PRACTICAL WIRELESS

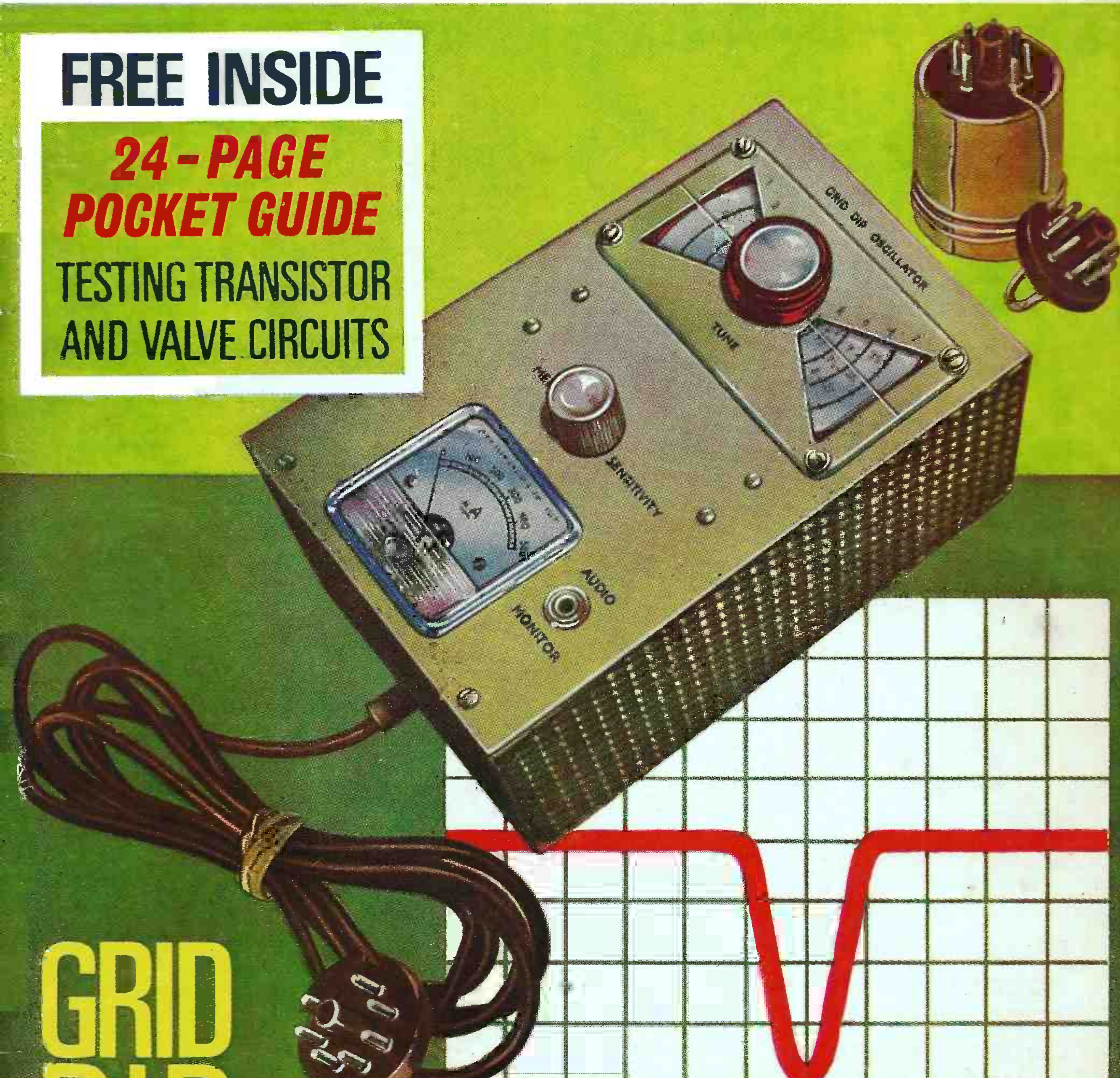
JULY 1966

2'6

FREE INSIDE

24-PAGE POCKET GUIDE

TESTING TRANSISTOR AND VALVE CIRCUITS



GRID DIP OSCILLATOR

VALUE IN VALVES GUARANTEED 3 MONTHS BY RETURN OF POST

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days. ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 9d., 2-11 6d. per valve. Free over 12.

1L4	2/3	6K25	8/6	25L6GT	7/9	ECC84	7/-	TK36	14/-	U22	6/9
1R5	4/9	6L1	9/6	25Z4G	6/6	ECC85	5/6	KT61	11/-	U24	12/6
1S4	4/9	6L6	12/6	30F5	8/3	ECC88	9/-	KT63	5/9	U25	8/6
1S5	4/6	6L6G	7/-	30FL1	9/6	ECF80	7/6	KT66	14/-	U26	8/9
1T4	3/-	6L18	7/9	30L15	9/6	ECF82	7/6	KT76	8/6	U35	12/6
2D21	5/6	6LD20	8/6	30P4	9/6	ECH21	10/-	KT88	21/-	U37	11/-
3A4	4/-	6P25	11/-	30P12	7/-	ECH35	11/-	KTW61	5/9	U107	12/6
3A5	6/-	6P28	9/-	30PL1	9/3	ECH42	8/6	KTW63	5/-	U191	9/6
3Q4	5/3	6Q7G	5/9	35C5	8/6	ECH81	6/9	KTZ63	7/-	U281	8/6
5R4GY	8/-	6Q7GT	8/6	35L6GT	8/-	ECH83	7/3	MU14	7/-	U282	15/-
5U4G	4/6	6SK7	5/-	35W4	6/-	ECL80	5/9	N37	9/6	U301	12/6
5Y3GT	4/9	6SL7GT	5/6	35Z4GT	5/6	ECL82	7/6	N78	13/-	U329	8/6
5Z4G	6/9	6SN7GT	4/6	50L6GT	8/6	ECL83	9/6	N108	13/-	U801	19/-
5Z4GT	9/6	6U4GT	9/6	80	5/-	ECL86	9/6	PC86	10/-	UABC80	6/6
6/30L2	8/9	6V6G	4/6	185BTA	19/6	EF36	3/3	PC97	7/6	UAF42	7/9
6A8G	7/9	6V6GT	5/9	807	8/-	EF39	5/-	PCC84	6/6	UB41	6/6
6AK5	4/9	6X4	4/6	955	2/6	EF40	10/-	PCC85	7/6	UBC41	7/6
6AQ5	5/-	6X5G	5/-	956	2/-	EF41	8/-	PCC88	11/9	UBC81	6/3
6AT6	5/-	6X5GT	6/-	9001	3/-	EF50	3/3	PCC89	9/9	UBF80	7/6
6AV6	6/-	7B6	9/6	9002	4/9	EF80	4/3	PCC189	11/-	UBF89	7/6
6BA6	5/6	7B7	6/6	9003	5/6	EF85	6/-	PCF80	6/9	UBL21	9/9
6BE6	5/6	7C5	7/9	AZ31	7/9	EF86	7/6	PCF82	6/-	UC92	6/9
6BG6G	15/-	7C6	6/9	CBL31	19/-	EF89	6/6	PCF86	8/3	UCC85	7/3
6BH6	5/-	7H7	5/-	CL33	9/-	EF91	3/-	PCL82	7/9	UCF80	8/6
6BJ6	5/-	7S7	14/6	CY31	7/6	EF92	3/-	PCL83	8/9	UCH21	9/3
6BR7	8/6	7Y4	5/-	DAF96	7/3	EF183	8/-	PCL84	8/3	UCH42	8/6
6BW6	7/6	10C1	11/-	DF92	3/-	EF184	8/-	PCL85	8/6	UCH81	7/-
6BW7	5/-	10C2	12/6	DF96	7/3	EL32	3/9	PCL86	9/6	UCL82	8/-
6C4	2/3	10F1	7/6	DK92	7/-	EL33	11/-	PL33	8/6	UCL83	10/-
6C5	5/6	10LD11	14/6	DK96	7/3	EL34	11/-	PL36	8/9	UF41	7/9
6C6	4/-	10P13	8/6	DL92	5/-	EL35	6/-	PL38	12/6	UF42	6/9
6C9	11/-	10P14	9/6	DL94	6/6	EL38	15/-	PL81	7/9	UF80	6/9
6CD6G	17/-	12AT7	4/9	DL96	7/3	EL41	8/6	PL82	5/9	UF85	7/6
6D6	3/-	12AU7	4/9	EABC80	6/6	EL42	8/6	PL83	6/-	UF89	5/9
6F1	6/6	12AX7	6/-	EAF42	7/6	EL84	6/6	PL84	7/-	UL41	8/6
6F6G	4/-	12BH7	8/9	EB41	4/-	EM80	7/-	PY31	7/6	UL44	14/-
6F13	4/6	12J7GT	8/-	EB91	2/-	EM81	7/3	PY32	9/-	UL46	8/3
6F14	5/-	12K7GT	4/-	EBC33	6/-	EM84	7/9	PY33	9/-	UL84	6/9
6F15	9/6	12K8GT	9/6	EBC41	6/6	EY51	7/6	PY80	5/9	URIC	7/6
6F23	8/6	12Q7GT	5/-	EBC81	6/6	EY86	7/3	PY81	5/9	UM80	9/6
6J5G	3/-	14S7	14/6	EBF80	7/6	EY88	8/6	PY82	5/6	UU8	15/-
6J5GT	4/6	19AQ5	5/-	EBF89	7/-	EZ40	6/6	PY83	5/9	UY21	8/9
6J6	3/3	20D1	8/9	EBL21	10/6	EZ41	6/6	PY88	8/6	UY41	6/-
6J7G	4/9	20F2	9/6	EBL31	19/6	EZ80	5/6	PY800	6/6	UY85	5/6
6J7GT	7/9	20L1	16/-	ECC40	6/9	EZ81	6/-	PZ30	9/6	VR105	5/-
6K7G	1/6	20P1	9/6	ECC81	4/9	FC4	8/-	SP61	2/-	VR150	5/-
6K7GT	4/9	20P3	9/6	ECC82	4/9	GZ32	9/6	T41	6/9	X66	7/9
6K8G	3/-	20P4	17/-	ECC83	5/9	GZ34	10/6	TDD4	7/-	Z66	8/6
6K8GT	8/-					KT33C	5/6	U18	7/6		

Transistorised FM Tuner

TYPE FMT. 41

HIGH QUALITY : LOW NOISE : BATTERY OR MAINS OPERATION.

Reproduction stands favourable comparison with tuners costing 3 times as much. Come and hear it (and compare it) at any of our branches or send to Brighton without delay as we anticipate a very heavy demand.

This beautifully compact 6 transistor machine (size 6in.x4in. x2½in.) will give quieter, more interference-free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise frequency changer with smooth 2-gang tuning feeding no less than three i.f. stages coupled to a double-tuned discriminator terminating in an l.f. stage giving ample output for all quality amplifiers.

Note Audio amplifiers of very interesting specification in the course of preparation.

avoid disappointment

ORDER NOW £8-10

100 HI-STABS 1% to 5% 100Ω to 5mΩ 9/6

CO-AX, low loss, **6d.** yd., 25 yds. **11/6;** 50 yds. **22/-;** 100 yds. **42/6.** Plugs, **1/3.**

100 RESISTORS SIZES ⅛–3 watt 6/6

MICROPHONE CABLE. Highest quality black, grey, white, **9d.** per yard.

100 CONDENSERS 9/6

Miniature Ceramic, Silver Mica, etc. 3pF to .1μF. LIST VALUE OVER £5.

DULCI (VHF) FM TUNERS

MODEL FMT/5. Self powered 200/250 v. A.C. A.F.C. High sensitivity for fringe and long distance reception. Size 11¾ x 8⅝in. x 3¼in. high. Weight 7½lb. In case finished in satin chrome and black. We can offer these high fidelity instruments. Normally **£21.13.5.** Limited number only at **15 Gns.**

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

ELPICO MONO PREAMPS

DPA15. Latest black/satin chrome finish multiple input channels selector, base and treble controls. Matches all pickups and mikes. Provision tape recording. Normally **10 gns.** our price **5 Gns.**

HITACHI PORTABLE TAPE RECORDER

STOCKS GOING FAST! Latest Hitachi. Fabulous quality reproduction of music, 6-transistor. 1⅞in. and 3¾in. speeds. Output 500 mW high quality speaker. Fast forward and rewind. Battery level and record level meter. Precision capstan drive. Size 8³/₁₆ x 3⅜ x 6⅞in. Genuine **normal price of 35 gns.** Unrepeatable. All spares available. With tape, tape reel, mike, etc. **19 Gns.**

CAR RADIOS 8 Gns.

