can be used, but they will not give such a good tone.

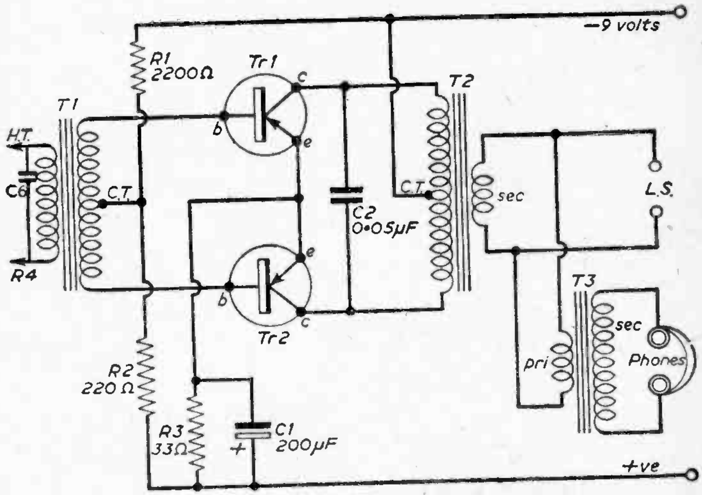
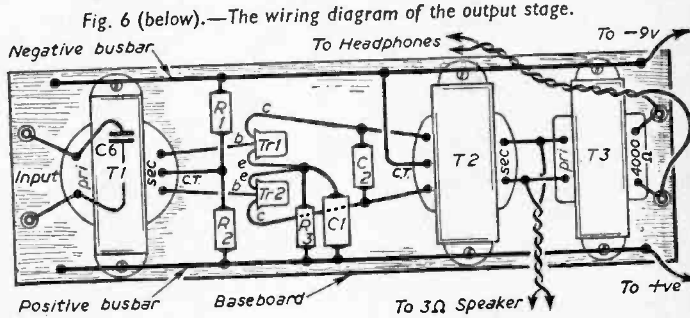


Fig. 5 (above).—The circuit of the transistorised output stage.

Fig. 6 (below).—The wiring diagram of the output stage.



The bus-bars can be of 18s.w.g. bare copper wire attached to the breadboard with insulated staples. The current for this unit is supplied by a PP9 battery, which will have a useful life of a year or even more. The switch for this part of the set can be accommodated in the loudspeaker cabinet. If a switch is desired for the detector stage, it may be wired in the positive L.T. lead and mounted on a suitable place on the panel. ■

An Amateur Communicati

COMPLETE CONSTRUCTIONAL DETAILS FOR THIS COMPREHENSIVE UNIT

THIS receiver was designed for use by the amateur or S.W. listener who requires an instrument which gives a better performance than the average domestic receiver. Such a receiver usually has no R.F. stage and only one I.F. stage. Consequently, it suffers from a lack of selectivity and sensitivity, and is prone to second-channel interference especially at the higher frequencies. Thus, to give above-average selectivity and sensitivity, the receiver to be described employs a number of I.F. stages.

Second Channel Interference

To reduce second-channel interference, the I.F. frequency should be increased or an R.F. stage included. In this design, the I.F. has been kept at the conventional figure of 465kc/s., so enabling the use of easily obtainable components; and therefore an R.F. stage is used.

The Circuit

The circuit is shown in Fig. 1, and it will be noticed immediately that a coil-pack is employed. There are many suitable coil-packs on the market, but if these are unobtainable or thought too expensive, separate coils may be used. If separate coils are used, one set can be purchased to reduce initial expense and the other wavebands added at a later date.

In the prototype, the R.F. stage was capacity-coupled to the EF91 mixer because the coil-pack used by the author did not have provision for inductive-coupling, but there is no reason why this method of coupling should not be used, provided the particular coils are suitable for such an arrangement.

The local oscillator is separate to reduce pulling and drift, especially at higher frequencies.

A triode-connected EF91 has a mutual conduction of nearly 10mA/V, and thus it is used as the oscillator valve, because a valve with a high mutual conductance helps towards stability.

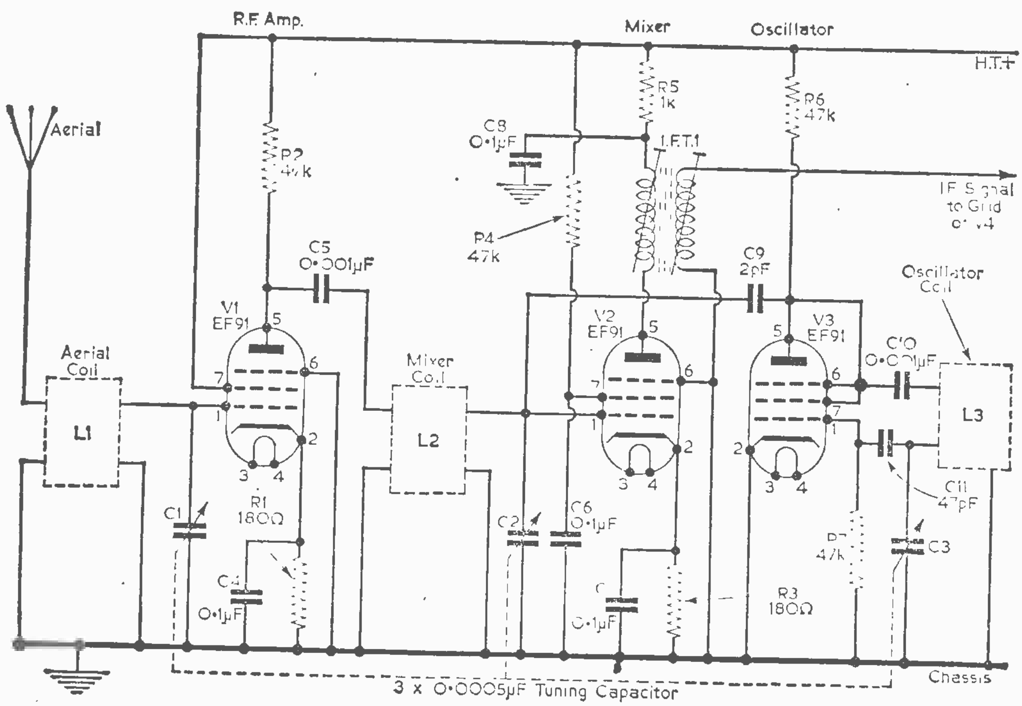
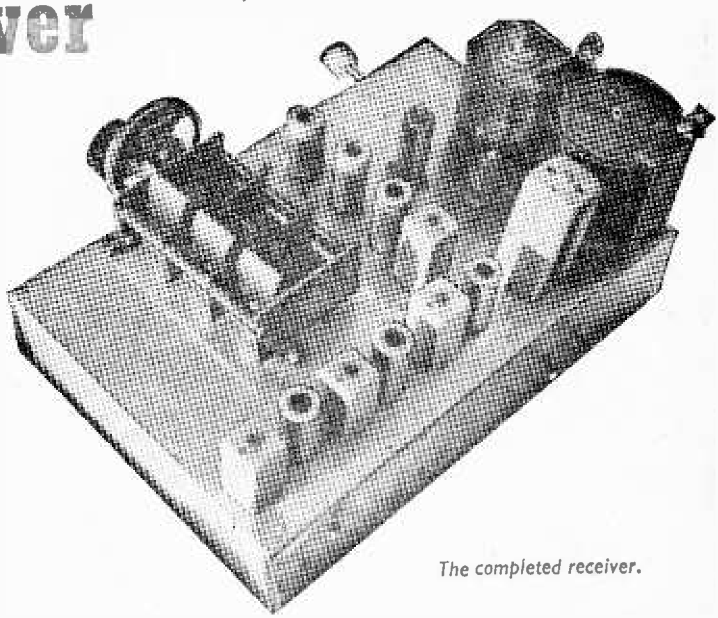


Fig. 1a.—The R.F. amplifier oscillator and mixer stages.

ons Receiver

By P. Hayes

The I.F. signal appears at the anode of V2, and is transferred via I.F.T.1 to the grid of V4. The screen grid of this valve is strapped to the screen grid of V5 and the voltage varied by VR1. This controls the gain of the I.F. amplifier. A comparatively high valve of bias resistor (1k) is used to reduce gain (intended to enhance stability, reduce valve noise, and increase valve life). No AVC is applied as this would only serve to reduce the gain of the I.F. amplifier, thus destroying the aim of having three I.F. stages. The amplified I.F. signal appears across V7 and is demodulated. The resulting A.F. signal appears across VR2 —the audio volume control—



The completed receiver.

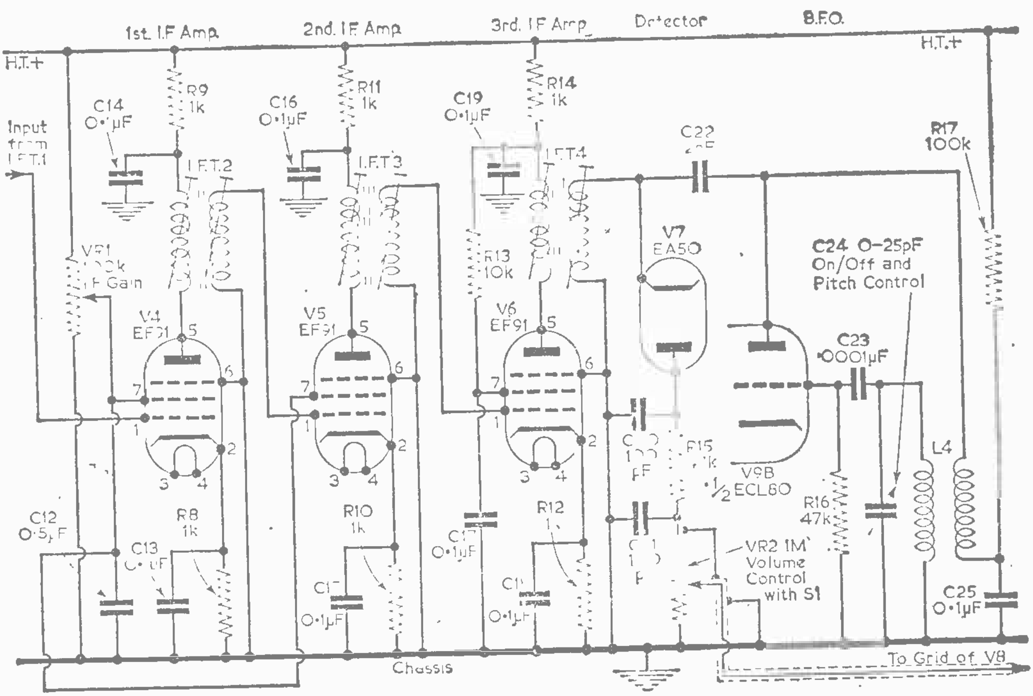
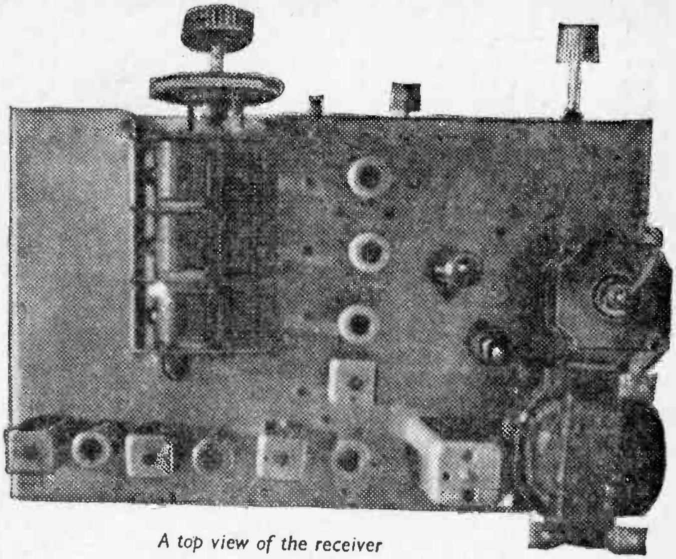


Fig. 1b.—The I.F. amplifier, detector and BFO stages.

and is applied to the grid of V8. (The audio volume control was not used in the prototype because the author found that it was always at maximum and gain was controlled by the I.F. gain control. A headphone jack was put in its place.) The amplified A.F. signal from V8 anode is coupled via C27 to the control grid of V9A. The audio output is developed across T1 and the headphones are capacity coupled via C32.