Latest Autolux fully transistorised complete with speaker and fittings. Large purchase enables us to sell these superb sets (normally approx. **14 gns.**) at the amazing price of **8 Gns.**

RADIOGRAM CHASSIS

QUALITY BARGAINS

Heavy duty A.C. mains, complete with large dials.

Stereo AM, 6 valve, all wave (normally 17 gns.). **11 Gns.**

Mono AM/FM, 6 valve. (normally 18 gns.). **12 Gns.**

Stereo AM/FM, 7 valve, (normally 24 gns.). **17 Gns.**

STEREO AMPLIFIERS

AC262 3-4 watts per channel, excellent control panel, quality finish. AC mains. Superior value at **6 Gns.**

230V AC CONVERTORS

INPUT 12V D.C. Output 40 watts from car battery (normally 10½ gns.). **£5.10.0**

ENORMOUS PURCHASE. GUARANTEED. APPROX. HALF PRICE. WORLD FAMOUS MAKE

★ TAPE ★

We offer you fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT YOURSELF.

Standard Play			Double Play		
3in.	150ft.	2/3	3in.	300ft.	4/-
4in.	300ft	4/6	4in.	600ft.	8/-
5in.	600ft.	7/6	5in.	1,200ft.	15/-
5¾in.	900ft.	10/6	5¾in.	1,800ft.	19/6
7in.	1,200ft.	13/6	7in.	2,400ft.	27/-
Long Play			**Triple Play**		
3in.	225ft.	2/9	4in.	900ft.	13/-
4in.	450ft.	5/6	5in.	1,800ft.	25/-
5in.	900ft.	10/6	5¾in.	2,400ft.	34/-
5¾in.	1,200ft.	13/-	7in.	3,600ft.	44/-
7in.	1,800ft.	18/6			
			Quadruple Play		
			3ft.	600ft.	8/-

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

SPEAKER FABRIC

Superior Gold/Brown Vynide with small perforations, gift at **2/6** sq.ft. or 12 sq.ft. (4 x 3) for only **19/-**

CRM141. CRM142. Special bulk purchase enables us to offer these tubes at this low price (carr. 9/-). **39/-**

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

TRANSISTORS

GUARANTEED TOP QUALITY

Huge reduction. **Red Spot** standard LF type now only **1/6**

White Spot R.F. **2/-**

Mullard Matched Output Kits OC81D and 2-OC81 **9/6**

R.F. Kits OC44, OC45 (2) 3 transistors **9/6**

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

GERMANIUM DIODES

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

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

SILICON RECTIFIERS

Guaranteed performance. Top makes. Tested 250v. working.
120 ma. (3 for **6/6**) **2/9** 500 ma. (3 for **19/6**) **7/6**

LATEST GARRARD

All Factory Fresh. All with cartridge.

Stereo cartridge fitted for 17/6 extra.
SRP12 Mono (Single) Player **£4.19.0**
SP25 Semi-Transcription (Single) **£11.19.0**
AUTOSLIM Standard Auto. **£5.19.0**
AT5 Slimline—similar to AT6 **£7.15.0**
Model 1,000—10 records **£6.19.0**
Model 2,000—large turntable **£7.19.0**
Model 3,000—wear **£10.10.0**
AT60—Heavy Automatic **£11.19.0**
A70—Automatic **£19.19.0**
LAB80—Transcription **£27.10.0**
401—Transcription **£29.19.0**
Model 50—Automatic **£9.10.0**

B.S.R.

TU14—Single player Complete **59/-**
GU7—Single Deck Complete **£4.5.0**
UA14—Auto Changer **£4.17.6**
UA16—Blue-silver **£5.10.0**
UA25SS—Super Slim **£5.15.0**

TUBES

SATISFACTION GUARANTEED OR MONEY REFUNDED IF RETURNED UNSOILED WITHIN 14 DAYS

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMISCOPE, BRIMAR, FERRANTI TYPES PROCESSED IN OUR OWN FACTORY	Carr. & Ins. 12/6	6 Months	12 Months	NEW TYPES
	12in.	£2. 0.0	£3. 0.0	AW47-91 £5.15.0
	14in.	£2.10.0	£3.10.0	
	15-17in.	£3. 5.0	£4. 5.0	AW59-91 £7.10.0
	19in.	£3. 5.0	£4. 5.0	
	21in.	£3.15.0	£5.15.0	AW43-80 £5. 5.0
	23in.	£3.15.0	£5.15.0	

Stockists of Leak, Quad, Chapman, Goodman, Armstrong, Tripletone, Linear, Rodgers, Truvox, Ferrograph, Wharfedale, etc., etc.

TECHNICAL TRADING

Post: 1lb. **1/6**, 1½lb. **2/6**, 2lb. **2/9**, 4lb. **3/3**, 6lb. **4/-**, 14lb. **5/6.**

All Mail Orders:— **DEPT. W7, Devonian Court,**

★ **BRIGHTON** Park Crescent Place. Tel. 680722 (*E.C. Weds.*)

★ **LONDON** 10 Tottenham Court Road. Tel. MUSeum 2639. (*E.C. Weds.*)

★ **PORTSMOUTH** 350-352 Fratton Road, Tel. 22034. (*E. C. Weds.*)

★ **SOUTHAMPTON** 72 East Street, Tel. 25851. (*E.C. Weds.*)

LASKY'S RADIO FOR THE FINEST VALUE AND TO HOME CONSTRUCTORS

DEMONSTRATION STUDIOS

Lasky's Radio are proud to announce the opening of their restyled and completely modernised Hi-Fidelity and Electronics components store and showroom at:

207 EDGWARE ROAD W.2

New features include spacious open layout, "Tape Bar", Self Service Components Dept., and Hi-Fi Demonstration Studio. Absolutely new and right up to date for your easy choice from the largest stocks in Great Britain—backed by Lasky's vast experience and name—synonymous with Electronics for over 30 years!

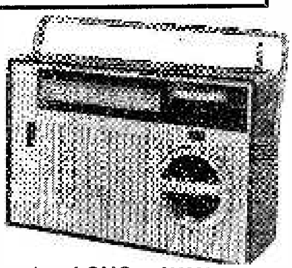
REMEMBER LASKY'S GUARANTEE YOU THE BEST IN ELECTRONICS

TRANSISTOR PORTABLES

We consider our Construction Parcels to be the finest value available on the home construction market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.

THE SKYROVER RANGE

7 transistor and 2 diode superhet portables—covering full med. plus 6 SW Bands.



The SKYROVER Mk. III.

(Illustrated). Now supplied with redesigned plastic cabinet in black, grey and chrome with edgewise controls.

Controls: Waveband Selector. Volume Control with on/off Switch, Tuning Control. In plastic cabinet, size 10 x 6½ x 3½in. with metal trim and carrying handle.

Can now be built for **£8 . 19 . 6** Post 5/- extra

H.P. Terms: 45/- deposit and 11 monthly payments of 13/9. Total H.P.P., £9.16.3.

THE SKYROVER De Luxe

Tone Circuit is incorporated, with separate Tone Control in addition to Volume Control. Tuning Control and Waveband Selector. In a wood cabinet, size 11½ x 6½ x 3in. covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

Can now be built for **£10.19.6** Post 5/- extra

H.P. Terms: 55/- deposit and 11 monthly payments of 16/11. Total H.P.P., £12.1.1.

★ LONG WAVEBAND COVERAGE IS NOW AVAILABLE FOR THE SKYROVER

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

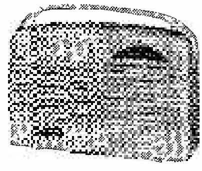
Only **10/-** extra Post Free.

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

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

REALISTIC SEVEN

Fully tunable long and medium bands. Uses 7 Mullard Transistors; plus Diode OA70.



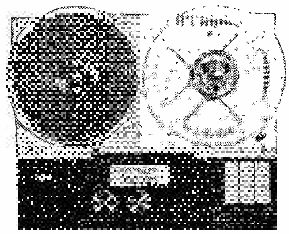
STAR features:
● 7 Transistor Superhet. ● 350 Milliwatt output 4in. high flux speaker. ● All components mounted on a single printed circuit board. Size 5½ x 5¾in. in one complete assembly. ● Plastic cabinet, with carrying handle, size 7 x 10 x 3¼in., in blue/grey. ● Easy to read dial. ● External socket for car aerial. ● I.F.-frequency 470 Kc/s. ● Ferrite rod internal aerial. ● Operates from PP9 or similar battery. ● Full comprehensive data supplied with each Receiver. ● All coils and I.F.s, etc., fully wound ready for immediate assembly. An outstanding Receiver.

Can be built for **£5 . 19 . 6** P. & P. 4/6

Battery **3/9** extra. (All components avail. sep.). Data and ins. **2/6**, refunded if you purchase parcel.

TAPE RECORDERS

MAGNAVOX-COLLARO 363 TAPE DECKS

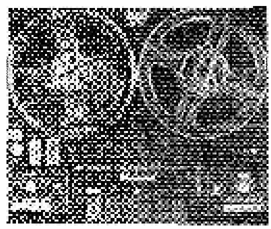


The very latest 3 speed model—1⅞, 3¾, 7½ ips, available with either ½ track or ¼ track head. Features include: pause control; digital counter: fast forward and rewind; new 4 pole fully screened induction motor, interlocking keys. Size of top plate 13½ x 11in. x 5¼in. deep below unit plate. For 200/250v. A.C. mains, 50 cps operation New, unused and fully guaranteed.

Lasky's Price ½ track model **£10.10.0**
Lasky's Price ¼ track model **£13.9.6.**

Carriage and Packing 7/6 extra.

THE NEW GARRARD STEREO DECK



Now available from stock—superb specification: three ¼ track stereo/mono heads; 3 speeds—1⅞, 3¾, 7½ i.p.s.; takes 7in. spools; fast forward and rewind; tape position indicator; pause control; separate record, replay and erase heads—4 tracks; piano key controls interlocked for all functions; stop/start can be remotely controlled; auto, tape-end stop. Heavy duty motor, capacitor start and run, large dynamically balanced flywheel. Deck finished in grey plastic, size: 14¼ x 12 x 6in., depth below plinth 4in. For 110v. 50 c.p.s. Mains operation. Auto-transformer for 200/250v. included free.

LASKY'S PRICE 29½ GNS. Carriage & Packing 10/6 extra

INTERNATIONAL TAPE

Famous American Brand—Fully Guaranteed

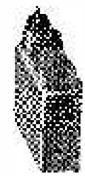
3in.	Message tape, 150ft	2 6	5¾in.	Long play, 1200ft. Acetate	12 6
3in.	Message tape, 225ft.	3 9	5¾in.	Standard play, 850ft. PVC	11 6
3in.	Message tape, 300ft.	7 6	5¾in.	Long play, 1200ft. Mylar	15 0
3¼in.	Triple play, 600ft. Mylar	10 0	5¾in.	Triple play, 2400ft. Mylar	45 0
4in.	Triple play, 900ft. Mylar	17 6	7in.	Standard play, 1200ft. Acet.	10 0
5in.	Double play, 1200ft. Mylar	15 0	7in.	Standard play, 1200ft. Mylar	12 6
5in.	Long play, 900ft. Acetate	10 0	7in.	Long play, 1800ft. Mylar	19 6
5in.	Standard play, 600ft. PVC	8 6	7in.	Double play, 2400ft. Mylar	25 0
5in.	Triple play, 1800ft. Mylar	35 0	7in.	Long play, 1800ft. Acetate	15 0
5¾in.	Double play, 1800ft. Mylar	22 6	7in.	Triple play, 3600ft. Mylar	58 6

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

SPECIAL INTEREST ITEMS!

SPECIAL PURCHASE—UHF/VHF TUNERS

Well known British makers surplus stocks. Now available for the first time to the Home Constructor.