It will be noticed that the triode section of V9 is used as BFO, instead of, as usually, the first A.F. amplifier. This is because, firstly, the DH77 gives greater gain than the ECL80, and secondly, it completely avoids instability owing both to the close wiring and the fact that the amplifier stage might act as a "cathode-coupled multivibrator" caused by the cathode being common to both triode and pentode sections in the ECL80.



A top view of the receiver

The BFO is conventional except for the method of switching on and off; one vane of the moving plates is bent to touch the corresponding fixed vane. This shorts out the grid coil and prevents oscillation.

The power supply is conventional, and either a metal rectifier or a valve rectifier may be used. If a valve rectifier is employed, there must be a suitable winding on the mains transformer to supply its heater.

(To be continued)

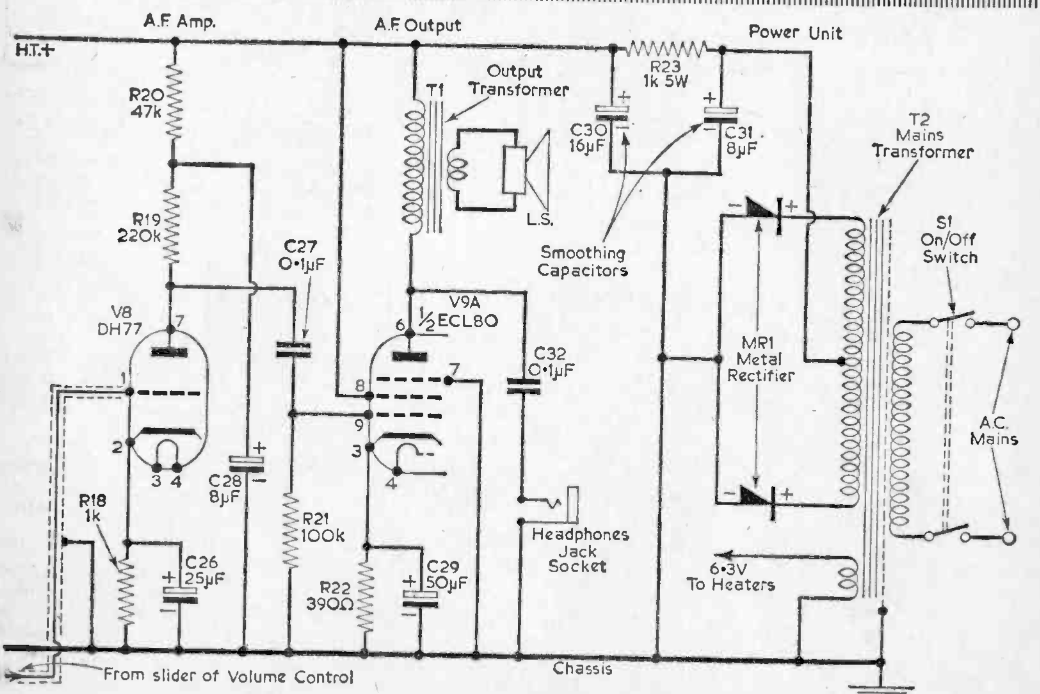


Fig. 1c.—The circuit of the A.F. amplifier and power unit.

Transistorised Signal Tracer

By D. P. Francis

THIS COMPACT UNIT WILL BE FOUND INVALUABLE WHEN TRACING FAULTS

WHEN tracing circuit faults this transistorised signal tracer will be found invaluable. It can be constructed with miniature components, thus making the unit very compact. Alternatively, standard size items may be used, and although they produce a comparatively larger unit it is not clumsy, owing to the fact that there are few components. An additional feature of this unit is the fact that it is transistorised and therefore

The Circuit

The signal tracer comprises a two stage resistance-capacity coupled amplifier using transistors. The method used to trace a fault is simple and consists of switching the unit on and placing the two input terminals on the appropriate points of the receiver under test. The diode section is switched in for tracing, e.g. either R.F. or I.F. circuits.

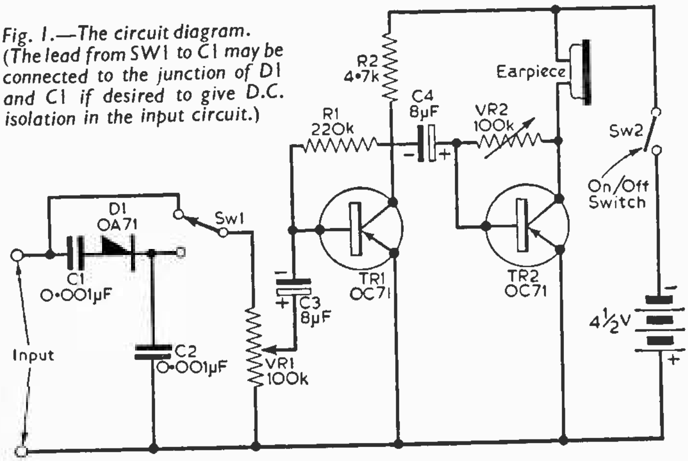


Fig. 1.—The circuit diagram. (The lead from SW1 to C1 may be connected to the junction of D1 and C1 if desired to give D.C. isolation in the input circuit.)

COMPONENTS LIST

Capacitors
C1 0·001 µF C3 8 µF 6VW D.C.
C2 0·001 µF C4 8 µF 6VW D.C.

Resistors
R1 220k ¼W R2 4·7k ¼W
VR1 100k (with SW2)
VR2 100k (preset)
D1 OA71
TR1 OC71
TR2 OC71
SW1 S.P.D.T. switch
4 miniature plugs and sockets
Baseboard
Suitable container
Miniature earpiece
4·5V battery
Transistor Holders

independent of any mains supply. The original model was built in a small plastic box, 2½in. x 3in. x 1½in., the components being mounted on a piece of acrylic sheet. The sockets; system switch and VR1 and VR2 were mounted on the lid of the box, which may be any suitable piece of insulated material.

One adjustment is necessary however. The collector current of TR2 must be 3mA. This can be accomplished by first wiring the unit temporarily, inserting a meter in series with emitter of TR2 and adjusting VR2 until the meter reads 3mA. The meter is then disconnected and VR2 is locked. ■

A TOP-BAND TRANSISTOR TX

(Continued from page 224)

already drilled and tapped. The mounting of the rod is thus somewhat simplified. The headphone is mounted by means of four small screws on to one side of the case (which can be purchased from multiple stores in the form of a soap box). The sub-chassis is constructed of Perspex, and is mounted on the back of the headphone; it functions also as a clip to keep the transistors in place, and as a clip for keeping the oscillator transistor (Tr2) against the headphone for heat shunt purposes (see page 224).

The battery, too, is mounted by means of Terry clips on the same side of the case as the headphone, and thus every component (excepting the threaded aerial rod) is mounted on the other half of the case.

The aerial (a length of 8B.A. threaded rod) is mounted on the remaining half of the case, so that it comes in contact with one of the ferrite rod connecting clips (see Fig. 3).

Testing

First check that the battery is connected correctly. Check also that the transistors are inserted in their appropriate holders the correct way round.

The unit is switched on and placed about 15ft away from the receiver, which is tuned to a point **on the top-band**, and then the transmitter should be trimmed finally to the required frequency, on the same band. It should then be tested with modulation, and should be received up to a distance of at least 50ft. ■

For general radio work, the serious constructor requires some form of multimeter; this article will help you in

Designing Multimeter Circuits

to suit your requirements

By A. Foord

FOR general radio work, the serious constructor requires some form of multimeter. It is essential to be able to measure at least D.C. voltage and direct current. It is also desirable to be able to measure A.C. voltage and to be able to determine resistance. Some while ago the author required a fairly comprehensive meter. After a quick survey of the prices of good commercially available meters the author decided that a home-constructed meter had its advantages.

An outline will be given of the methods of converting meters to read different ranges, and of switching methods.

The Measurement of D.C. Voltage

A moving coil meter can be made to measure voltage by connecting a high value resistance in **series** with it; as shown in Fig. 1. In effect, the meter measures the **current** the battery can force through the resistance. In Fig. 1, Rm represents the meter resistance, Rs represents the series resistor, I represents the FSD (full scale deflection) of the meter, and V represents the applied voltage.

By Ohm's Law,

V = IR (where R is the total resistance)

or V = I(Rm + Rs) volts.

$$\text{Thus } Rs = \frac{V}{I} - Rm \qquad (1)$$

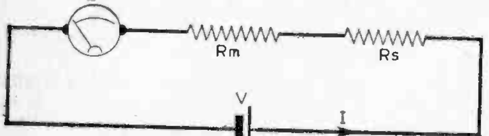
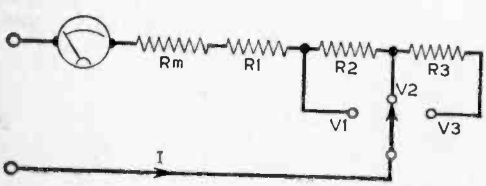


Fig. 1 (above).—Adding a resistance, Rs, in series with a moving coil meter enables it to be used to measure D.C voltages.

Fig. 2 (below).—One method of switching resistors in series with a meter.



Where Rm is less than about 2per cent of Rs. then Rm can be ignored for most purposes. On low voltage ranges, however, Rm should be taken into account. By means of equation (1), the value of Rs for any single range can be calculated. In multirange meters, a number of series resistors may be switched to provide the required ranges.

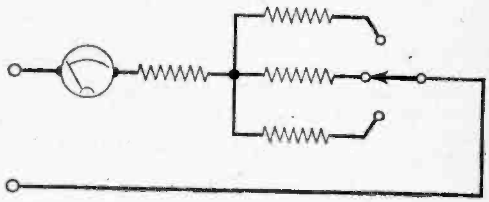


Fig. 3.—Alternative switching for series resistors.

Switching

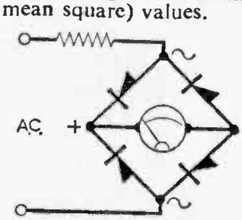
Two methods of switching are available, as shown in Fig. 2 and Fig. 3. In Fig. 2, all the resistors are in series, while, in Fig. 3, separate resistors are used for each range. It should be noticed that in Fig. 2 the total series resistance for each range is made up of several resistors. In this case R2, say, has to drop (V2−V1) volts only.

$$\text{Thus, } R2 = \frac{V2 - V1}{I}\ \Omega$$

In Fig. 3, each series resistor is calculated by means of equation (1).

The Measurement of A.C. Voltrge

To measure A.C. voltage, it is necessary to place some form of rectifier in series with the meter. Normally, a bridge rectifier is used—as shown in Fig. 4. If the series resistors are calculated from Ohm's Law as in the previous case, then the meter reads **average** values of A.C. voltage. However, A.C. voltages are normally given in r.m.s. (root mean square) values.



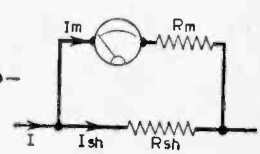
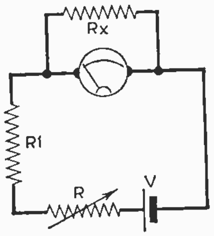


Fig. 4 (left).—The circuit of a bridge rectifier.

Fig. 5 (right).—Adding a resistance, Rsh, in parallel with a moving coil meter enables it to be used to measure direct current.

If the same resistors are used for A.C. and D.C. either a separate scale could be used for A.C. or a chart could be made up to show the A.C. r.m.s. values corresponding to particular meter readings. To avoid this inconvenience, it is desirable to use separate series resistors for A.C. and D.C.



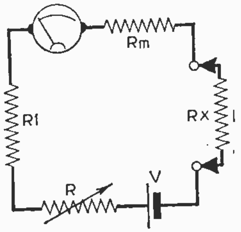


Fig. 6 (left).—For measurements of low resistance, the unknown resistor is shunted across the meter terminals.

Fig. 7 (right).—For measurements of high resistance, the unknown resistor is wired in series with the meter.

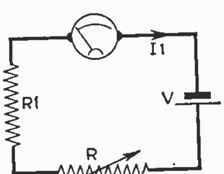
For a sine wave:—
r.m.s. value = (**average** value × 1·11) volts.
It will be seen that for the meter to read r.m.s. values, more current will have to flow through the meter than before. For this to occur the D.C. value of the series resistor will have to be reduced.
Thus,

$$\text{A.C. resistor} = \frac{\text{D.C. resistor}}{1{\cdot}11} \qquad (2)$$

In using bridge rectifiers, there is one disadvantage: they are not quite linear. This means that when the rectifier forms a large part of the series resistances, the meter scale is not linear. For voltages of 10, or lower, the meter scale would have to be calibrated against known voltages.

The Measurement of Direct Current

A normal ammeter or milliammeter only measures one range. By placing a shunt across the meter the FSD can be altered. By bypassing a suitable fraction of the total current to be measured, any required range can be obtained. In Fig. 5, Im is the current to flow through the meter,



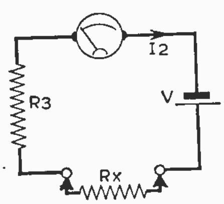


Fig. 8 (left).—Shorting out the Rx terminals in Fig. 7 enables the meter to be set to its FSD.

Fig. 9 (right).—When the meter has been set to FSD., Rx may be connected into circuit.

I is the total current to be measured, and Rsh is the shunt resistance. It will be seen from the diagram that the current to be measured (I) splits up into Im and Ish. Thus:—

$$I = (Im + Ish)$$

or $\quad Ish = (I - Im).$

It can also be seen that the P.D. across the shunt is the same as the P.D. across the meter.
Thus,

$$Ish \,.\, Rsh = Im \,.\, Rm$$

or $\quad Rsh = \dfrac{Im \,.\, Rm}{Ish}$

but $\quad Ish = I - Im$

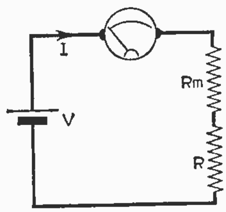
Thus $\quad Rs = \dfrac{Im \,.\, Rm}{I - Im} = \dfrac{Rm}{I/Im - 1}$

If $I/Im = N$ = number of times FSD is to be multiplied,

Then $\quad Rs = \dfrac{Rm}{N - 1}\ \Omega \qquad (3)$

The Measurement of Resistance

For low resistance measurements, it is usual to shunt the unknown resistor Rx across the meter, as shown in Fig. 6. For high resistances, the unknown resistor is placed in series with the meter, as shown in Fig. 7. In Fig. 6, the meter reads high for high resistance, and low for low resistance. A scale could be marked out by Ohm's Law, but it is better to calibrate a scale using known resistors. R1 and R are used to set the meter to FSD before the unknown resistor is connected. The values of R and R1 should be chosen so that it is only possible to pass just over FSD current through the meter. R is adjustable to compensate for the fall in battery voltage with use, and should be



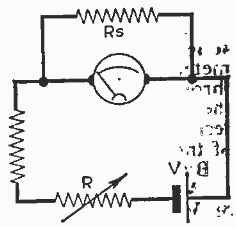


Fig. 10 (left).—The internal resistance of the meter may be found by using a known resistance, R, in series.

Fig. 11 (right).—Circuit for obtaining the correct shunts (see text).

about 10per cent of the total resistance of the circuit.

In Fig. 7 the meter reads FSD for zero resistance, and zero for an infinitely high resistance. R and R1 serve the same function as in Fig. 6. Again, it is better to calibrate the scale using known resistors. However, the calibration expected can easily be worked out in this case.

In Fig. 7, the Rx terminals are shorted out (see Fig. 8) and the meter adjusted to FSD by means of R. Then the total resistance in the circuit (R3) is V/I1 where I1 is the FSD current. Rx is now connected into the circuit as shown in Fig. 9.

$V = I2(R3 + Rx)$ where I2 is the current now read by the meter

$= I2 \,.\, R3 + I2 \,.\, Rx$

Thus $\quad I2 \,.\, Rx = V - I2 \,.\, R3$

Therefore $\quad Rx = V/I2 - R3$

But $\quad R3 = V/I1$

Thus $\quad Rx = V/I2 - V/I1 \qquad (4)$

Practical Matters

It will be noticed that frequent mention has been made of the internal resistance Rm of the meter. This will normally be marked on the scale, but may be calculated if it is not marked. This can be carried out quite simply by placing a known resistor in series with the meter and a battery. As shown in Fig. 10, the current I can be read from the meter, and V and R are known. Thus only Rm remains unknown. For this method, R should be known accurately, preferably to within 1per cent or 2per cent. and should be of such a value that I cannot exceed the FSD current. It would be best to use as low a voltage as possible for V. so that Rm is an appreciable part of the total resistance in the circuit.

$$V = I(Rm + R)$$

Thus $$Rm = \frac{V - IR}{I}$$

or $$Rm = \frac{V}{I} - R$$

Once the internal resistance of the meter has been found, the calculations for D.C. voltage presents no difficulty. For A.C. ranges, however, the effect of the bridge rectifier has to be taken into account. Since this will depend on the meter, and on the rectifier used, the procedure is difficult. The best method would be to use a pre-set potentiometer for the lowest A.C. voltage range. This can be set so that the lowest range reads true (as compared with a known voltage). Once the lowest range has been set the others will automatically be correct. If desired, the resistance of the potentiometer could be measured and the nearest standard value inserted.

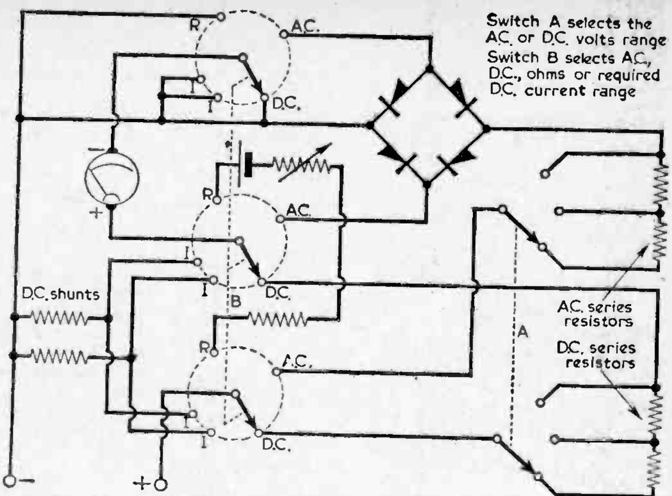


Fig. 12.—A complete multimeter switching arrangement which may be adapted to suit individual requirements.

Calibration

When calibrating the direct current ranges, the approximate value of the shunt resistor can be calculated using equation (3). Once the shunt resistor value has been calculated, the length of resistance wire can be found. In Fig. 11, with the shunt resistor disconnected, the resistor R can be adjusted until the meter passes FSD current. When Rs is connected, the current through the meter will fall, and the length of the shunt can be adjusted until the meter reading is correct for the new range.

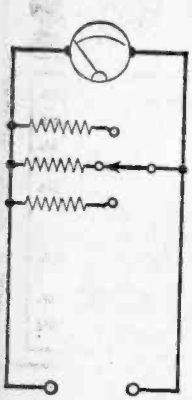
The other D.C. ranges can be adjusted in a similar manner. The only disadvantage is that any errors will be accumulative. Where possible the highest current ranges should be checked against another meter.

Tolerances

For best results the series resistors for A.C. and D.C. should be 1per cent or 2per cent tolerance. The bridge rectifier could be one designed for meters; or four crystal diodes such as OA81's could be arranged in bridge form. Most constructors will be able to borrow some form of meter for a short while, and it is highly desirable to check all the ranges against a standard meter.

Final Design

In conclusion, Fig. 12 shows a switching arrangement which could be adapted by the constructor to suit any meter or desired ranges. The values for the series and shunt resistors, and for the ohms range, can be calculated from the formulae given above. It will be noticed that in Fig. 12, both the meter and the shunt are switched on direct current ranges. The reason for this will be clear from Figs. 13 and 14; in Fig. 13, if the switch became open circuit, the meter would pass an excessive current. In Fig. 14, however, it will be seen that if the switch became open circuit the meter would not be damaged. Switch contact resistance effects are also minimised.



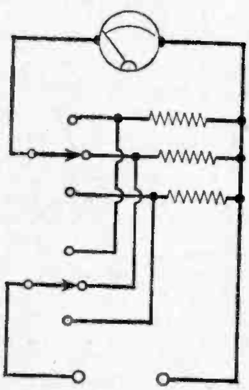


Fig. 13 (left).—A simple switching circuit for shunts which may endanger the meter or introduce errors.

Fig. 14 (right).—A circuit for switching shunts without risk to the meter.

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Trade News

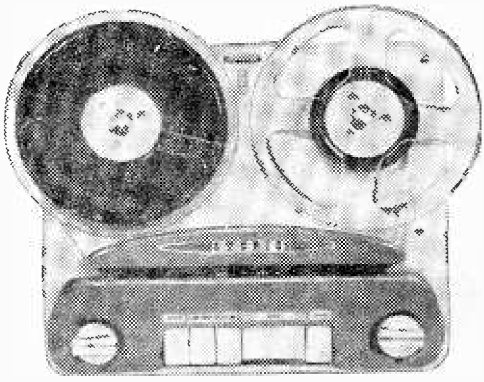
NEW PRODUCTS AND DEVELOPMENTS

XENON-FILLED GRID-CONTROLLED RECTIFIER

THE Ediswan 21B12 is a Xenon-filled valve designed for ignition control in welding equipment, motor control duty, or as a straight grid-controlled rectifier.

The Ediswan 21B12 is a direct replacement for the American C3JA and conforms to joint Army and Navy specification. The disc-sealed construction of the valve offers a number of advantages: it is mechanically robust, the electrical characteristics are maintained to closer limits, the risk of backfiring is reduced, and the valve life is increased.

Direct heating of the valve, coupled with the use of Xenon gas for filling reduces the heating time to approximately 30 seconds. The 21B12 is now available from *Industrial Valves and Cathode Ray Tubes Department, A.E.I. Radio and Electronic Component Division, 155, Charing Cross Road, London, W.C.2.*



The "Studio" tape transcriptor made by Collaro Ltd.

TAPE TRANSCRIPTOR

AMONG other exhibits at this year's R.E.C.M.F. Exhibition, Collaro Ltd. had on show the latest version of the "Studio" Tape Transcriptor. This is a three-speed deck ($1\frac{7}{8}$, $3\frac{3}{4}$, and $7\frac{1}{2}$in./s) with either half or quarter track magnetic heads, giving a frequency response of 50 to 12,000c/s at $7\frac{1}{2}$in./s. plus or minus 3dB with suitable equalisation. *Collaro Ltd., Ripple Works, By-Pass Road, Barking, Essex,* produce this tape transcriptor.