TRANSISTORISED UHF MINIATURE MODEL
Shielded metal case only 3¾ x 1½ x 3in. Fully tunable—complete with two AF139 transistors. LASKY'S PRICE **39/6**

VALVE UHF MODEL
In metal case size 4 x 6 x 1½in. Fully tunable—complete with PCC86 and PCC88 valves. LASKY'S PRICE **32/6** Without valves **25/-**

TRANSISTORISED VHF MODEL I
Miniature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors. In metal case size 4 x 2 x 3¼in. LASKY'S PRICE **29/6**

TRANSISTORISED VHF MODEL 2
Sub-Miniature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors. In metal case size 3 x 1½ x 2½in. LASKY'S PRICE **37/6**

Add 2/6 Post and Packing on each.

GORLER UT 340 FM/VHF TUNING HEART

Permeability tuned—covering 87 to 108 Mc/s. For use with one ECC85 valve. In metal case, size 3 x 2¾ x 1½in. Circuit supplied.
LASKY'S PRICE **15/11** Post 2/-. ECC85 valve **9/-** extra.

TRANSISTORS

ALL BRAND NEW AND GUARANTEED

GET 81, GET 85, GET 86 **2/6**; 873A, 874P **3/6**; OC45, OC71, OC81D **4/6**; OC 44, OC 70, OC76, OC81 **5/6**; (match pair **10/6**); AF 117, OC 200 **6/6**; OC42, OC 43, OC 73, OC 82D **7/6**; OC 201, OC 204 **15/-**; OC 205, OC 206 **19/6**; OC 28 **24/6**. OC 75 **8/-**.

TRANSFILTERS

by BRUSH CRYSTAL CO., Available from stock.

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

7/6 each
Post 6d.

SINCLAIR SUPER MINIATURE KITS

THE MICRO-6 miniature radio only $1\frac{4}{5} \times 1 \times \frac{3}{10}$ 1½in.	£2 19 6
THE SLIMLINE 2-transistor pocket radio	£2 9 6
THE MICRO-FM (tuner/receiver)	£5 19 6
THE X-20 20 watt P.W.M. amplifier	£7 19 6
Available ready built, tested and guaranteed	£9 19 6
THE X-10 10 watt amplifier and pre-amp	£5 19 6
Available ready built, tested and guaranteed	£6 19 6
THE Z-12 12 watt amp. and pre-amp., fully built	£4 9 6

Write for details of package deals.

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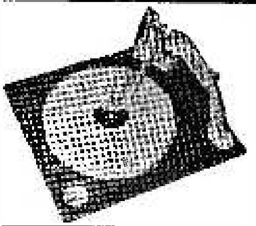

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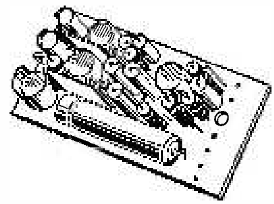

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EL37	12/3
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EY81	7/3
EY83	9/3
EY84	9/6
EY86	5/6
EY87	6/-
EY88	8/9
EY91	3/-
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EZ41	6/3
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PY32	8/9
PY33	8/9
PY80	4/9
PY81	5/-
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PY83	5/6
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UBC41	6/3
UBC81	6/3
UBF80	5/6
UBF89	6/3
UBL21	10/9
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UCF80	8/3
UCH21	8/-
UCH42	8/-
UCH81	6/6
UCL82	7/3
UCL83	9/-
UF41	6/9
UF42	4/9
UF80	6/3
UF85	6/9
UF86	9/-
UF89	5/6
UL41	7/-
UL46	8/6
UL84	5/6
UM4	17/6
UM34	17/6
UM80	8/3
UR1C	6/6
UU5	7/-
UU6	13/-
UU7	13/-
UU8	14/-
UU9	5/6
UU12	4/3
UY1N	10/3
UY21	9/-
UY41	5/-
UY85	4/9
U10	9/-
U12/14	7/6
U16	15/-
U17	5/-
U18/20	6/6
U19	48/6
U22	5/9
U25	8/6
U26	8/6
U31	6/6
U33	13/6
U35	16/6
U37	34/11
U45	15/6
U47	8/6
U50	4/9
U52	4/9
U76	4/6
U78	3/9
U101	19/6
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U191	9/6
U251	9/-
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U282	12/3
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U329	9/-
U339	9/6
U403	9/9
U404	6/-
U801	15/-
U4020	6/6
VMP4G	11/9
VMS4B	12/-
VP2	3/6
VP2B	9/6
VP4	14/6
VP4A	14/6
VP4B	12/-
VP13C	7/-
VP23	2/6
VP41	5/-
VP133	9/9
VR75	21/-
VR105	5/6
VR150	4/9
VT61A	7/-
VT501	3/-
VU111	5/-
VU120	10/-
VU120A	10/-
VU133	7/-
W21	5/-
W42	12/-
W61M	24/6
W63	10/6
W76	3/6
W77	2/6
W81M	5/9
W101	26/2
W107	10/6
W729	17/6
X14	7/9
X18	8/-
X24	16/6
X41	10/-
X61	6/-
X63	5/9
X64	5/6
X65	5/6
X66	7/3
X76M	8/6
X78	26/2
X79	27/-
X81M	29/1
X101	29/1
X109	26/-
X118	9/9
X119	6/6
X142	8/-
Y63	5/-
Y65	5/-
Z63	4/6
Z66	7/3
Z77	3/-
Z329	8/3
Z729	6/6
Z749	9/-
Z759	36/-
Transistors and diodes	
AA120	4/6
AA129	4/6
AC107	14/6
AC113	8/-
AC114	8/-
AC127	9/6
AD140	17/6
AD149	17/6
AF102	27/6
AF114	11/-
AF115	10/6
AF116	10/-
AF117	5/6
AF118	20/-
AF124	11/-
AF125	10/6
AF126	10/-
AF127	9/6
AF139	27/6
AF186	27/6
AFZ12	26/6
BYZ13	11/6
GD3	6/6
GD6	5/6
GD14	10/-
GET103	7/-
GET104	10/-
GET106	17/6
GET111	12/-
GET113	6/9
GET114	6/6
GET116	17/-
GET873	9/3
GET874	9/6
GEX13	3/6
GEX35	3/-
GEX36	10/-
GEX45	6/6
GEX64	11/6
GEX66	15/-
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
OA5	6/-
OA10	9/6
OA70	3/-
OA73	3/-
OA79	3/-
OA81	3/-
OA85	3/-
OA86	4/-
OA90	3/-
OA91	3/-
OA95	3/6
OA200	5/-
OA211	13/6
OAZ200	12/6
OAZ203	9/6
OAZ204	9/6
OAZ210	7/6
OC16W	35/-
OC19	25/-
OC22	23/-
OC23	57/-
OC25	12/-
OC26	8/-
OC28	23/-
OC29	16/6
OC35	9/6
OC36	21/6
OC41	8/-
OC42	6/9
OC43	12/6
OC44	4/9
OC44PM	8/3
OC45	3/6
OC45M	8/-
OC65	22/6
OC66	25/-
OC70	6/6
OC71	3/6
OC72	8/-
OC73	16/-
OC74	8/-
OC75	8/-
OC76	8/6
OC77	13/-
OC78	8/-
OC81	4/-
OC81D	4/-
OC81M	4/-
OC82	10/-
OC83	6/-
OC84	8/-
OC139	12/-
OC140	19/-
OC170	8/6
OC171	9/-
OC200	9/-
OC201	29/-
OC203	12/6
OC204	10/6
OC206	10/6
OCP71	27/6
ORP12	18/6
TS2	12/6
TS3	15/-
V10/15A	12/-
XA103	15/-

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF VALVES, LOOSE OR BOXED, BUT MUST BE NEW

ELECTROLYTICS. Can types: 8 x 8/500v. **6/6**; 8 x 16/500v. **7/-**; 16/500v. **5/-**; 16 x 16/500v. **7/6**; 16 x 32/450v. **8/9**; 32/500v. **6/6**; 32 x 32/450v. **6/-**; 50 x 50/350v. **6/-**; 60 x 250/275v. **9/6**; 60 x 250/350v. **15/6**; 60 x 250 x 10/275v. **11/9**; 64/450v. **8/-**; 64 x 100/450v. **15/6**; 64 x 120/350v. **9/-**; 100/450v. **9/6**; 100/275v. **3/6**; 100 x 200/275v. **8/6**; 100 x 200/350v. **16/6**; 100 x 200 x 60/300v. **16/6**; 100 x 300 x 100 x 16/275v. **24/-**; 100 x 400/275v. **12/6**; 100 x 400 x 16/275v. **19/6**; 150 x 200/350v. **18/-**; 200/275v. **4/-**; 200/350v. **10/6**; 200 x 200 x 100/350v. **22/6**; 1000/50v. **7/-**; 2000/50v. **10/6**; 5000/25v. **12/-**; 5000/50v. **22/6**. **Tubular types:** 1/500v. **2/-**; 2/500v. **2/6**; 4/500v. **2/6**; 8/450v. **1/9**; 8/500v. **2/6**; 8 x 8/450v. **3/-**; 8 x 16/450v. **3/9**; 10/50v. **1/6**; 16/450v. **2/9**; 16 x 16/450v. **4/-**; 16 x 32/350v. **4/3**; 32/350v. **3/-**; 32/450v. **3/9**; 32 x 32/350v. **4/-**; 50/50v. **1/9**; 50/350v. **4/6**; 100/50v. **3/-**; 250/25v. **3/9**; 500/25v. **4/6**; 500/50v. **5/-**; 1000/12v. **2/6**; 2000/25v. **5/9**. **Specials:** 16 x 16 x 16/275v. **6/-**: 50 x 50 x 50/350v. **10/6**: 2/150v. x 150/25v. **5/9**: 8/600v. **8/9**: 16/600v. **12/-**: 47/450v. **6/6.**
Midget silicon rectifiers. Types BY100. Output 250 volts ½ amp. No larger than a shirt button, **6/6** each. Series limiting resistance, **1/6.**

EXPRESS POSTAL SERVICE! ALL ORDERS DESPATCHED SAME DAY AS RECEIVED

Terms of business—Cash with order only. Post/Packing 6d. per item. Orders over £5 post free. No C.O.D. All orders cleared day of receipt. Any parcel insured against damage in transit for 6d. extra. We are open for personal shoppers 9.00—5 p.m. Sats. 9.00—1 p.m. Complete list of modern and obsolete valves, resistors, condensers, transformers, potentiometers, microphones, etc. with terms of business 6d. Please enquire for any item not listed with S.A.E.

STERN-CLYNE ELECTRONIC CENTRES

MEMBER OF THE PANTIYA GROUP OF COMPANIES

MAIL ORDER & ALL ENQUIRIES TO: DEPT. PW. 3-5 EDEN GROVE, HOLLOWAY, LONDON, N.7. Tel. NORth 8161/5.

LONDON:
18 Tottenham Court Road, W.1. MUS 5929/0095
23 Tottenham Court Road, W.1 MUSeum 3451
309 Edgware Road, W.2. PADdington 6963
109 Fleet Street, E.C.4. FLEet Street 5812/3
162 Holloway Road, N.7. NORth 7941

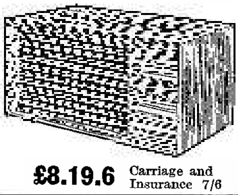
9 Camberwell Church Street, S.E.5. RODney 2875
220 Edgware Road, W.2. PADdington 5607
CROYDON: 12 Suffolk House, George Street. MUNicipal 3250
BRISTOL: 26 Merchant Street, Bristol 1. Bristol 20261

LIVERPOOL: 52 Lord Street. Royal 7450
MANCHESTER: 20/22 Withy Grove, M/c 4. Blackfriars 5379/5246
SHEFFIELD: 125 The Moor. Sheffield 29993
NOTTINGHAM: Eastown House, Lincoln St. Nottingham 45889

EXCLUSIVE TO STERN-CLYNE

The New MEGAMITE

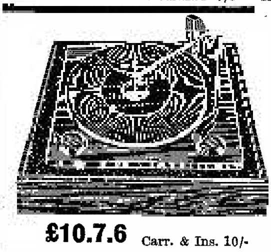
Bookshelf size, full range Hi-Fi Speaker System



Special 5 inch, free-cone bass unit uses powerful Feroba magnet to permit exceptional cone movement and provide superb, deep down bass response. Matching 4 inch tweeter is crossover coupled and housed with bass unit in heavily lugged, handsomely styled teak veneered cabinet, size only 13 x 7 x 8in. deep. Ideal for fitment in bookshelves, room dividers, etc., as unobtrusive but high quality reproducers from Hi-Fi equipment. Imp. 15 ohms. Max. input 10 watts.

£8.19.6 Carriage and Insurance 7/6

another superb exclusive from STERN-CLYNE The GRAMSTAND plinth-mounted Changer unit



Specially designed, and exclusively manufactured for Stern-Clyne to meet modern demands for bookshelf mounting, space limited Hi-Fi systems. Famous high quality B.S.R. Changer is specially fitted with lightweight tubular pick-up arm, Stereo/Mono combined ceramic cartridge and diamond stylus. Heavy, balanced 10, 1/2 in. turntable has spun silver centre and radially drilled mat. Hardwood plinth has matt black top and is fitted with integral P.V. plug and socket and 6ft. length of mains connecting lead.

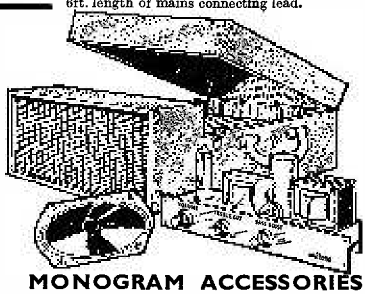
£10.7.6 Carr. & Ins. 10/-

MONOGRAM AMPLIFIER

Superb space and cost economy design specially developed by Mullard Research Laboratories and quality constructed by Stern-Clyne. Actually uses only one multi valve but provides an undistorted output from any standard xtal pick-up. Plus features include Bass Boost and Treble Cut controls, panel illumination and specially wound output transformer. Size only 10 x 2½ x 4, ¾in. high. Silver hammer chassis finish, satin silver finish engraved panel.

Kit of parts **£4.10.0** Carr. 4/6.

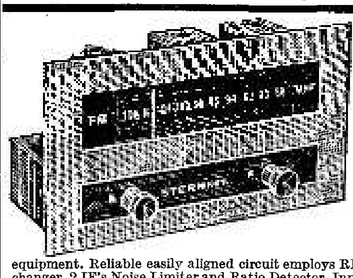
Assembled and tested **£6.0.0** Carriage 4/6.



MONOGRAM ACCESSORIES

Specially designed PC3 Carrying case takes Monogram Amplifier, 8 x 5 Elliptical Speaker (illustrated) and any standard turntable or Autochanger. Size overall 18 x 16, 1/2 x 8, 1/2 in. Handsomely finished in dark grey fabric weave.
PC3 Case £3.5.0. Carriage 5/6d.
8 x 5 Speaker £1. Carriage 2/6d.

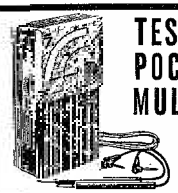
SUPERB NEW STERN-CLYNE FM1 VHF TUNER



Specially designed for the Amateur builder, a new sensitive tuner unit that provides stable, interference-free reception of BBC FM transmissions. High quality output signal ensures optimum performance from any Hi-Fi audio system; superb styling makes for harmonious installation with existing equipment. Reliable easily aligned circuit employs RF stage, tuned anode tuned grid freq. changer, 2 IF's Noise Limiter and Ratio Detector. Input sens. 100mV for 40 db. Distortion less than 1% at full deviation. Power req. 200v at 20 mA and 6.3v at 1.8A. Panel black and silver-grey, size 8 x 5 in.

FM1 Kit of parts **£7.9.6** Carr. 4/-.
Assembled and tested £10.9.6 Carr. 4/-.
Optional Power Pack available.

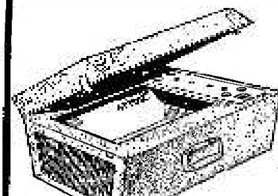
TEST 7 POCKET MULTIMETER



39/6 Carr. 2/-

A really versatile instrument that makes a handy pocket-size tool. Measures AC or DC voltage in three ranges of 0-15-150-1000v. Resistance 0-1000,000 ohms, and Current 0-150 mA. DC. Size only 3¾ x 2¼ x 1⅛in., with ingenious dial design providing a clear, easily read scale. Complete with battery and test leads.

TAPE RECORDER EQUIPMENT

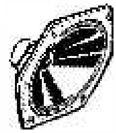


RECORDER CASE TYPE 3B1

Specially designed to house the Magnavox 363 Tapedeck, HF/TR3 Amplifier and up to 10 x 6in. speaker to do justice to the results. Superbly styled, handsomely finished, in grey fabric weave. Size 20 x 15 x 10, 1/2in. overall.

£5.0.0 Carr. 7/6.

RECOMMENDED SPEAKER UNIT

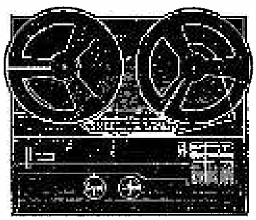


High quality Celestion 10 x 6 elliptical speaker (illustrated).

30/- Carr. 3/6.

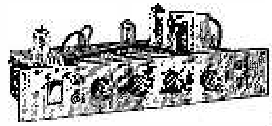
★ *Make a high quality Tape Recorder economically, using the Magnavox 363 Tapedeck, HF/TR3 Amplifier Type 3B1 Recorder case and Elliptical Speaker*

MAGNAVOX 363 TAPE TRANSPORTER



Manufactured to precise limits that permit recording and tape playback to the highest standards set by the Music Industry. Simple reliable design employs a single high-duty motor with heavy flywheel. Features include fast wind on and rapid rewind, pause control, 3-speed selection with interlock, built-in revolution indicator, piano key controls. Speeds 1⅞, 3¾ and 7½ i.p.s. Wow and flutter 0.15% on 7½ i.p.s. Max. spool size 7in. Playing time up to 120 min. per track from 1,200ft. standard tape. Size 43¼ x 11in. plus 5¼in. below mounting board. **With ½ track heads, £10.10.0. With ¼ track heads. £13.19.6.** *Add 10/- carriage and insurance.*

HF/TR3 TAPE AMPLIFIER



Easily the best complete tape amplifier available to the home builder. Supplied already matched for the Magnavox 363 tapedeck, but may be readily matched to most other decks.

Features include: switched equalization for all speeds (CCIR standards at 7½ i.p.s.) Treble boost incorporated during Record. Bass boost during playback, speaker output matched for 3, 7.5, and 15 ohms, additional outputs for extension speaker, phone monitoring on Record and Hi-Fi playback through existing systems, Inputs for Mic. Pick-up, and VHF Radio, Valves: EF86, ECC83, EL84, EM81, EZ81. Size overall: 11 x 6 x 6in. (Panel 13¾ x 3in.). Power pack on separate chassis size 7½ x 3 x 4⅝in. **Amp. and power pack. Kit of parts £13.13s. Assembled and tested £19.** *Add 7/6 carriage.*

Carrying Case specially designed to take Magnavox 363 and HF/TR3 unit. Superbly constructed finish, dark grey cloth. £5 extra.

10in. x 6in. elliptical speaker suitable for use with above.

EXCLUSIVE OFFER OF TOP QUALITY RECORDING TAPE

New American branded tape by world renowned manufacturers and equal in quality to the best obtainable anywhere. Guaranteed splice free, red oxide coated, with full frequency response and uniform output. Resistant to moisture, heat, cold and abrasion. Available in a wide range of Acetate and Polyester qualities, each distinctive boxed and cellophane wrapped in colour coded cartons showing recording times at 7½, 3¾ and 1⅞ i.p.s. Compare the prices!

RANGE AVAILABLE

POLYESTER

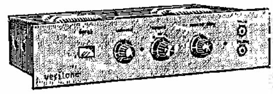
		s.	d.
3¾in.	600ft. Double Play	11	6
7in.	1,200ft. Standard	12	6
5in.	1,200ft. Double Play	15	0
7in.	1,800ft Long Play	20	0
5¾in.	1,800ft. Double Play	22	6
7in.	2,400ft. Double Play	25	0

ACETATE

		s.	d.
5in.	600ft. Standard	8	6
5in.	900ft. Long Play	10	0
5¾in.	1,200ft. Long Play	12	6

Both types post and packing 1/- per reel. Four or more reels post free.
Spare spools, splicers and all Tape Accessories also in stock.

TAPE PRE-AMPLIFIER TYPE 'C'

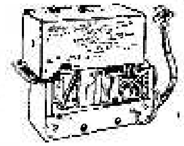


Specially developed by Mullard Laboratories for use with high quality replay matched for use with the Magnavox: systems, and supplied specifically, 363 tapedeck. Features included ferroxcube pot core inductors for treble equalization, push pull oscillator incorporating ferroxcube transformer, adjustable output for matching to existing high-quality amplifier systems, inputs for Mic., Pick-up, Radio, etc. Valves: 3 x. EF86, EC82 and EM81. Totally enclosed in case size 11¼ x 6¼ x 3⅝in. high. (Panel 11¾ x 3½in.) Power supply of 300 vdc at 25 mA. and 6.3 v. at 1.5 A. is on separate sub-chassis size 6¼ x 4½ x 4⅝in. high to facilitate remote location from tape heads. **Pre-amp and power pack Kit of parts £14. Assembled and tested £19. 10s.** *Add 7/6 carriage.*

BSR MONARCH UA16 with FULL-FI HEAD

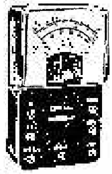
4-speed, plays 10 records, 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in., and 12in. records of the same speed. Has manual play position: colour, brown. Dimensions: 12½ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Ful-Fi-turn-over crystal head. P. & P. 7/6. **£4.19.6**

CHANNEL TUNER I.F.



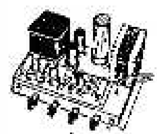
16-19 Mc/s. Continuously tunable from 174-216 Mc/s. Valves required—PCF80 and PCC84 (in series). Cover BBC and ITA ranges. Also Police, Fire and Taxis, etc. Brand new by famous maker, 10/-, P. & P. 3/-.

POCKET MULTI-METER



Size 3⅞ x 2½ x 1⅜in. Meter size 2¼ x 1⅝in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. volts. 0-15, 0.150, 0-1,000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test prods, battery and full instructions, 42/6. P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

8-WATT 5-VALVE PUSH-PULL AMPLIFIER & Metal RECTIFIER



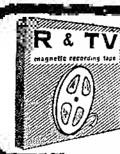
Size: 9 x 6 x 1½in. A.C. Mains, 200-250v. 5 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs, with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested, **£3.19.6**. P. & P. 10/-.

"MAYFAIR" 5-Transistor TAPE RECORDER

Capstan-driven, battery operated. 7½ and 3¾ i.p.s. Precision made. Push-button controls. High quality 2¾in. speaker. Push-pull circuit. Output 400mW. Frequency response: 200-7,000 k/s. Fast rewind. Up to 1 hour twin track playing time. Automatic erasing for re-recording. Dimensions: 8in. x 11in. x 3¾in. Weighs only 7lb. Takes 5in. spools.

£11.11.0 plus 7/6. P. & P.

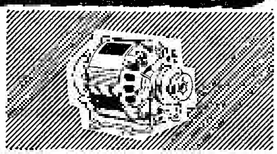
FIRST QUALITY P.V.C. TAPE



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

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

MOTOR

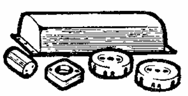


¼ H.P. 1440 revs., £2.10.0.

P. & P. 10/-.

These have been removed from equipment and have been fully reconditioned. Single-phase 230/250V.

40W FLUORESCENT LIGHT KIT

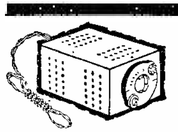


Incorporating **GEC** Choke size 8½in. x 1⅝in. x 1⅝in., 2 bi-pin holders, starter and starter-holder. **11/6** P. & P. 4/6.

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

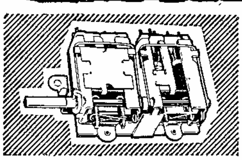
Similar to above: 80W. Fluorescent Light Kit incorporating **GEC** choke size 11½in. x 1⅝in. x 1⅝in. 2 bi-pin holders, starter and starter holder. **17/6** P. & P. 5/6

POWER SUPPLY KIT



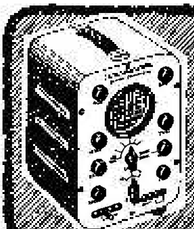
In metal case, size 3¾in. x 2¼in. x 2in. incorporating mains transformer, rectifier and condensers. 230/250 A.C. Mains Output: 9v. 100 mA. Price 10/6 plus 3/-. P. & P.