NEW MAINS RADIO

CONTEMPORARY styling is the main feature of a new table model receiver made by Philips Ltd. This set, the 205U, replaces the model 204U, and includes some internal refinements which makes servicing easier.

The tuning system has been adapted for control from the outside band rather than the centre button. The receiver works on A.C. or D.C. between 200 and 250V and is made by *Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.*

The "Super Ten" record player uses the amplifying section of radio sets or tape recorders for reproducing music.

PORTABLE RECORD PLAYER

A NEW four-speed record player, manufactured by Electronic Ades Ltd., uses for its operation the amplifying sections of any radio receiver or tape-recorder that is convenient. The "Super Ten" as the record player is called, is connected either to a radio or a tape recorder by a lead supplied by the makers.

The high impedance crystal cartridge pick-up has a response of 30 to 8,000c/s. The player is housed in a lightweight case of small dimensions and weighs about 5lb. The "Super Ten" costs £7 19s. 0d., and is made by *Electronic Ades London Ltd., Alpha Road, Teddington, Middlesex.*

TRANSISTOR TESTER

THE T.T.1. transistor tester from Advance Components Ltd., has been specially designed for testing low and medium power transistors while still in circuit. This not only saves considerable time, but eliminates the risk of physical damage, particularly to printed circuit boards.

Grounded emitter current gain may be measured in or out of circuit and leakage current (grounded emitter) with the transistors out of circuit.

The tester is battery operated and provision is made for checking the condition of the batteries. The tester is made by *Advance Components Limited, Hainault, Essex.*

The Brenell Engineering Co. Mk. 5, Type "M" tape recorder.

This instrument from Advance Components Ltd. checks transistors in circuit.

PORTABLE TAPE RECORDER

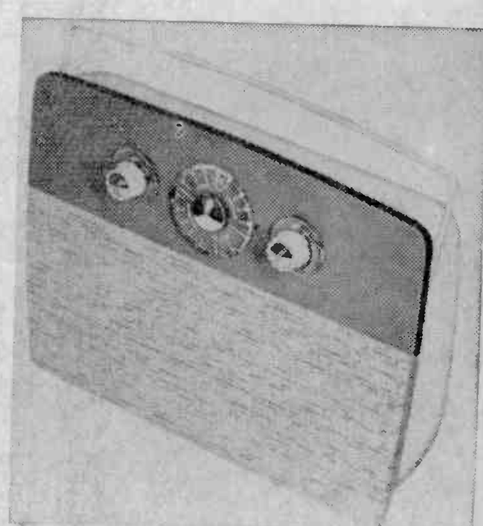
THE Mk 5 Type "M" tape recorder, which is made by the Brenell Engineering Co. Ltd., has improved frequency response over the earlier Mk 5. The amplifier response is from 40c/s to 40,000c/s.

It has superimposing and mixing facilities, a recording level meter and an adjustable rotary tape guide. The Mk 5 is made by the *Brenell Engineering Co. Ltd., 1a Doughty Street, London, W.C. 1* and costs 88 guineas.

PORTABLE RECEIVER

THE "Sky Captain" is a new battery portable receiver made by Ever Ready Ltd. It is powered by a B141 battery which combines 90V H.T. and 1½V L.T.

The receiver is a 4-valve superhet with a printed circuit. The loudspeaker is a 4in. highly sensitive moving coil type. The price of this receiver is 9 guineas and is made by *Ever Ready Ltd., Hercules Place, Holloway, London, N.7.*



The "Sky Captain" portable radio made by Ever Ready Ltd.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Phase Splitters and Phase Reversers

By J. B. Dance

CIRCUITS FOR AUDIO AMPLIFIERS AND OSCILLOSCOPES

THE circuits to be discussed in this article enable two balanced push-pull voltages to be obtained from a single (unbalanced) input voltage. When one of the output voltages from a phase splitter becomes momentarily more positive, the other output voltage becomes more negative by the same amount. These two voltages feed a following push-pull amplifier. The design of phase splitter circuits is closely connected with the requirements and design of the following push-pull stages themselves.

Why Push-pull?

Push-pull amplifiers are widely used in high fidelity audio amplifiers which have a large power output for the following reasons:—

(1) There is no steady magnetic flux in the output transformer, because the flux

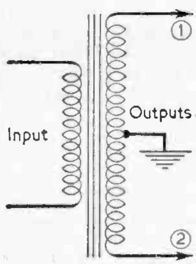

Fig. 1 (right).—A push-pull input transformer.

due to the D.C. currents through the output valves cancels in the transformer; this considerably eases the problems of transformer design and efficiency.

(2) Even harmonic distortion (second, fourth, sixth harmonics, etc.) is cancelled out in the output stage.

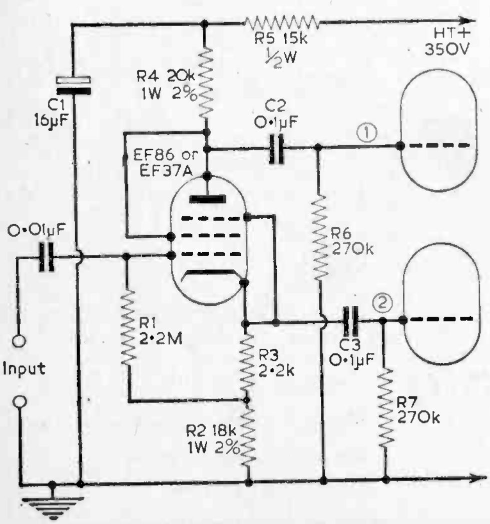

Fig. 2.—The "concertina" phase splitter.

(3) No A.C. of the signal frequency flows through the power supply. A small reservoir condenser is therefore satisfactory, as a low impedance power supply is unnecessary.

(4) Less smoothing is required, as any hum voltage on the H.T. line will not appear in the output.

(5) It is a convenient method of obtaining at least twice the output power than could be obtained from a single valve of the same type.

Oscilloscopes

Push-pull amplifiers are also used to feed the deflector plates of the cathode ray tubes used in oscilloscopes. As the potential of one of the plates rises with respect to earth, the potential of the other plate falls by the same amount so that the average potential of the two plates remains constant. If one of the deflector plates were to be kept at a constant potential with respect to earth, whilst the other was connected to the output of a single valve amplifier, the oscilloscope pattern would be distorted ("trapezium distortion") owing to a change in the deflection sensitivity with the average deflector plate voltage. Push-pull operation also enables a voltage output to be obtained which is twice the maximum obtainable from a single valve under the same conditions.

Balance

If full advantage is to be taken of push-pull operation, it is necessary that the two sections of the push-pull amplifier shall be reasonably closely balanced. That is, the signal currents and voltages in any part of one section of the amplifier must be as close in value as possible to the corresponding current or voltage in the other section, or otherwise the even harmonic distortion will not cancel and currents of the signal frequency will flow in the power supply circuit. It is necessary that the phase splitter shall provide two accurately balanced voltages over the whole frequency range for which it is designed, and that the two succeeding sections of the push-pull amplifier shall give the same gain.

Unbalance can be classified into two types. The first type consists of ordinary amplitude unbalance and can easily be corrected by a suitable choice of resistor values. The second type of unbalance occurs when voltages and currents which are 90° out of phase with the signal voltage exist in one half of a push-pull amplifier. This is known as phase quadrature unbalance or, more briefly, phase unbalance. It cannot be corrected merely by altering the gain of one of the sections of the push-pull stage or by any other simple method. Phase unbalance is caused by currents flowing through coupling or decoupling condensers.

Transformer Method

Audio transformers were widely used for interstage coupling about twenty to thirty years ago instead of the resistance capacity coupling which is almost invariably used between audio stages nowadays. The transformer served to isolate the H.T. in the input circuit from the following grid circuit, and in addition could be used as a matching device. If the secondary of the transformer were centre tapped (as in Fig. 1), two outputs were obtained which were in push-pull. These could be used for feeding the two sections of the following push-pull amplifier. The balance was usually good, but depended on the quality of the transformer.

Good audio inter-stage transformers are comparatively heavy, fairly expensive, and must normally be fed from a triode stage, as the anode resistance of voltage amplifying pentodes is too high to match into practical transformer primary windings. Transformers cause considerable phase shift which would prevent the use of the heavy negative feedback which is necessary in high fidelity audio amplifiers. In addition, the frequency response of transformers normally falls at each end of the range. Audio transformers (except output transformers) are seldom used nowadays because they can be replaced by more satisfactory circuits.

Push-pull voltages can also be obtained from a transformer which does not have a centre tapped secondary winding if two equal resistors (about 150k) are connected in series across the secondary winding of the transformer and the junction of the resistors is earthed. This arrangement is more prone to distortion than the method employing a transformer with a centre tapped secondary winding.

Transistors

It is desirable to operate transistor power output stages in push-pull whenever possible. Phase splitter design tends to be more complicated than when valves are used because the phase splitter must provide two anti-phase currents rather than two anti-phase voltages. Transformer phase splitters are used in most cases, but there are transistor phase splitting circuits in which transformers are not used.

Concertina Phase Splitter

The type of circuit shown in Fig. 2 is called the concertina phase splitter because the anode and cathode resistors bear some resemblance to a concertina when one looks at the circuit diagram. This circuit, which is also termed the cathode follower phase splitter, has been known for many years—probably even before the cathode follower itself.

A normal valve amplifier has a load resistor in its anode circuit whilst a cathode follower has its load resistor in the cathode circuit, but the cathode follower phase splitter has equal resistors in its anode (R4) and cathode circuits (R2 + R3). The voltages developed across these resistors are the push-pull output voltages. The load resistor in the cathode circuits of Fig. 2 is tapped (R2 + R3), the position of the tapping being chosen so that the voltage across R3 provides a suitable bias for the valve. R2 + R3 = R4. R1 is the grid resistor which is returned to the tapping which provides the bias. R5 and C1 are the decoupling components.

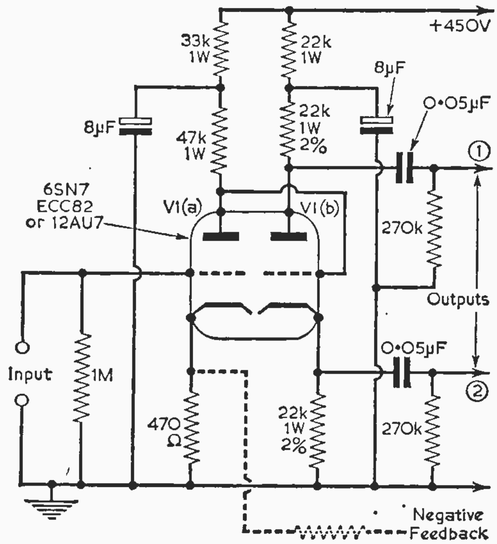

Fig. 3.—Direct coupled "concertina" phase splitter as used in the Williamson amplifier.

Balance

It is most important that the anode resistor R4 should have a value which is almost exactly the same as the total resistance in the cathode circuit, or otherwise the two outputs will not be balanced. The anode and cathode load resistors should normally be about two or three times greater than the valve's internal anode resistance. One of the advantages of this type of phase splitter is that the balance is, for all practical purposes, only dependent on the values of the anode and cathode load resistors; it does not depend on the valve characteristics. The resistors can easily be matched to better than ±2per cent, and good quality components should be used so that they will keep their resistance value over a long period of time.