CYLDON A.M./F.M. PERMEABILITY TUNER FOR ALL TRANSISTOR OPERATION



Size 2¼in. x 2¼in. approx. By famous manufacturer. A.M.-I.F. 470 kc/s. F.M.-I.F. 10.7 Mc/s. A.M. coverage from 1,620 kc/s.-525 kc/s, F.M. coverage 108 Mc/s.-88 Mc/s. Circuit diagram 2/6. FREE with Tuner. 1st, 2nd 3rd A.M.-I.F.'s, 1st, 2nd, 3rd and 4th F.M.-I.F.'s, V.H.F. Osc. choke A.M.-F. trap. All the above are the R.F. end of an A.M./F.M. receiver car radio etc. The above items: **£2.10.0**

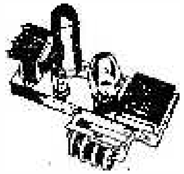
OSCILLOSCOPE for D.C. & A.C. Applications



Push-pull X amplifier: Flyback suppression; Internal Time-base Scan Wave form available for external use; pulse output available for checking TV line O/P Transformers, etc. Provision for external—I/P and C.R.T. Brightness Modulation. A.C. mains 200/250 v., £18/18/-. P. & P. 10/-.

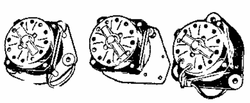
SILICON RECTIFIERS 250 v. P.I.V. 750 milliamps. Six for 7/6, post paid.

3 to 4 WATT AMPLIFIER KIT



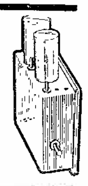
Comprising chassis 8⅜in. x 2½in. x 1in. Double wound mains transformer, output transformer. Volume and tone controls, resistors, condensers, etc. 6V6. ECC81 and metal rectifier. Circuit 1/6, free with kit. 29/6 plus 4/6. P. & P.

MAGNAVOX COLLARO



Set of three Tape Deck Motors. These are made for 110 v. but suitable auto. transformer is supplied. Three motors 39/6, P. & P. 6/-.

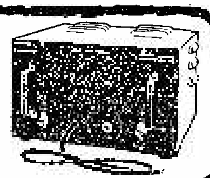
CYLDON U.H.F. TUNER



Complete with PC.88 and PC.86 Valves. Full variable tuning. New and unused. Size 4¾ x 5½ x 1½in. Complete with circuit diagram.

35/- plus 2/6 P. & P.

Fixed Frequency SIGNAL GENERATOR



Crystal control in metal case, size 10in. x 6in. x 6in. Incorporating 2 FC13 valves, mains transformer, metal rectifier, choke, indicator lamp, crystal and numerous components. Modulated and unmodulated output sockets. Originally used for I.T.V. frequencies. Brand new, 39/6, plus 7/- P. & P. A.C. Mains 200/250 volts.

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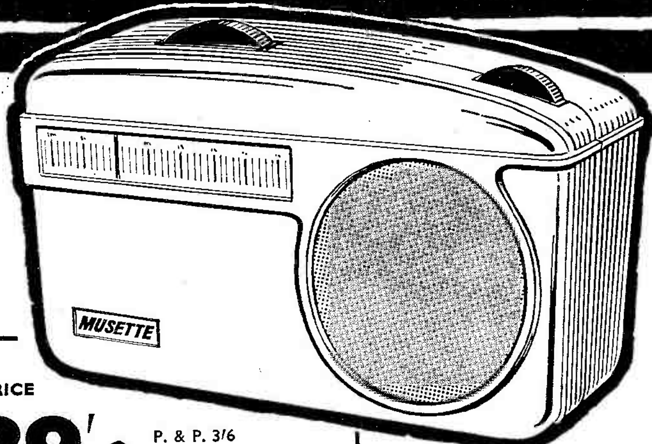

- 2¼″ Speaker.
- 6 Transistors Superhet Output 200mw.
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- Horizontal Tuning Scale.
- Ferrite Rod Internal Aerial.
- IF·470 Kc.
- All components, Ferrite Rod and Tuning Assembly mount on printed board.
- Operated from PP3 Battery.
- Full comprehensive instructions and point-to-point wiring diagram.
- Printed Circuit Board.
- Tunable over medium and long wave band. Car aerial and ear piece socket.

PRICE

39/6 P. & P. 3/6
Circuit diagram 2/6. Free with parts.

INCLUDING CARRYING STRAP.

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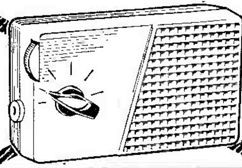

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- ★ I.F. neutralisation on each stage 460 kc/s.
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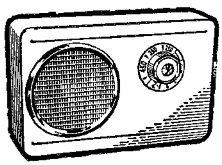

New TRANSONA FIVE

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NOW READY!
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7 WAVEBAND PORTABLE OR CAR RADIO — *Amazing performance and specification*

★ *Now with PHILCO MICRO-ALLOY R.F. TRANSISTORS*

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

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

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Total cost of parts now only **£5.19.6** P. & P. 5/6

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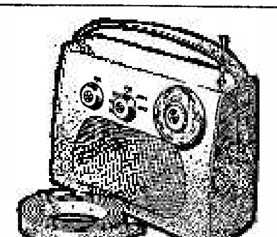

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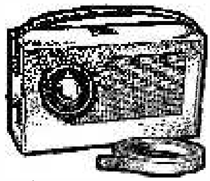
"... amazed at volume and performance ... has really come up to my expectations." S.G. Stockton-on-Tees.



● 8 stages—6 transistors and 2 diodes

Our latest completely portable transistor radio covering medium and long waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C., Home and Light, 208 and many Continental stations. Handsome leather-look pocket size case, only 6¾ x 3¾ x 1⅝in. approx. with gilt speaker grille and supplied with hand and shoulder straps.

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TRANSONA SIX

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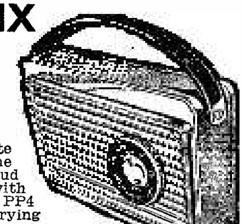
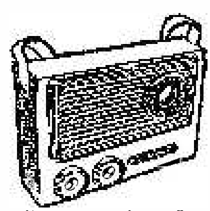
This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. speaker makes listening a pleasure. Push-pull output. Ferrite rod aerial. Many stations listed in one evening, including Luxembourg loud and clear. Attractive case in grey with red grille.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



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

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



SUPER SEVEN

● 9 stages—7 transistors and 2 diodes

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

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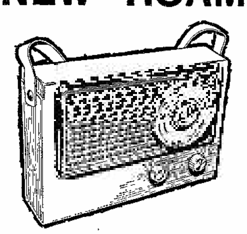
Parts Price List and easy build plans 2/- (FREE with Kit)

NEW ROAMER SIX



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	Kit	Assembled
● **5in. OSCILLOSCOPE, 10-12U** TB 10 c/s—500 kc/s.	£35 17 6	£45 15 0
● **3in. OSCILLOSCOPE, OS-2** TB 20 c/s—200 kc/s.	£22 18 0	£30 8 0
● **4½in. VALVE VOLTMETER, V-7A**	£13 18 6	£19 18 6
● **6in. VALVE VOLTMETER, IM-13U**	£18 18 0	£26 18 0

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	Kit	Assembled
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● **TV ALIGN GENERATOR, HFW-1**, 3·6, 220 Mc/s	£37 18 0	£47 10 0
● **RF SIGNAL GENERATOR, RF-1U.** (Up to 100 Mc/s fund.) ...	£13 8 0	£19 18 0
● **MULTIMETER, MM-1U** (V. A, Res, dB)	£12 18 0	£18 11 6


V-7A

	Kit	Assembled
● **ELECTRONIC SWITCH, S-3U** Scope Trace doubler	£12 18 0	£18 10 0
● **AUDIO SIGNAL GENERATOR, AG-9U** 10 c/s—100 kc/s	£22 10 0	£30 10 0
● **AUDIO SINE/SQ GENERATOR, A0-1U** Sq wave 20 c/s-25 kc/s	£14 15 0	£21 5 0
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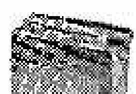

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	Kit	Assembled
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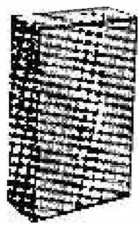
● **MAGNAVOX 363 DECK,** ½ Track	£13 10 0	

SPEAKER SYSTEMS


Berkeley

	Kit	Assembled
● **BERKELEY slim-line,** 2-LS, Cabinet, fully finished ...	£18 10 0	£23 0 0
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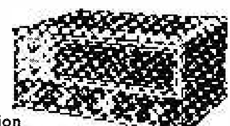

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	Kit	Assembled
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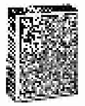

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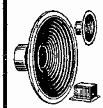

Consisting of matched 12in. 12,000 line, 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. Or **Senior 20 watt** inc. Fane 122/10 speaker **£6.19.9**. Carr. 7/6. Or Dep. 21/- and 9 mthly pmts of 15/4 (Ttl £7.19.0). **£4.19.9** Carr. 5/6

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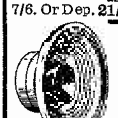

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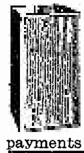
HIGH FIDELITY LOUDSPEAKER UNITS



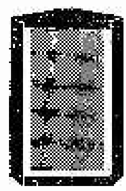
AUDIOTRINE PETITE Really astounding performance. Size only 10½ x 6½ x 7½in. Rating 10 watts. Frequency range 45-20,000 c.p.s. Cabinet beautifully finished in Teak (light) or Walnut (medium). Fitted specially designed Heavy cast 5in. speaker with large pole pieces, extra long voice coil and rubber cone surround. Impedance 3 ohms or 15 ohms. Or Deposit 36/- and 9 monthly payments of 25/- (Total £13.1.0). **11 Gns.** Carr. 7/6

The GLOUCESTER Handsome "slimline" cabinet, acoustically lined. Size 24 x 20 x 6½in. Finished light Teak or medium Walnut. 12in. high flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40-20,000 c.p.s. Impedance 15 ohms. Or Deposit 36/- and 9 monthly payments 25/- (Total £13.1.0). **11 Gns.** Carr. 15/-

The BRONTE Handsome cabinet of modern styling. Acoustically lined and finished Teak or Walnut. Size 22 x 15 x 7½in. Fitted Wharfedale Super 8 RSDD Speaker, with Roll surround and dual cone. Rating 6 watts. Impedance 15 ohms. Or Deposit 39/- and 9 monthly payments 27/3 (Total £14.4.3). **12 Gns.** Carr. 15/-

TWEETERS R.A. 3 ohm 25/9. 15 ohm 25/9

CORNER CONSOLE CABINETS



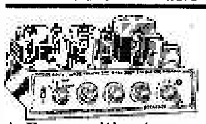
Strongly made. Beautiful polished walnut veneered finish. Pleasing design. **Junior Model.** For up to 8in. speaker. Approx. 20 x 11 x 8in. Carr. 5/6 **49/9**
Standard Model. To take up to 10in. speaker. Size 27 x 18 x 8in. Carr. 7/6 **5 Gns.**
Senior Model. To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30 x 30 x 15in. (Recommended for use with Audiotrine speaker system.) Terms available. Carr. 8/6 **8 Gns.**

R.S.C. GRAM AMPLIFIER KIT. 3 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit, etc., supplied. Only 44/9. Carr. 3/9.

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

A complete set of parts for the construction of a stereo amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Control give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point to point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. Full constructional details and price list 2/6. Or supplied factory assembled with 12 months' guarantee for **11 gns.** **Terms:** Deposit 36/- and 9 monthly payments 25/5 (Total £13.4.9). **£8.15.0** Carr. 11/6

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



PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. Based on a current Mullard design and employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 5 millivolts maximum. **Harmonic distortion:** (each channel) 0.2%. Send s.a.e. for leaflet.

- ★ **Four-position tone compensation. and Input Selector switch.**
- ★ **Will amplify direct from Tape Heads**
- ★ **Stereo/Mono switch.**
- ★ **Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls.**
- ★ **Neon panel indicator.**
- ★ **Handsome Perspex Frontplate.**

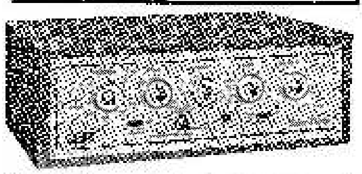
Output transformers are high-quality sectionally wound to required specification. Output matching for 3 and 15 ohm speakers on each channel. Complete set of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **14 Gns.**
Or factory assembled, tested and supplied with our usual 12 months guarantee. Or Deposit £3 and 9 monthly payments 43/2 (Total £22.4.6). Carr. 12/6 **19 Gns.**

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

COMPLETELY NEW UNITS WITH TECHNICAL SPECIFICATIONS APPEARANCE AND COMPARING MORE THAN FAVOURABLY WITH SIMILAR AMPLIFIERS AT 2-3 TIMES THE COST

R.S.C. SUPER 30 STEREO AMPLIFIER

FULLY TRANSISTORISED 200/250v. A.C. Mains Operation.
OUTPUT 10 WATTS R.M.S. into 15 ohms.
15 WATTS R.M.S. into 3-4 ohms.
Maximum instantaneous Peak power output 28 watts
PRINTED CIRCUIT CONSTRUCTION.
LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2.5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10 Kc/s.
BASS CONTROL: +12dB to —15dB at 50 c/s.
HARMONIC DISTORTION at 10 Watts R.M.S. 1,000 c.p.s. 0.35%. **HUM LEVEL:** —75dB.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Or Kit with Printed Circuit wired and tested 30/- extra, or Deposit 72/- and 9 monthly payments of 22/6 (Total £13.14.6). **10½ Gns.** Carr. 10/-
Attractive Walnut or Teak finished cabinet 5 gns. or Deposit 17/- and 9 monthly payments 11/- (Total £5.16.0). Or unit factory built and tested, complete with cabinet and with our usual 12 months guarantee. Or Deposit £3.9.0 and 9 monthly payments £2 (Total £21.9.0). **18½ Gns.** Carr. 12/6



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

ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components.
CROSS-TALK: —52dB at 1,000 c.p.s.
CONTROLS: 5 position Input Selector, Bass Control, Treble Control, Volume Control, Balance Control, Stereo/Mono Switch. Tape Monitor Switch, Mains Switch.
INPUT SOCKETS (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone.
Operation of the Input Selector Switch assures appropriate equalisation.
Rigid 18 s.w.g. Chassis. Size approx. 12in. Wide, 3in. High and 8in. Deep.
Attractive rigid Perspex Facia Plate and Matching Spun Silver Knobs. Neon Panel Indicator.
Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon) CURRENTLY AVAILABLE REGARDLESS OF THE COST. SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. If required printed circuits can be supplied with appropriate components assembled, soldered and tested for £3 extra. Terms: Deposit 6 Gns. and 9 mthly pmts 38/6 (Total £23.12.6). Carr. 12/6 **18 Gns.**
Attractive Walnut or Teak finished cabinet **5 Gns.** or Deposit 17/- and 9 monthly payments 11/- (Total £5.16.0). Or unit completely assembled ready for use housed in cabinet. **29 Gns.** Carr. 15/-. Or Deposit £4.12.0 and 9 mthly pmts 64/- (Total £33.8.0).
Send S.A.E. for leaflet.

AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST. CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.
Incorporating the latest Magnavox Tapedeck. The Audiotrine High Quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a handsome Portable Carrying Cabinet of latest styling and finished dark grey leather-cloth. Size 14½ x 17 x 8½in. high and circuit. Total cost if purchased individually approximately **£35.** Performance equal to units in the £50-£60 class. S.A.E. for leaflets. **TERMS: Deposit 4 gns.** and 9 monthly payments of **59/6** (Total **29½ gns.**). 4 Track Model **3 gns.** extra.

26 Gns. Carr. 19/6

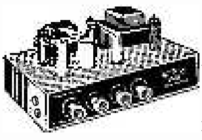
R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER

A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and practically all "mikes". Separate Bass and Treble controls giving "lift" and "cut". Hum level 71dB down. Negative Feedback 15dB. H.T. of 300v. 25mA and L.T. of 6.3v. 1.5a. available for supply of Radio Tuner or Tape Deck pre-amp. For A.C. mains 200-250v. Speaker output 3 ohms. Kit is complete in every detail with fully punched Hammer finished chassis, point-to-point wiring diagrams and instructions. Exceptional value **£4.17.9**
or assembled ready for use 25/- extra, plus 3/6 carr. Deposit 22/6 and 5 monthly payments of 22/6 (Total £6.15.0) for assembled unit.

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

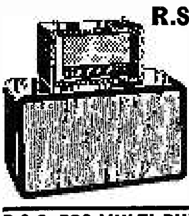
A highly sensitive Push-Pull high output unit with self-contained Pre-amp./Tone Control Stages. Performance figures compare equally with most expensive amplifiers available. Hum level —70dB. Frequency response ±3dB 30-20,000 c/s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All first grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Minimum input required for full output 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. Gram, Radio or Tape. **Output Socket provides** L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50 c/s A.C. mains. Output for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point to point wiring diagrams and instructions. **12 Gns.** Carr. 10/-
Supplied factory built with EL34 output valves, 12 months guarantee for **15 gns.** If required perforated cover with carrying handles can be supplied for **21/-.** Send s.a.e. for leaflet. **TERMS: Deposit 48/- & 9 monthly payments of 33/7 (Total £17.10.3).**

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP
Two input sockets with associated controls allow mixing of "mike" and gram, etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ±3dB 30-20,000 c/s. Six negative feedback loops. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.Us, all types "mikes". Comparable with the very best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Output Socket** provides 300v. 30mA, and 6.3v. 1.5a. for supply of a **Radio Tuner.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit complete to last nut. Chassis fully punched. Full instructions and point-to-point wiring diagrams supplied (or factory built **£11.15.0.** Carr. 11/6). ONLY **£8.15.0**
Metal covers with 2 carrying handles can be supplied for **£1. TERMS ON ASSEMBLED UNITS: Deposit 36/6** and 9 monthly payments of **25/9** (Total **£13.8.3**). Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Mikes, etc.

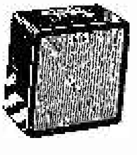
R.S.C. BASS-REGENT 50 WATT AMPLIFIER



AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape and general public address
★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response. ★ 4 Jack Inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".
★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles. ★ Separate Bass and Treble Controls giving "lift" and "cut". Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at three times the cost. Or deposit **£7.17.6** and 9 monthly payments of **£5.10.0.** (Total **55 gns.**)

49½ Gns. Carr. 30/-

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



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

29½ Gns. Carr. 17/6

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

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

ONLY **19½ Gns.** Carr. 15/-

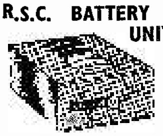
COMPLETE POWER PACK KIT

Consisting of Mains Transformer, Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA, 6.3v. 2a or with metal cover **26/9** **22/9**

TRANSISTORISED SOUND MIXER

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

R.S.C. BATTERY TO MAINS CONVERSION UNITS.



Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.4v. and 90v. where A.C. mains 200/250v. 50 c/s is available. Complete kit with diagram **44/9** or ready for use **59/6.**

LINEAR TREMOLO PRE-AMP UNIT

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

GARRARD 3000 AUTO-CHANGERS

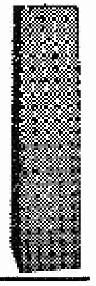
with Sonotone low mass Hi-fi Stereo/Mono Cartridge. Approx. ⅔ normal price. Carr. 6/6. **£8.19.9**

FANE HEAVY DUTY HI-FI SPEAKERS

12in. 20 watt. Type 122/10. Post 5/6. ONLY **5 Gns.**

R.S.C. (MANCHESTER) LTD.

R.S.C. COLUMN SPEAKERS

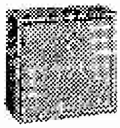


Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. 15 ohm matching.
Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. Or Deposit **£2** and 9 mthly pmts **28-/** (Total **£14.12.0**) **12½ Gns.** Carr. 10/-
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **19½ Gns.** Or Deposit **3 gns.** and 9 monthly payments of **43/7** (Total **£22.15.3**).

18in. 60 WATT EXTRA HEAVY DUTY LOUDSPEAKERS

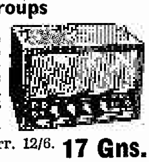
Famous make. Normal price over **£25.** Very limited number to clear with full guarantee. Terms available. Carr. 15/- **17 Gns.**

12in. HIGH QUALITY LOUDSPEAKERS



In walnut veneered cabinet. **10 Watt Model.** Gauss 12,000 lines. Speech coil 3 or 15 ohms. **£4.19.6** **Terms:** Deposit **15/-** and 9 monthly payments of **11/2** (Total **£5.15.6**) Carr. 5/6
20 Watt Model. 15 ohm. Size 18x18x10in. **Terms:** Deposit **24/6** and 9 monthly payments of **17/3** (Total **£8.19.9**). **£7.19.6** Carr. 8/6
30 Watt Model. 15 ohms. Or Deposit **22/4** and 9 monthly payments of **22/4** (Total **£11.13.0**). **10 Gns.** Carr. 10/- **Any of above in extra heavy Rexine covered Cabinets, £1 extra.**

30 WATT HI-FI AMPLIFIER for Lead, Rhythm, Bass Guitar, Vocal or Instrumental Groups



A Four Input, two volume control Hi-Fi unit with separate Bass and Treble 'cut' and 'boost' controls. Latest type valves. Housed in strong Rexine covered cabinet with twin carrying handles. Attractive black and gold perspex fascia plate. For 200-250v. A.C. mains. Output for 3 or 15 ohm speakers. Send S.A.E. for leaflet. Deposit **£3** and 9 monthly payments of **37/5** (Total **£19.16.9**). Carr. 12/6. **17 Gns.**

HEAVY DUTY SELENIUM RECTIFIERS

12v. 15 amps. F.W. (Bridge). Only **19/9**

TRANSISTOR SALE

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

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

R.S.C. MAINS TRANSFORMERS

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

MIDGET CLAMPED TYPE 2⅝ × 2⅝ × 2¼in.	
250v., 60mA, 6.3v. 2a	14/11
250-0-250v., 60mA, 6.3v. 2a	15/11
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a, 2½ × 3 × 3in.	19/9
250-0-250v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	33/9
300-0-300v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	33/9
300-0-300v. 130 mA, 6.3v. 4a c.t., 6.3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	33/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a	42/9
425-0-425v. 200mA, 6.3v. 4a, c.t., 5v. 3a	63/9
425-0-425v. 200mA, 6.3v. 4a, 6.3v. 4a, 5v. 3a	65/9
450-0-450v. 250mA, 6.3v. 4a, c.t., 5v. 3a	79/9
TOP SHROUDED DROP-THROUGH TYPE	
250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a	19/9
250-0-250v. 100mA, 6.3v. 3.5a	21/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a	22/9
350-0-350v. 80mA, 6.3v. 2a, 0-5-6.3v. 2a	23/9
250-0-250v. 100mA, 6.3v. 4a. 0-5-6.3v. 3a	32/9
300-0-300v. 100mA, 6.3v. 4a. 0-5-6.3v. 3a	32/9
300-0-300v. 130mA, 6.3v. 4a, 0-5-6.3v. 1a suitable for Mullard 510 Amplifier	39/9
350-0-350v. 100mA, 6.3v. 4a, 0-5-6.3v. 3a	32/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a	39/11

FILAMENT TRANSFORMERS

6.3v. 1.5a	6/9	6.3v. 3a	9/9
6.3v. 2a	7/9	6.3v. 6a	19/9
12v. 1a	8/9	12v. 3a or 24v. 1.5a	19/9

AUTO (Step UP/Step DOWN) TRANSFORMERS
0-110/120v.-200-230-250v.

50-80 watts	14/9	250 watts	49/9
150 watts	29/11	500 watts	99/9

CHARGER TRANSFORMERS

0-9-15v. 1¼a	13/9	0-9-15v. 5a	21/9
0-9-15v. 2½a	16/9	0-9-15v. 6a	25/11
0-9-15v. 3a	18/9	0-9-15v. 8a	31/9

OUTPUT TRANSFORMERS

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

SMOOTHING CHOKES

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

LEARN ELECTRONICS —AS YOU BUILD

over 40 CIRCUITS EXPERIMENTS TEST GEAR

including . . .