Owing to the flow of current from the input through R1 and R2 (which act as a potential divider), an additional voltage is present across the cathode resistor besides that due to the valve anode current. If R1 is greater than about 100k, however, this voltage is very small and the unbalance quite negligible. R1 should be fairly large, but not so large that the maximum permissible value for the valve used is exceeded.

Gain

Each of the two output voltages is slightly less than the input voltage; the gain is usually between 0·85 and 0·95. If the input is applied across R1 instead of as shown in Fig. 2, a gain of ten to twenty times can be obtained, but this is not normal in practice because neither side of the input circuit could then be earthed. The cathode feedback in the circuit of Fig. 2 reduces the gain, but it does improve the linearity. The harmonic distortion given by this type of phase splitter is extremely low.

The cathode follower phase splitter has the advantage of a very large input impedance (equal

(Continued on page 245)

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2 a. or 4 v. 2 a. ditto, 350-0-350 .. 22/6
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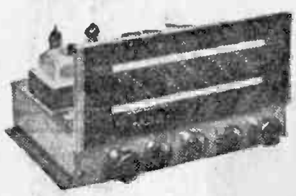

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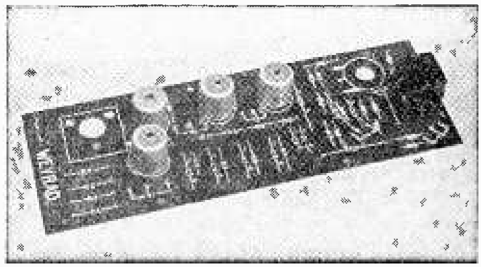

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(Continued from page 242)

to approximately ten times R1). The coupling capacitor on the input side of the phase splitter can therefore be about one-tenth of the usual value. When the component values shown in Fig. 2 are used, the input impedance will be about twenty megohms.

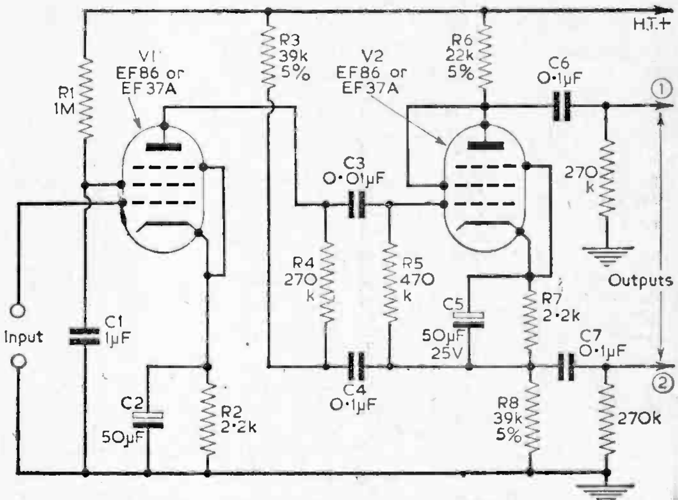

Fig. 4.—A high gain amplifier with a phase splitter.

The output impedance is much higher at the anode than at the cathode, but in actual practice this if of no importance, as it does not affect the balance.

The amount of unbalance at high frequencies owing to stray capacities is negligible at 15kc/s (assuming the two sections of the following push-pull amplifier are similar), but the decoupling condenser, C1, should be 8μF or more if low frequency phase unbalance is to be kept small. R5 should be fairly large, but not large enough to reduce the anode voltage too much.

A triode or triode-connected pentode is almost always used in the cathode follower phase splitter, as a pentode would require a screen supply which would have to be decoupled to the cathode, and this would be likely to cause unbalance at the ends of the frequency range.

If a bypassing condenser is connected across R3, then R2 should be increased to equal R4, and the cathode output should be taken from the junction of R2 and R3.

Hum

The concertina phase splitter is liable to introduce a very small amount of hum, but it will not be possible to detect this unless the phase splitter is followed by a fairly high gain amplifier. The principal cause of the hum is that the cathode is at a higher potential (about 100V) than the heater owing to the large value of cathode resistor: electron emission can, therefore, occur from the heater to the cathode. The hum can usually be greatly reduced by operating the valve from a separate heater supply insulated from the chassis and kept at about the same potential as the cathode (approximately +100V with respect to the chassis).

Care must be taken that the cathode resistor is not too large or the maximum heater-cathode voltage rating of the valve may be exceeded.

Output Voltage

The audio voltage obtainable from either output without distortion varies with the H.T. supply voltage, but is about half that which can be obtained from the same valve used in a normal amplifier circuit with an anode resistor of value twice R4 and with the same H.T. voltage. This is because in this phase splitter circuit one valve supplies both outputs. When the voltage across C1 is 200, the maximum peak voltage from each output is about 15 for 2per cent distortion, but this increases as the voltage across C1 is increased. Unless the H.T. voltage is high, this type of phase splitter will not be capable of driving a pair of large output valves such at KT66's. A push-pull amplifying stage is almost always required between the phase splitter and the output valves (as in the Williamson amplifier), or appreciable distortion will be found at large audio outputs. This requirement increases the number of stages which are needed and is one of the principal reasons why this type of phase splitter (or modifications of it) is not used in most modern equipment.

Direct Coupling

The grid of the concertina phase splitter can be directly coupled to the anode of the previous stage as shown in Fig. 3, this circuit being part of the Williamson amplifier. Besides avoiding the cost of the three coupling components, the direct coupling eliminates any phase shift: this is very advantageous if the circuit is within a negative feedback loop. The very slight unbalance due to the flow of current from the input through R1 of Fig. 2 is also avoided.

The current through the valve automatically adjusts itself so that the voltage across the cathode resistor of V1(b) is a few volts more than the positive voltage applied to the grid of V1(b). This few volts difference constitutes the bias voltage. Any increase in the voltage applied to the grid causes an increase in the cathode voltage; thus the bias is stabilised.

Increased Gain

As mentioned previously, the use of the concertina phase splitter causes a slight loss in voltage. Increased gain may be obtained when the circuit of Fig. 3 is used by connecting a suitable resistor from the cathode of V1(a) to a tapping on the cathode resistor of V1(b) so as to introduce some positive feedback.

Another circuit (Fig. 4) enables increased amplification to be obtained, not from the phase splitter itself, but from the preceding stage. It utilises the high input impedance of the cathode follower phase splitter as a load on an EF86 pentode stage so as to obtain a gain of well over 1,000. If the pentode had been connected by an ordinary resistance capacity coupling to the phase splitter, the gain would have been a little less than that of the pentode alone—approximately 100. The second pentode is, of course, triode-connected.

Such circuits have been used to feed a pair of KT66's directly without an intermediate push-pull voltage amplifying stage, but appreciable distortion would probably occur in the phase splitter if an attempt were made to operate the KT66's at their maximum rated output. There is slight unbalance in the circuit, as the sum of the alternating

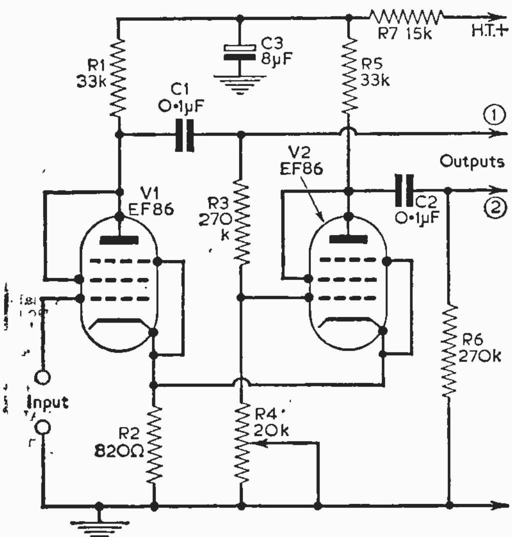

Fig. 5.—A phase reverser with a preamplifier.

anode currents flows in the cathode load of V2 (R8 and R3), whilst only the alternating anode current of V2 flows in the anode load of this valve (R6). The unbalance is, however, only about 1per cent of the signal voltage. R7 is bypassed to increase the input resistance of the stage. The cathode load of V2 is R3 and R8 in parallel (each 39k) as far as signal frequencies are concerned, whilst R6 (22k) forms the anode load. This circuit gives more gain than any other two valve phase splitter. Various forms of it have been used in many amplifier designs.

The cathode follower phase splitter is an excellent circuit which has been used in many high quality amplifiers.

Phase Reversers

In phase reversing circuits the input voltage is used as one of the output voltages and is also applied to a valve circuit which reverses the phase whilst not affecting the amplitude. Such circuits are usually drawn as two valve circuits, but the first valve is actually an ordinary amplifying stage which takes no part in the phase inversion. The amplification is equal to that of the first valve alone. There is quite a variety of phase reversing circuits; they are also known as paraphase amplifiers.

Simple Phase Reverser

A typical circuit which has often been used in the past is shown in Fig. 5. The first valve is a normal amplifying stage providing one of the push-pull outputs. A portion of the output from V1 is tapped off by the potential divider R3, R4 and fed into V2 which functions as an ordinary resistance capacity coupled amplifier. The output of V2 is of opposite phase to its input and therefore serves as the other output voltage. R3 and R4 are chosen so that the two push-pull outputs are equal in amplitude.

A rather better high frequency response can be obtained by using a tapped anode load resistance instead of the tapped grid resistance. The input to V2 is taken from the tapping on the anode load. The position of the tapping must be chosen so that the two outputs are equal in amplitude. The cathode resistor is not bypassed, as the signal currents in the two valves should be equal and opposite; if they are not, the omission of this capacitor helps to balance the stage, provided that the two valves are of the same type.

Disadvantages

The balance of either of these two circuits is critically dependent on the valve characteristic of V2, the position of the tapping point and the value of the anode load resistor of V2. The position of the tapping point requires adjustment for accurate balance when the amplifier is first made, whenever V2 is replaced, and from time to time during use to compensate for valve and resistor ageing. A pre-set potentiometer is therefore used as one of the resistors from which the tapping is taken.

There is serious phase unbalance at low frequencies owing to the presence of C2 in one channel and not in the other. Similarly there is considerable high frequency phase unbalance owing to the valve capacities.

Advantages

The above disadvantages prevent the circuit of Fig. 5 from meeting the requirements of a modern high fidelity amplifier, but there are nevertheless two advantages over the cathode follower phase splitter circuit. In the circuit of Fig. 5, each valve provides only one output and therefore each of the output voltages can be twice as great as when a cathode follower phase spitter is used. Phase reversers can therefore usually drive power valves direct without any intermediate stage of push-pull voltage amplification. In addition, phase reversers do not have the large heater-cathode voltage which is found in the cathode follower phase splitter circuits.

In order to remove the disadvantages of the simple phase reverser, it is necessary to introduce feedback which will preserve the balance of the stage over the whole frequency range and at the same time vastly reduce any changes in gain of the phase reversing stage when the valve characteristics change.

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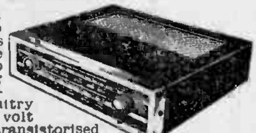

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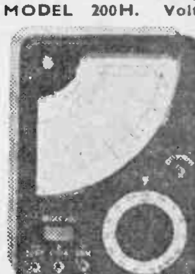

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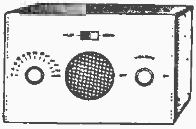

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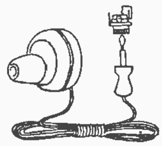

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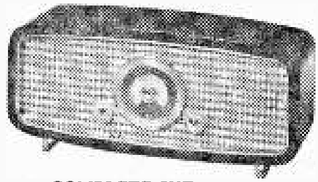

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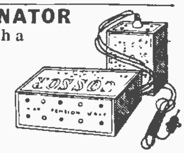

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Letters to the Editor

The Editor does not necessarily agree with the opinions expressed by his correspondents

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of the cover.