- **CATHODE RAY OSCILLOSCOPE**

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

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

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PRACTICAL WIRELESS

VOL 42 No 3
issue 713

JULY 1966

TOPIC OF THE MONTH

Pilkington Revisited

THE socialogical and cultural findings of the Pilkington Committee on Broadcasting, which delivered its report in 1962, provided a seven-day wonder which was eagerly exploited by the Press, the Industry and do-it-yourself psychiatrists.

The technical problems discussed in the famous report, however, are still with us in part. For example, despite a strong recommendation to start local broadcasting, the Government of the day took no action, nor have subsequent Governments. As the subject is again "under review" we took out our report and waded through the evidence, reports, statements, opinions in this vade-mecum. The Committee came out in favour of local radio stations, organised by the BBC. And we feel inclined to agree.

As the BBC is already organised on both a National and Regional basis, it would be a natural development to purely local broadcasting. And local station managers could always call upon selected BBC programmes to supplement local items. A comprehensive and flexible network as opposed to the likelihood of non-stop juke-box radio.

Stations run by commercial companies are placed in the invidious position of trying to serve local interests and also obligations to advertisers—which, in the long run, is incompatible. To serve local hopes, endeavours and interests there must be as much freedom as possible from external direction. The BBC, financed by licence revenue, would have no obligation to pursue any objective other than that of the public radio service.

There must be an answerable public corporation to assume responsibilities for a service. The BBC, as such, fulfils this requirement. But a corporation made answerable to a multitude of commercial companies would find it impossible to ensure that the major obligation to the public was met—and the essential purpose of the service would be largely frustrated.

Moreover, the BBC estimate that a nationwide system of local v.h.f. stations could be set up at an additional licence fee of only five shillings. This, we feel, would be good value for the money.

W. N. STEVENS, Editor

NEWS AND COMMENT

CONSTRUCTIONAL

GENERAL ARTICLES

AUGUST ISSUE WILL BE PUBLISHED ON JULY 7th

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 36s. per year to any part of the world.

Simple Proximity Detector

WITH reference to the article in the March issue of PRACTICAL WIRELESS, "A Simple Proximity Detector" I would like to draw attention to page 940, column 2, paragraph 4, regarding the d.c. setting of this unit.

(1) It is the responsibility of the Police Force to protect your property and if they are informed of your absence they will do so.

(2) The Electricity Authority cannot as far as I am aware, in the majority of cases, cut off the electricity without entering the premises, so your door is likely to be damaged and very insecure.

(3) The nuisance caused by the ringing could cause neighbours to take civil court action against you for interfering with their peace and comfort and may be able to claim damages for the interference.

All of these points could be overcome if the operator leaves his keys with a responsible neighbour who can turn the implement off and possibly reset it. You must also of course inform the local police of the keyholder's name and address. This will save tying up a member of the understaffed police for some considerable time.

D. E. McNair.

Slough,
Buckinghamshire.

Wake Up Dealers

I AM getting weary in my search for a dealer who will take money from me and, in exchange, do at least one of two things—namely, align my home-built f.m. tuner and test for me some valves.

Because I have no proof of where the parts for the tuner were bought the best I have been able to achieve so far, and after almost begging for it, was 17s. 6d. worth of very dubious alignment. The tuner very little better than before and no explanation. Possibly the construction is at fault, but as it once worked well I doubt it.

And the valves! London is littered with radio shops whose testers are permanently out of order, not available for use at any time other than those set down by unwritten and ever changing rules, or just not available owing to staff shortage. Where valve testing is done it is usually as a favour rather than a service and I hate paying for a favour.

Own up gentlemen. Both these services can only be performed by you and you are entitled to charge at a rate that makes them economical for you. Isn't it obvious to you that the man who does the job willingly and properly—even if he is charging more for it now than before—is the man we will go to when we are next spending out on a large item of equipment.

Barry Fox.

London N.W.3.

NEWS AND..

BETTER COMMENTARY FOR RACE FANS

Standard Telephones and Cables Limited used two 1,000W audio amplifiers, 300 horn loudspeakers and some thirty miles of wire to provide Brands Hatch motor-racing circuit with a new sound commentary system.

The loudspeakers, pole-mounted around stands and track, take speech from a possible six different commentary spots throughout the circuit, to sixteen acres of open-air spectator area. Another 25 cabinet speakers are used in indoor enclosures.

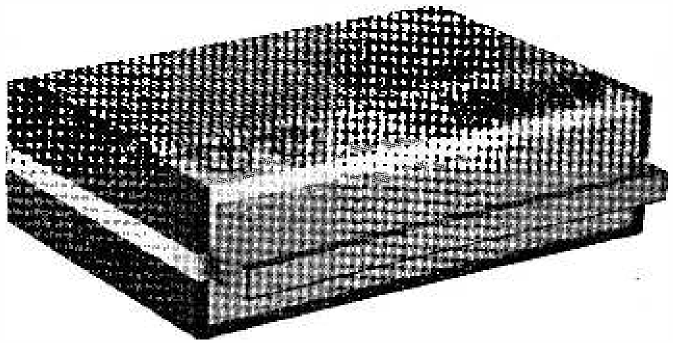
The new system provides clearer and more powerful sound using equipment transistorised throughout, except for the amplifier power output stages.

HOSPITAL SOUND SYSTEM

A new hospital nearing completion at High Wycombe, Buckinghamshire, will have one of the most comprehensive communications systems of its kind.

A £30,000 installation will enable patients to speak to nurses from their beds, as well as providing the usual radio and television sound programmes. The system, by Hadley Telephone and Sound Systems Ltd., of Smethwick, serves 228 beds in thirteen wards.

NEW CASETTE RECORDER



Telefunken enter the field of casette tape recorders with their "Magnetophon 401". This recorder, shown above, uses casettes conforming to the "DC System International", a system acknowledged throughout the Continent as standard for this type of equipment.

Battery-operated, the Magnetophon 401 half-track recorder provides a total of 90 or 120 minutes playing time, depending on the casette used. The amplifier employs 12 transistors for its 2W output. Frequency response is 40-10,000 c/s, and signal-to-noise ratio better than 45dB. The price is 46 guineas.

LIGHTHOUSES WIRED WITH BICC CABLES

Two lighthouses—one of legendary interest, the other a unique modern structure—have been wired exclusively with cables manufactured by British Insulated Callender's Cables Limited.

The 155 year old, 115 foot Bell Rock lighthouse, built on Inchcape Rock 11 miles south east of Arbroath by Robert Stevenson, grandfather of Robert Louis, has been electrified after operating hitherto on oil. Its 730,000 candlepower red and white signal has now been replaced by a 3·5kW 100 volt tungsten filament lamp.

BICC supplied Bell Rock with approximately 1100 yards of 660/1100 volt mineral insulated cables and accessories.

The new lighthouse is on Kish Bank, 9 miles out in Dublin Bay, and is the largest of its type to be built anywhere. It is 117 feet high and has a 2,000,000 candlepower light giving a double flashing character every 30 seconds.

The light apparatus, rotated by an electric motor once every 60 seconds, comprises eight 120 volt 1000W filament type projector lamps in the focus of eight 18 inch diameter parabolic reflectors, each flash being made up by two reflectors. The voltage applied to the lamps is reduced to 90 volts to increase their average life to 800 hours.

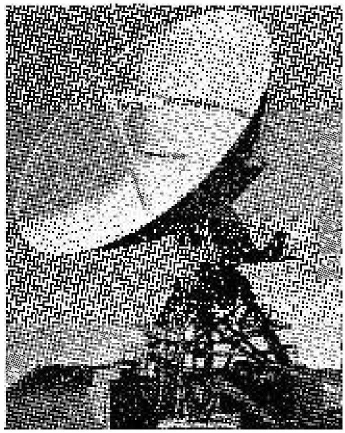
...COMMENT

BRITAIN'S PART IN MOON SHOT

Britain is providing a vital link in the communications network American astronauts will use in speaking to Earth, when the first U.S. space-shot heads for the moon.

The Marconi Company is building a satellite communications ground station which will be erected on Ascension Island in the Atlantic, ready for the Apollo moon-shot which is planned to put men on the moon.

This photograph shows a model of the station. Parts of the supporting gantry are already on the Island and other sections, including the 42ft. diameter dish aerial and electronic sub-systems are under test at Marconi's Chelmsford factory.

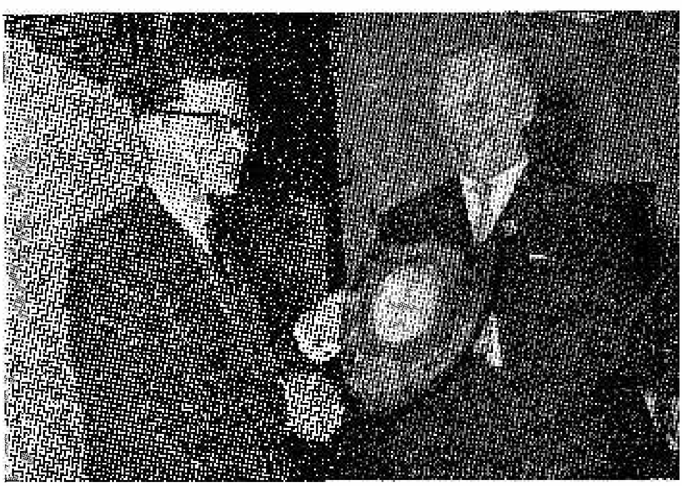


COMPACT STEREO AMPLIFIER

Silicon transistors are used throughout a new stereophonic amplifier made by Goodmans Industries Limited. Feeding into 8Ω, this amplifier, the Maxamp 30, will deliver 15W per channel with a total harmonic distortion claimed to be less than 0·4% (at 1,000c/s).

The Maxamp 30 measures only 10½in. x 5½in. x 7¼in. and its polished wood cabinet contains integrated pre-amplifier and power-pack as well as the amplifier itself. The amplifier features all the usual controls and facilities (including provision for stereo headphone listening) and costs £49 10s. 0d. Frequency response is 20c/s—20kc/s.

DERBY WINNER



A few months ago, Derby and District Amateur Radio Society held their Annual Dinner.

Over 180 people attended the Dinner and members voted it a great success. During the evening Mr. A. G. G. Melville, the Society's President, presented awards won by various members during 1965. Our photograph shows Mr. R. E. F. Street (left), Derby and District Vice-Chairman, receiving the Founder Members' Trophy for winning the Constructors' Contest.

Don't Sink the Pirates

WHILST one must agree with the sentiments expressed in the Editorial of the April PRACTICAL WIRELESS, I nevertheless feel that our off-shore buccaneers have proved useful in a few respects.

Firstly they have probably indicated to the BBC that there is a healthy demand for "Wallpaper" music throughout the day, and that in a fun-crazy trend-setting 1966 England the younger generation look for "live" radio. Whether they are going to get it after we finally sink the pirates is another matter, but they have a case if our legal system still wishes to live up to its claim of catering for all tastes.

Secondly it seems to have proved that a commercial radio network of some sort or another would go down well over here (possibly via v.h.f. on a local basis), and that leading manufacturers and traders would not be slow in coming forward to take advantage of it. Critics have made much of the possible evils of endless advertising breaks, but I hardly consider this to be a particularly valid argument. If the nation's eyeballs can lap it up on TV without undue ill effect, likewise the ears should be able to take it.

In conclusion, I shouldn't worry too much about interference complaints from Eastern Europe whilst our pirates eke out the threatened last days. I have not noticed any particular eagerness on the part of the Communist bloc to honour frequency agreements, and for a good example of the "Law of the Jungle" what could be better than the new Peking transmitter on approximately 1525 kc/s? It nearly blots out Caroline at times . . . !

P. H. Dobbs.

Westbury-on-Trym,
Bristol.

No. 19 Set Mods

YOUR contributor S. Simpson is to be congratulated for his article on No. 19 Set modifications. At no time can I recall a more explicit set of instructions for carrying out a modification.

Unfortunately I do not possess a 19 set but do have an R1155 and BC348 which I would like to modernise. As these sets are quite common, many readers, I am sure, would like to see similar articles on these.

I wonder if there is a volunteer amongst your contributors who may have done similar mods on the R1155?

R. E. Robinson.

Darlington.

Well, how about it?—Editor.