ITV SOUND

SIR,—I recently constructed a four-valve battery TRF set using two tuned circuits. (On the medium wave the coils cover 200 to 557m.)

On completing and testing the set I was amazed to find that on the medium waveband, using an inverted "L" aerial, with the tuning condenser at minimum capacitance, I could hear, quite clearly, the ITV sound.

Reception is quite independent of my television set, and the ITV sound can be heard throughout the time of transmission. Can any reader explain this occurrence?—B. QUEST (Leeds, 7).

QUARTZ CRYSTAL ETCHING

SIR.—Several articles have appeared in PRACTICAL WIRELESS from time to time explaining the use of hydrofluoric acid and ammonium bifluoride for crystal etching. In the May issue G30FJ points out ammonium bifluoride dissociates in solution to hydrofluoric acid and ammonium fluoride.

No one has yet pointed out that a crystal can have its frequency raised by careful grinding.

Place a small amount of scouring powder—the type used for cleaning sinks, etc.—on a plate of glass and moisten it with a little water to a smooth paste. Spread the paste evenly over the glass and lay the crystal on top of it. By moving the crystal in a circular motion over the paste, with one finger, small amounts of the crystal will be ground away. After a short while rinse the crystal and dry it well. Now replace it in a crystal holder and check the new frequency with a calibrated receiver.

This method can be repeated until the required frequency is obtained.

However crude this method of grinding a crystal may seem, the complete operation may be carried out with no danger whatsoever.—G. GALLAMORE (Manchester).

CRYSTAL SETS

SIR,—I would like to add something to the great amount of comment that has recently appeared on this page of your magazine, about the usefulness and reception of crystal sets.

Firstly, crystal sets are almost the best type of tape tuners, and are certainly the cheapest.

The other point I would like to make is about reception. One night three stations came in together: Moscow Radio, Stara Zagore—a Bulgarian station—and Luxembourg, and to me this proved enjoyable listening. I read the explanation of this given by A. Dyson in the May issue, but I still think that crystal set reception is far more exciting than with an ordinary commercial set.—N. J. PLANT (Staffordshire).

TRANSMITTER LICENCES

SIR,—The low power transistor transmitters, which are ever growing in popularity, usually have a maximum range of two to five miles, and yet the owner of such a transmitter must sit exactly the same GPO examination as a person owning a 75W instrument.

Would it not be possible to have a separate test for enthusiasts with transmitters of, say, one watt and under and to abolish the morse test for those not using morse? The test could be on transmitting techniques and radio theory. Only a fairly simple test would be required to satisfy the authorities that the operator is not a potential nuisance.—D. C. DICK (Glasgow, C5).

HIGH FIDELITY

SIR,—How I agree with P.H. (March issue) on the mis-use of the term High Fidelity. Nowadays everything seems to be termed high fidelity, even to articles not in the radio or sound field. I would go so far as to state that many items sold under this name, even although very expensive and employing multi-stage amplifier with quite large output valves, are not really "high-fidelity". Is it not time the British Standard Institute drew up some standard to which the term could be applied? I would say that this is not the frequency range—an amplifier stated to be suitable for reproduction "from 20 to 20,000c/s" is not necessarily "high fidelity". What about its handling of transients and square waves? No, let us have some standard of fidelity.—G. NOTTACE (Wimbledon).

AERIAL RE-RADIATION

SIR,—The various letters which you have published on the subject of unusual crystal reception, can, I think, be in very many cases, attributed to aerial re-radiation. I remember some years ago I carried out some tests on this subject, and found that under certain conditions with some receivers, an aerial re-radiated a signal to which the set was tuned. In one case, even with aerials at right-angles, it was possible to use a receiver with reaction as a miniature short-range transmitter, one listener shouting into his loudspeaker, the other being able to hear him. The aerials in this case were over 20ft apart at the nearest point. —F. NASH (Wembley).

VINTAGE MODELS

SIR,—While listening to a friend's radio recently I was much impressed by its excellent reproduction. I then discovered that it was a 1934 model with what appeared to be the original valves. It also had a mains energised moving coil loudspeaker, which obviously accounted for its superb quality.

It seems a pity that this type of speaker went out of fashion, as now, to obtain comparable quality from its permanent magnet counterpart, one has to pay quite a large sum of money.—A. V. NEWMAN (London, S.E.25).

RADIO MOSCOW

SIR,—With reference to J. Lowrie's letter in the May issue, the 1734m waveband is used by both the million watt Voice of America transmitter at Munich, and the 500,000W Radio Moscow transmitter. Radio Moscow transmits its main programme between 03.00 and 23.00hr GMT, while Voice of America has three transmissions a day at 04.30 to 07.30 hr, 10.45 to 12.00 hr, and 17.00 to 24.00hr. These transmissions are in English, German, Polish and Russian. During these programmes Radio Moscow cannot usually be heard.—T. THOMPSON (Bristol).

Short-wave Listeners' Log

IT can be found that an expensive, high-quality receiver with a bad aerial may give less satisfactory results than a much more simple and inexpensive set which is provided with an efficient aerial. A poor aerial may cause insufficient signal strength, inability to receive distant stations, and a high background noise.

A random length of wire, merely connected to the aerial terminal, is often used. Actually, the wire will be some fraction of a wavelength. on the frequency to which the receiver is tuned. Assume, for example, that the wire chances to be near a quarter wavelength. Its end impedance is then roughly 50Ω. If the wire were twice as long, it would be about a half wavelength, and its end impedance can be assumed to be roughly 1,000Ω. To obtain a proper transfer of energy from aerial to receiver, the receiver input impedance should equal the aerial impedance—which is obviously impossible if the latter is anything between about 50Ω and 1,000Ω or more. In addition, the aerial wire will be a different fraction of a wavelength on other frequencies, so that its impedance continually changes as the receiver is tuned.

π-Coupler

One way of overcoming this difficulty is to use a radio frequency impedance matching network, or pi coupler. This is easily made for receiving purposes, by means of two air-spaced variable condensers, and a coil. The condensers can usually be about 100pF to 500pF. The coil may be tapped, to obtain resonance at the band wanted. The coil is inserted in series with the aerial lead to the receiver, and one condenser is connected from each end of it, to earth, which also forms the receiver earth.

Resonant Aerial Tuner

A parallel resonant aerial tuner is also suitable with some aerials. This has a coil with a parallel variable condenser, tunable to the waveband wanted. The aerial is taken to one end of the coil, and a centre-tap to earth. A loop consisting of a few turns of wire, round the centre of the coil, is connected to the receiver aerial and earth terminals.

Such tuners may increase signal strength five to ten times, or even more, when the original impedance match was bad. They can be easily adjusted to permit reception on several bands.

Another cause of bad results may be poor signal pick-up of the aerial itself. For good signal strength, the aerial should be as high as possible, well clear of earthed objects, and reasonably long. Insulation at all suspension points should be good. These conditions are usually most easily met by using some kind of outdoor aerial. The down-lead forms part of the system. Single 14s.w.g. wire, 7/22 wire, or anything similar, with one or two ribbed insulators each end, will do very well.

Simple, single wire aerials can give world-wide reception, when efficiently arranged. They do, however, result in a rather high level of background static and untunable interference. This can be greatly reduced by using some form of doublet aerial. The simplest is cut to be a half-wave on the desired band, and has a twin feeder from its centre. For use on several S.W. bands, an aerial tuned at the receiver end is preferable.

A Tunable Doublet

A tunable doublet can consist of two equal lengths of wire, which form both the aerial and feeder. The two portions forming the feeder are kept a few inches from each other by means of spacers. The aerial is suspended by insulators at its ends, so that it forms a long "T", the twin feeder being the vertical portion.

The parallel tuner mentioned can be used for receiver coupling, with one feeder connected to each end of the centre-tapped coil. The whole system is tuned to resonance on the required frequency. This can be done by parallel tuning where the whole is a little short of a multiple of half-waves. On bands where the aerial is too long, a variable condenser in one feeder (series tuning) will provide resonance. The simplest procedure is simply to adjust tuning for maximum signal strength.

Good single wire aerial lengths for amateur bands are about 138ft ($\frac{1}{2}$-wave on 80m), 68ft ($\frac{1}{2}$-wave on 40m), or 34ft ($\frac{1}{2}$-wave on 20m band).

TRANSMITTING TOPICS

TUNING UP

By O. J. Russell

CONSIDERABLE argument prevails on various aspects of the efficiency of amateur transmitters under varying conditions of drive, loading and so on. These aspects often confuse beginners and even experienced amateurs into uncertainty as to what is actually happening when they tune up their rigs, and tends to create doubt as to whether the transmitter is operating at proper efficiency.

Artificial Aerial

A few facts and figures may be of assistance in illuminating what is really happening when a transmitter is tuned up and adjusted for loading with variable grid drive. The use of an artificial aerial is to be recommended when experimenting with a new transmitter. With a suitable artificial load circuit the transmitter may be tuned up, and the effects of various adjustments noted, without radiating needless interference to fellow amateurs.

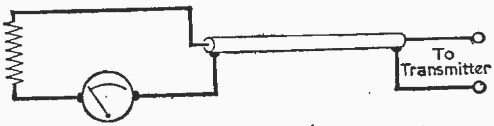


Fig. 1.—The simplest "artificial aerial" is a resistance and R.F. ammeter.

Unless the artificial aerial *is* well screened, it most certainly will radiate. Local amateurs may be copied as good signals when they are using unscreened artificial aerials. The local DX record is a VP6 contact when the amateur in question was using a 50Ω R.F. resistor as an "aerial". Hence, unless constructed with load resistors in a screened enclosure, feeding with coaxial cable, an artificial aerial may well radiate appreciably and even be a cause of TVI. Normally there is no need to screen an artificial aerial, but the possibility of some radiation should be remembered. Even if the aerial is screened, enough R.F. for monitoring is usually present in the shack. Monitoring of the "leakage" signal with a receiver is needed to check note quality, on CW, and modulation quality on telephony.

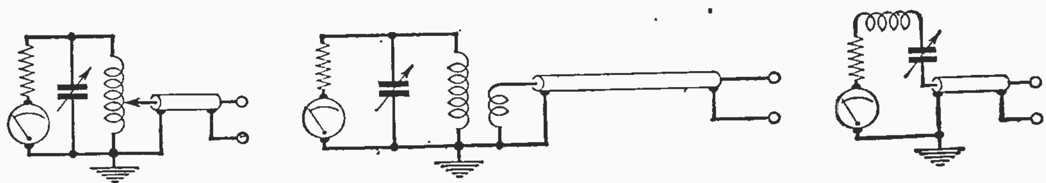
With the popular π-tank transmitters, the simplest artificial load is an R.F. resistor of 50Ω or 75Ω resistance (see Fig. 1). This may be connected by 50Ω or 75Ω coaxial cable to the transmitter output socket. An R.F. ammeter in series with the resistor gives a convenient indication of the transmitter output. Suitable carbon film R.F. resistors may be obtained in high power ratings from "surplus" supply houses. Wire-wound resistors have appreciable inductance and are not suitable. Medium power load resistors may be made by wiring composition type 2W resistors in parallel. Thus, nine resistors of 470Ω wired in parallel will give a 50Ω load resistor, and if 2W resistors are used, will handle 18 or 20W comfortably, and thus serve for a 30W P.A. stage. Similar parallel combinations of 2W composition resistors will enable higher wattage rating loads to be built up if suitable large wattage R.F. resistors are not available.

Lamp loads may be used, but these have the disadvantage that their resistance varies very greatly with the power input. If an R.F. resistor is available that does not match the output impedance of the transmitter, a simple tuned matching unit may be built that will enable it to be matched into the transmitter as shown in Figs. 2, 3 and 4.

Variations in Efficiency

Having arranged a suitable loading circuit, so that the transmitter may be loaded into a more or less non-radiating load, the owner can investigate the actual efficiency variations that occur with loading. This is of interest because, under some conditions, there is a choice of power level control by such means as controlling loading or controlling (by means of a clamp valve) the screen voltage of the P.A., and hence the P.A. input power. Moreover, grid drive also alters efficiency and power input, particularly if a clamp valve is in use, as the clamp valve may start to conduct if the grid drive falls off below a certain figure.

Indeed, grid drive is somewhat of a problem with many hams, and constantly one hears anguished cries concerning low grid drive. To show just how



Figs. 2, 3 and 4.—If an R.F. resistor is available that does not match the output impedance of the transmitter, one of the above three tuned matching units may be built. This will enable the resistor to be matched.

grid drive affects P.A. operation, the reader may be interested in the curves taken on a P.A. stage with the loading normal but with varying amounts of grid drive. The P.A. valve is an 807, but similar results will apply for many other types.

For the record, all measurements were taken on a conventional P.A. stage, running 500V H.T. Two 807 valves were used in parallel, but the grid drive per valve is the figure used. Similar results will be obtained with the usual valve-types used in P.A. stages. It should be understood that the P.A. stage employed a clamp valve. This affects the issue somewhat, as at low grid drive figures, the clamp valve may start to draw current, and thus reduce the P.A. screen voltage. This results in a further efficiency drop in the P.A. stage. This in fact, is the situation with most P.A. stages using clamp valves, so that the curves represent practical operating conditions, rather than textbook examples.

Any question about the "right" amount of grid drive are settled by Fig. 5. Provided the drive is about 2mA, the efficiency is high and constant. This assumes of course that the correct grid leak, or the correct grid bias, is in use. Thus, for C.W. operation, the recommended grid current value of 2mA is confirmed. For 'phone use 2·5 to 3mA grid current is desirable in order that the P.A. tube may be adequately excited at the peaks of modulation, when the instantaneous anode potential is double the actual H.T. voltage in use.

It may require a radical overhaul, and possibly a complete redesign in order to provide the increase in drive power needed for obtaining grid current to spare. This is why the man who tinkers around with a rig complaining he cannot get enough grid drive is likely to be dissatisfied until the driver stages are rebuilt to provide several times more power. If three or four times as much drive power is needed a fairly drastic modification may be needed. However, in some cases where the driver stages provide adequate drive power,

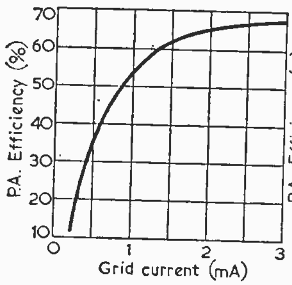


Fig. 5.—The power-amplifier efficiency/grid-current curve.

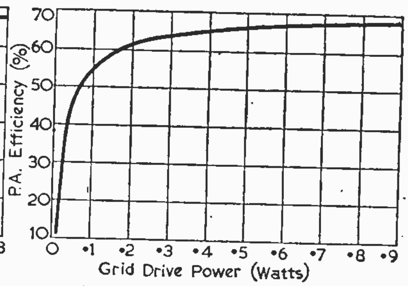


Fig. 6.—The curve of the power-amplifier efficiency plotted against the grid driving power.

some investigation may reveal a circuit error or a wiring slip if drive is low. Fig. 6 shows that if we have around 1mA of drive, rather than 2 or 3mA, the drive is providing only a quarter or a ninth of the required power output to the P.A. grid circuit. Investigation may reveal a simple cause for this.

Required Drive Power

However, notice that even with only 1·5mA of grid current the P.A. performance is still good. It is only at below about 1mA grid current that performance drops off drastically. Hence, a grid current between 1mA to 3mA gives good performance. Hence, if one has adequate drive there is little point in trying to increase it. One point is that the grid driving *power* required increases as the *square* of the grid current. Thus increasing the grid current from 1mA to 3mA involves a ninefold increase in grid drive power. This is shown in Fig. 6 which shows that if drive is adequate, even a small increase in efficiency requires a very large increase in driving power. Furthermore, if drive is *not* adequate, a relatively small increase in driving power effects an appreciable improvement. However, it is clear that to increase drive from a barely adequate amount to "plenty of drive" involves quite a large increase in driving power. Most amateurs would rightly consider 1mA drive for an 807 to be on the low side. To increase this to 2mA, however, requires that the exciter should furnish four times as much power. This does mean that an exciter stage capable of giving 1mA drive may be quite incapable of giving the four times increased output needed to give 2mA of drive, let alone the nine times increase needed to achieve the 3mA drive. Thus, "low drive" may require more than a perfunctory "tune-up" of the exciter before it is overcome.

Loading

Having disposed of, or eliminated, the question of drive power, the question of "loading" may be investigated. It is often necessary or advisable to reduce power. One case is when engaged in local contacts. In other cases many learned observations on beam aerials, S-meter readings and so forth are obtained by reducing power input. It is often assumed that a decrease in power by reducing the P.A. loading to a fraction of full loading results in a similar decrease in output power. On this basis many erroneous assumptions may easily be made about S-meter calibrations and aerial gain. As Fig. 7 shows, the P.A. efficiency is *not* constant with reduced loading, and starts to drop rapidly as P.A. loading is reduced. This fact is not too well appreciated in amateur circles. If, for example, an 807 P.A. for top-band were religiously reduced to 10W input by underloading, the P.A. efficiency would be very low indeed. Naturally, a P.A. stage for top-band would be operated in any case with reduced H.T. voltage, and this is important, for the P.A. efficiency is actually reduced still further with reduced anode potentials, so that the P.A. efficiency of a top-band rig using popular valves might indeed be quite small. As top-banders very often assume that 160m is an "easy" band, little attention is paid to P.A. efficiency, and provided the P.A. stage works—that is provides RF output—it is assumed that efficiency is, at any rate, "reason-

(Continued on page 257)

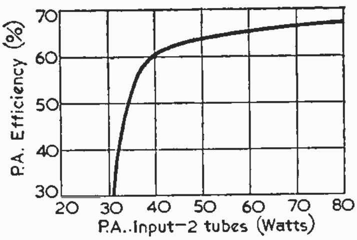


Fig. 7.—The variation in power-amplifier efficiency with loading.

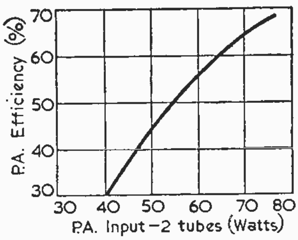


Fig. 8.—The graph obtained from the power-amplifier efficiency when the power level is varied by the clamp tube control.

(Continued from page 254)

able." In fact, an efficient P.A. stage running at reduced input of ten watts is a case where special consideration of valve operating conditions is necessary if efficiency is to be good. The large drop in efficiency with reduced loading shown in Fig. 7 should illustrate this.

Screen Voltage

It might be argued that "input" and hence "output" could be satisfactorily reduced in a top-band P.A. stage by reducing the screen voltage. This, of course, is the function of the usual clamp valve in a conventional P.A. stage. As Fig. 8 illustrates, while reducing the screen voltage by means of the clamp valve reduces input, this is also accompanied by a drop in efficiency. However, the drop of efficiency is smoother than when output is controlled by loading, and quite a linear response is obtained. This explains why a clamp valve may be used for modulation purposes. Here again it will be noted that efficiency drops off to a low figure at low inputs, being around only 25per cent with 10W output power for around 40W D.C. input power. Thus, running a top-band P.A. valve with a reduced screen voltage to reduce the input down to 10W results in poor efficiency. This underlines the fact that the maker's ratings are those at which good efficiency may be achieved. Provided screen, anode and grid voltages are correct and the rated grid current is obtained, a P.A. stage will give good efficiency. However, a reduction of P.A. input by one S-point—6dB as indicated on the anode meter, may show up in actual power output on a receiver as possibly two S-points or 10 to 12dB. This is borne out by the curves given, which are the results of careful measurements on a typical P.A. stage. Thus, a rough-check on aerial gain or S-meter calibration, or various other tests, may be hopelessly in error if the above facts are not appreciated. Finally, that top-band rig may give a healthy increase in output if the fact is appreciated that an "under-run" P.A. valve may in fact be giving a very low efficiency, so that for the 10W allowed on 160m very little is put into the aerial from the transmitter. All this underlines the fact that top-band operation is not as easy as it looks, and that in fact very few amateurs obtain optimum results there. ■

THE P.W. SIGNAL GENERATOR

(Continued from page 220)

pin 8. Connect the far end tag of VR1 to chassis, and the centre one to the output socket via C17.

Reference to the diagrams will show that R21 has been taken to pin 7 via an unearthed tag of the tag strip. This is not absolutely necessary, but it is thus held securely in position.

Finally, connect pin 6 (V4a) to tag 6 on the power unit via the remaining insulated tag on tag strip A (which is on top of the chassis).

Switch on as before. Connect the phones to the output socket. A note should now be heard and should be variable in *volume*, but not in pitch. If VR1 works the wrong way round, reverse the connection to the outside tags. If VR1 is linear, the output will be approximately in accordance with the setting, i.e. half rotation giving half output.

Adding the Amplifier Stage

For some tests of amplifiers it is necessary to have a high voltage signal for input, and in order to be able to obtain this, an additional amplifier stage is used. The other half of V4 (V4b) is used as a conventional triode amplifier. The circuit of the triode amplifier stage is shown in Fig. 20, and the *additional* wiring required in Fig. 21.

(To be continued)

NEW COMPONENTS

AMONG the range of components on the Egen Electric stand at the Radio and Electronic Component Manufacturers' Federation Exhibition, Olympia (May 30th-June 2nd), was a recently introduced range of miniature potentiometers for use in transistor circuits.

Constructed on a die-cast body of only ½in. diameter, these bush-mounted controls have a moulded spindle of $\frac{3}{16}$in. maximum diameter and are available with standard resistance values in the range 1,000Ω to 3M logarithmic or linear law. Lower values can be made to special requirements. Two models are being manufactured initially, Type 363—non-switch; and Type 365 with a 50V 150mA double-pole single tag switch—both with standard soldering tags, while other models for printed panel mounting are planned for production in the near future.

Another recent introduction to the Egen range is an aerial isolator, Type 364, which provides aerial isolation on A.C./D.C. television receivers in a single compact and rugged unit complying fully with the individual requirements of B.S.415. Insertion loss is less than 0·3dB at 50Mc/s and it is completely co-axial with full screening of the inner conductor. *Egen Electric Ltd., Charfleet Industrial Estate, Canvey Island, Essex.*

Club News

REPORTS OF CURRENT ACTIVITIES

BRITISH TIMKEN RADIO CLUB

Hon. Sec: J. B. Johnson, G3JJW 44 Castle Avenue, Duston, Northampton.

The club transmitter is now active on 80, 20 and 10m. Arrangements are in hand for the British Timken show day when the club will be on the air, from the show ground, on August 27th and 28th.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec: C. H. Bullivant, G3DIC 25 St. Fillas Road, London S.E.6.

The society won the second round of the inter-club quiz, beating Crystal Palace by a very narrow margin. On May 19th G3HGE demonstrated "TW" VHF equipment.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec: F. C. Ward, G2CVV 5 Uplands Avenue, Littleover, Derby.

The first Two Metre field day was held on May 7th. A direction finding practice run was organised for May 10th. and started at 7.30 p.m. from the club rooms. May 31st was an open evening.

GUILDFORD AND DISTRICT RADIO SOCIETY

Hon. Sec: E. Bennett, The Inglenook, Sravetts Lane, Worplesdon, Guildford.

The Annual General Meeting was held on Friday, April 28th. On April 13th Maurice Child gave a talk on the Early Development of Radio.

HALIFAX AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec: A. Robinson, G3MDW Candy Cabin, Ogden, Halifax, Yorkshire.

The society has moved to the new meeting rooms at the Beehive and Crosskeys Inn Halifax; meetings start at 7.45 p.m.

MITCHAM AND DISTRICT RADIO SOCIETY

Hon. Sec: M. Pharaoh, G3LCH 1 Madeira Road, Mitcham.

"The History and Development of the National Grid System" was the subject of the talk given by Mr. W. G. Todd on May 5th. On June 2nd G3DWW gave a talk on "Recorded Noises". On May 14th the Dummy Run for the National Field Day was held.

The society recently gave a talk and demonstration of "Amateur Radio as a Hobby" at the Beverly Secondary School.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY

Hon. Sec: A. Robinson, G3MDW Candy Cabin, Ogden, Yorkshire.

April 19th saw the inauguration of this radio society. Meetings will be held every alternate Wednesday at 7.45 p.m. at the Sportsman Inn, Ogden, Halifax. The chairman is C. Longman, G2DYY.

ROYSTON AND DISTRICT RADIO CLUB

Hon. Sec: E. H. Taylor, G3NAH 32 Ledgard Drive, Wakefield, Yorkshire.

Meetings are held on the first. third and fifth Thursdays in each month, and on the second and fourth Thursdays members take part in some constructional practice. Slow morse class is held every meeting night from 7.30 to 8.00 p.m. Meetings are all at the headquarters; The Cudworth Hotel, Cudworth, Barnsley, and start at 7.30 p.m.

SHEFFIELD AMATEUR RADIO CLUB

Hon. Sec: D R. A. Hill, 16 Tylney Road, Sheffield 2.

The club meets on the second and fourth Wednesdays of each month at the Dog and Partridge Hotel, Trippett Lane, Sheffield 1. Douglas Hill is now the new secretary of the club.

SLADE RADIO SOCIETY

Hon. Sec: C. N. Smart, 110 Woolmore Road, Erdington, Birmingham 23.

On May 5th, Mr. L. Sanders and Mr. Chilton gave a lecture called "The use of electronic devices in industry", which explained the principles of practical applications of industrial electronics. D. S. Chapman gave a talk on "Map reading for direction finding" on the 19th of May.

Future Events:

June 11th—Harcourt Trophy test.

June 16th—"Transistors", by N. B. Simmonds.

June 30th—A talk and demonstration of electric tools for the radio amateur entitled "Portable electric tools".

STOKE-ON-TRENT AMATEUR RADIO SOCIETY, G3GBU

Hon. Sec: J. R. Brindley, 40 Milehouse Lane, Newcastle, Staffordshire.

At the Annual General Meeting in April, K. Parkes was elected President, V. Bloor, Chairman, V. Reynolds is the new Treasurer, and J. H. Brindley is the Secretary. New members should contact A. Bucknall, 35 Freehold Street, Newcastle, Staffordshire.

WEST KENT AMATEUR RADIO SOCIETY

Hon. Sec: R. Trevitt, 28 Delves Avenue, Tunbridge Wells. Kent.

On April 28th G2UJ and G4LB gave their views on the subject of how to become a "Radio Amateur". Final preparations for the National Field Day were discussed.

Future Events:

June 9th—Quartz Crystals and how they work.

July 21st—Direction finding competition.

YEOVIL AMATEUR RADIO CLUB

Hon. Sec: D. Maclean, G3NOF 9 Cedar Grove, Yeovil. Somerset.

On March 29th members listened to a tape recorder lecture from the R.S.G.B. tape library. The Lecture was illustrated by coloured slides and was about the Expedition to the Saint Pierre and Miquolin islands by W1PFA and FP8BH.

YORK AMATEUR RADIO SOCIETY

Hon. Sec: M. Watson, G3JME 36 The Paddock, Boroughbridge Road York.

A new transmitter for C.W. or N.B.F.M. and using an 813 P.A. is being tried out, although there are a few minor amendments and additions to be made. The club transmitter is on the air mostly on 20m with the call G3HWW on meeting nights.

A 4-Watt Amplifier

SINCE this amplifier was described in the January issue of *Practical Wireless* several readers have written in with similar queries about this design. For those readers, and any others who have constructed this amplifier, the following explanation is given of one or two points.

The oscillation and feedback troubles that may be encountered can be cured by reducing the value of R17 to 100k or less, at the same time ensuring that the feedback connections to the output transformer secondary are in the correct sense and not giving positive feedback. The resistor R12 may be increased to 10k if required and it is very important to ensure that neither C1 nor C7 is leaky.

The readings given below were obtained from the prototype connected as shown in Fig. 1 (page 779 of the January issue). The figures in brackets in the Table were those obtained when pin 4, V2, was connected to full H.T. instead of to C10 and with R12 increased to 22k to achieve greater gain. The meter used was sensitivity 1000Ω/V.

Location	Reading	Meter Scale Range
H.T. Line	350V (320V)	1000V
Pin 4, V2	260V (320V)	1000V
Pin 3, V1	4.6V (4V)	10V
Pin 8, V1	2.8V (2V)	10V
Pin 8, V2	11V (14V)	50V

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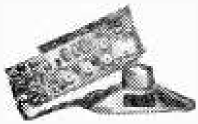

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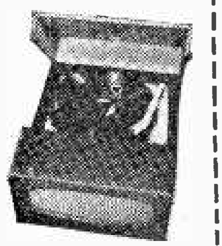

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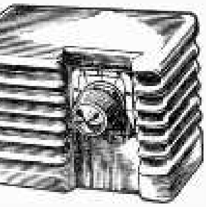

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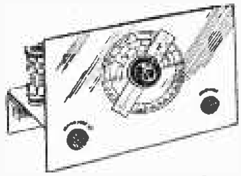

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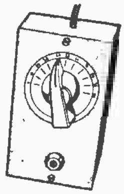

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(continued on next page)

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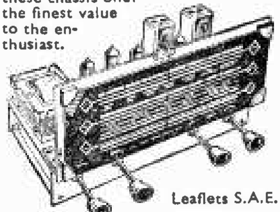

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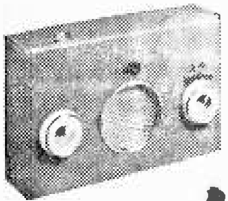

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This receiver uses the most up-to-date printed circuit method and construction is simplicity itself with the aid of the point-to-point instructions supplied, using 6 Transistors and one Diode and internal Ferrite Rod Aerial, with provision for Car Radio Aerial. Full medium and long waveband coverage and when constructed the Receiver is housed in an attractive leatherette Case, size 6½in. x 4¼in. x 1¾in.

The "Petite" PORTABLE

MAY BE BUILT FOR

£7.0.0 Plus 3/- p. & p.

BATTERIES EXTRA. H.T. 10/- (Type B126) or equivalent L.T. 1/6 (Type AD35) or equivalent.

★ Size only 8in. x 8in. x 4½in.
★ instruction book 1/6.

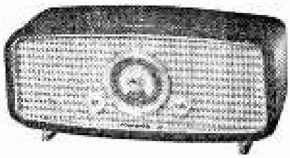
The SUPER 60

6-Transistor Battery Receiver

May be Built for

£9.15.0

Plus 4/6 P. & P.
Ever-Ready PP10 Battery Extra 11/-



STAR FEATURES:—

★ Six 1st grade Mullard Transistors and one Diode.
★ Internal Ferrite Rod Aerial.
★ 7in. x 4in. Elliptical Speaker.
★ Printed Circuit.
★ 500 mW Push-Pull Output.
★ Full medium and long waveband coverage.
★ Calibrated Direct Drive Dial Drive Assembly.
★ Full point-to-point instructions supplied.
★ Dimensions 18in. x 7¾in. x 5¾in.

The Receiver is housed in an attractive contemporary mahogany finished cabinet trimmed with gilt, supported by gilt stands.

The receiver will operate for months on one 9-volt long-life battery.

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Why not convert your battery portable to mains operation with the **COSSOR MU2 BATTERY ELIMINATOR?**

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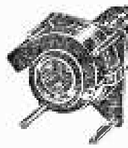

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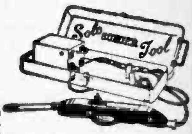
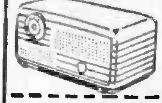


BAKELITE CABINET 2/9



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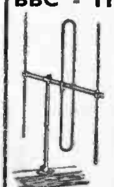

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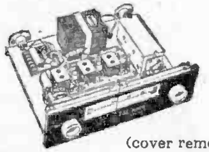

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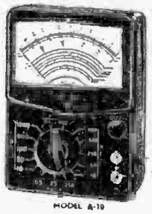

Model A-10 (500 Micro-amp. movement) D.C. (2K per volt) 0/10/50/250/500/1,000V A.C. (2k per volt) 0/10/50/250/500/1,000 D.C. current 0/0.5/25/250mA. Resistance: 0/10K/1 Meg. Size 5¼ x 3⅜ x 1⅜in. Weight 17 oz. inclusive of test prods, instruction book and batteries. **£4.17.6.** P.P. 1/6.

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TRANSISTORS From 3/6 each

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OC44	11/-	XA102	15/-	OC169	18/-
OC45	10/-	XA101	12/6	OC170	13/6
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* Available in matched pairs.

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in new condition with test leads & batteries.

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● **Both Types Tested & Guaranteed**

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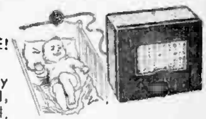
ALL TRANSISTOR BABY OR INVALID ALARM

MORE SENSITIVE!



Battery operated, push-pull, 400mW output. Low impedance microphone enables unit to be used up to 200 yards. Output on 5in. speaker.

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—BLUEPRINT— —SERVICE—

ALL OF these blueprints are drawn full-size and although the issues containing descriptions of these sets are now out of print, constructional details are available free with each blueprint except for the PW Monophonic Electronic Organ.

The index letters which precede the Blueprint Number indicate the periodical in which the description appeared. Thus PW refers to PRACTICAL WIRELESS; AW to *Amateur Wireless* and WM to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

SPECIAL NOTE

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. *The majority of the components for these receivers are no longer stocked by retailers.*

Title	*Number*	*Price*
CRYSTAL SETS		
Junior Crystal Set	PW94	2/-
Dual-wave Crystal Diode	PW95	2/6
STRAIGHT SETS — Battery Operated		
Modern One-valver	PW96	2/6
All-dry Three	PW97	3/6
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A.C. Coronet-4	PW100	4/-
A.C./D.C. Coronet	PW101	4/-
The PW Pocket Superhet	—	5/-
MISCELLANEOUS		
The PW 3-speed Autogram	—	8/-
The PW Monophonic Electronic Organ (*No constructional details are available with this blueprint*)	—	8/-
TELEVISION		
The PT band III converter	—	1/6

Title	*Number*	*Price*
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Midget Short Wave Two	PW38a	2/6
Band-Spread Three (Battery)	PW68	2/6
Crystal Receiver	PW71	2/-
Signet Two (Battery)	PW76	2/6
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Pyramid One-valver	PW93	2/6
BBC Special One-valver	AW387	2/6
Short-Wave Two	AW429	2/6
Short-Wave World Beater	AW436	3/6
Standard Four Valve S.W.	WM383	3/6
Enthusiast's Power Amplifier	WM387	3/6
Standard Four Valve	WM391	3/6
Listener's 5-Watt Amplifier	WM392	3/6

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