More News and Comment on Page 200

GRID DIP OSCILLATOR

A.S. CARPENTER G3TYJ

AT some time or other most radio constructors find themselves in need of frequency checking apparatus. Because of this, the familiar g.d.o. is frequently found in amateur stations for, although very precise frequency checking is scarcely possible with the device, it is a most useful one and is sometimes considered handier than a signal generator.

The usefulness of a g.d.o. is dependent on its calibration accuracy and holding stability, therefore in a home-built item care is required, firstly to construct a physical rugged specimen, secondly to ensure reasonably good calibration and thirdly to obtain an attractive unit.

G.D.O. circuitry and uses is already well-known so the emphasis here is on construction, since converting a circuit diagram into a satisfactory practical physical form is not always easy. The prototype is attractive in appearance and it can, with care, be copied easily. A fair amount of work is involved, but only simple tools are needed; to construct the prototype, for instance, a 3in. vice, a hand drill and a few files were the only items used to fashion the metal work.

In the prototype, power requirements are met via a separate power supply unit which is also used to power various other items from time to time. Space does exist, however, for an internally fitted power unit where considered necessary.

Circuitry

Looking at Fig. 1, valve V1 is arranged in an oscillatory type of circuit, coil L and capacitor VC1 forming the main frequency-determining components. At switch-on, the oscillator produces valve grid current and this is recorded by meter M inserted at the earthy end of R1. Adequate sensitivity demands use of a meter of 500μA f.s.d. or better, VR1 ensuring that at no time can the meter be over-driven.

Fitment of the closed circuit jack socket is beneficial, for headphones may be plugged in for monitoring purposes, or an audio signal may be injected to modulate the r.f. signal being generated. When no jack plug is inserted the g.d.o. functions normally.

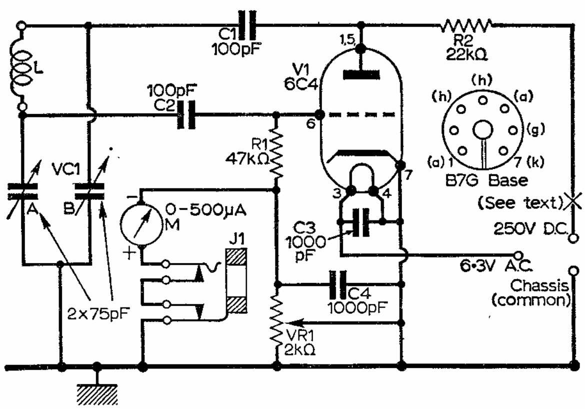


Fig. 1: Circuit of the oscillator.

The g.d.o. may also be used as an absorbtion wavemeter if its h.t. supply is disconnected and if this facility is required a simple toggle or slide switch should be inserted at point "X". Such a switch may be mounted on the front panel to the left of the indicating meter. Since an excellent absorption wavemeter already exists at the author's location the facility was not necessary.

No calibration of the meter scale is necessary. Calibration scales are associated with VC1 plug-in coils (L) enabling unbroken coverage of the frequency range 1·75-150Mc/s this embracing virtually all amateur bands. U.H.F. bands are not accommodated, a separate device being recommended at these frequencies.

Capacitor VC1 consists of a 2 x 75pF specimen pruned from a discarded RF27 unit, but other types are usable—the Jackson 02 for example, or a suitable split-stator item.

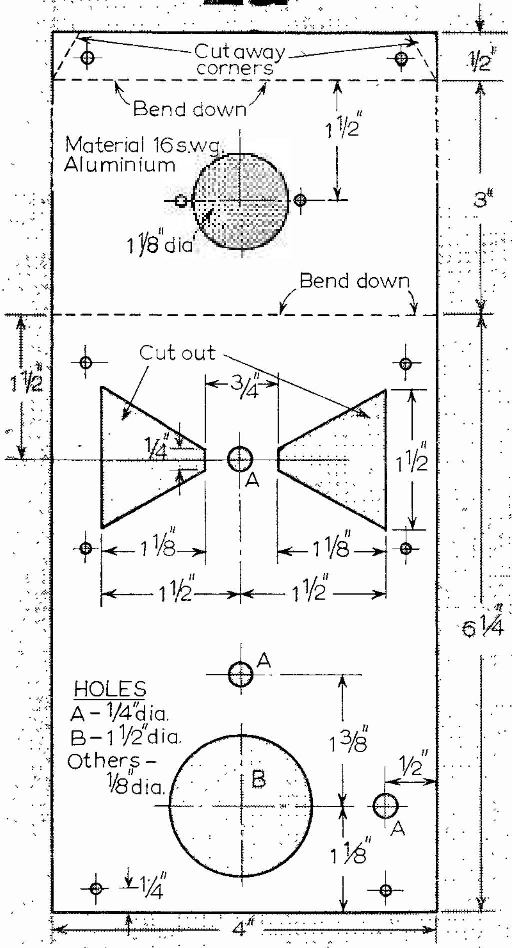
Constructional

The main casing consists basically of two L-shaped pieces of 16 s.w.g. aluminium—Fig. 2*a*, *b*—section *a* carrying most of the assembly. The final length of each section is 9¾in. but it may be beneficial to commence with pieces 12in. long and 4in. wide, making the bends as indicated but leaving an oddment to be cut away from *both* ends of each piece later. In this way neatness is assured and matching sections result.

The front panel and end-plate cut-outs may then be marked out as is shown in Fig. 2*a*. In the absence of more refined tools, a series of small holes should be drilled along the inners of the cut-outs marked, after which the unwanted metal may be carefully pruned away leaving ragged edges which may be cleaned up with a file.

The panel becomes progressively weaker as the work proceeds but this is not too important for rigidity returns with the fitment of components. The

2a



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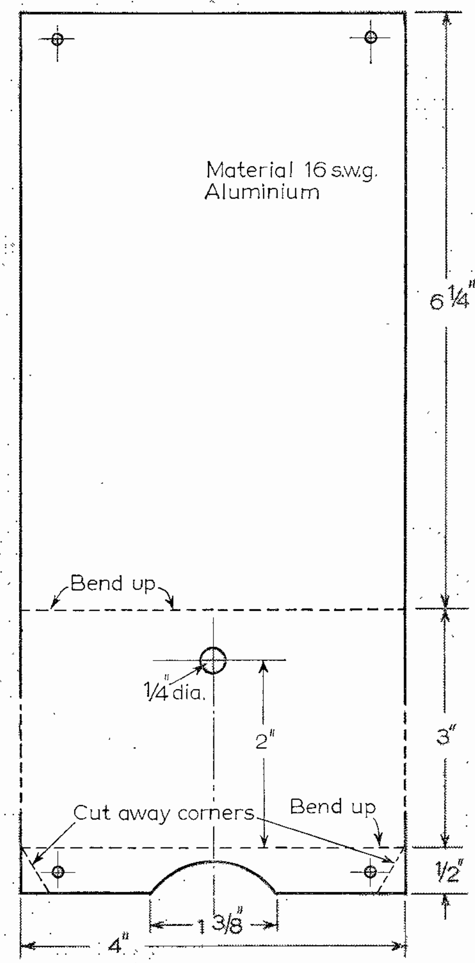

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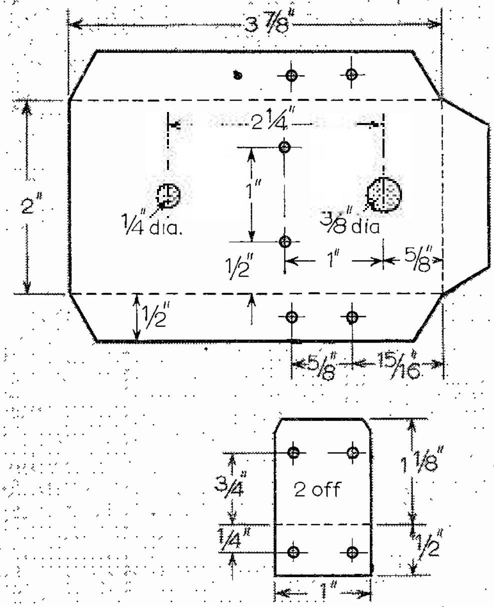
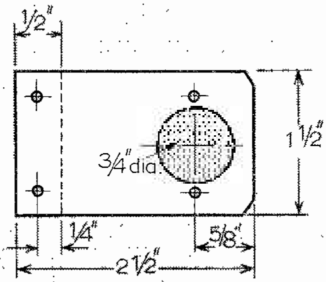




MATERIALS: 16 s.w.g. Aluminium
All small holes 1/8" dia.
Bend all flanges up at dotted lines.

Fig. 2a: Details of the top main casing.
Fig. 2b: Other part of the main casing.
Fig. 3: Metalwork details relating to the main chassis.

section shown in Fig. 2*b* is also prepared along the lines indicated.

The Main Chassis

To avoid defacing the front panel unduly, the bulk of the construction is carried on a small chassis, the scheme being shown in Fig. 3. This chassis is constructed and wired separately, eventually being located and held by a pair of retaining brackets. Control shafts of VC1 and VR1 then pass through the front panel, a 2¾in. diameter drum of the type used with cord drive tuning mechanisms being first fitted to VC1.

A piece of stiff white card on which arcs are drawn in Indian ink is glued to the drum flat surface. The card measures 3in. in diameter and carries the calibration. A piece of perspex affixed to the front panel affords protection and keeps out dust; a cursor line is scribed and inked in.

Details relating to the main chassis and which completes the metalwork are shown in Fig. 3 and are self-explanatory.

The valve holder may then be fitted as indicated and this assembly wired as far as is convenient. The meter may then be mounted on the front panel casing together with the international valve holder and the jack socket. The main chassis is then affixed after which final connections are made using tags 1 and 5 of the octal valveholder to take the connections from VC1. A tag strip bolted under one of the retaining bracket bolts may be used as an anchor point for the 3-core power supply cable from the p.s.u.

It should be noted that at this juncture no power should be applied, or damage to the valve will result!

Coils

Prototype coils are wound on plastic formers of 1½in. outside diameter and 2in. long, force-fitted on to the bases of discarded octal valves of the 6K8, 6K7, etc., variety, the glass bulbs and internal structures having been removed.

Before smashing the bulb of an unwanted valve it should be placed in a paper bag. Holding the base of the valve firmly the glass bulb is tapped smartly with a hammer! Careful removal of all debris leaves a strong former which, unfortunately, is not long enough for g.d.o. purposes. Plastic, paxolin, or even stiff card, tubing suitable for fitting over the base is now sought and fixed firmly.

At this point a test coil of about 12 turns of

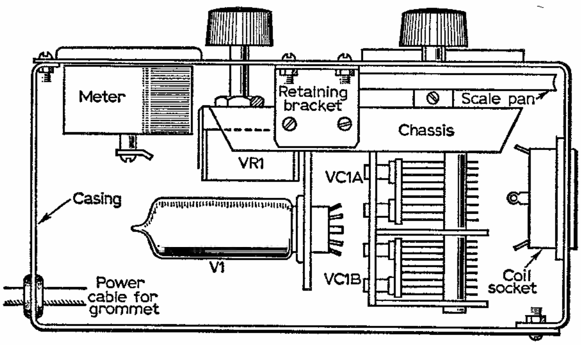


Fig. 4: General layout of main components.

enamelled copper wire should be wound up and plugged in to the g.d.o. Power is then applied and VR1 adjusted to give a meter reading of approximately half scale deflection. If the coil turns are now gripped firmly between a finger and thumb the meter reading should decrease, thus indicating that the device is functioning. The g.d.o. may then be switched off and the sample coil removed for subsequent amendment.

A total of seven coils are needed, plus a loop or hairpin coil, and while details relating to each range are given in Table I, in another construction variations are likely. This is of no importance, the main requirement being to obtain overlapping coverage from range to range.

TABLE I

Coil	Turns	Spacing	S.W.G.*	Range in Mc/s
L1	76	Close	30	1·75—3·50
L2	40	„	24	2·80—5·50
L3	28	„	24	5·0 —9·0
L4	12	Wire dia	24	8·50—16·5
L5	5	„	24	16·0—32·0
L6	2½	„	20	31·0—60·0
L7	1¼	„	20	45·0—80·0
L8	Loop	—	20	70·0—150·0

*enamelled copper wire.

Note: L8 consists of a hairpin loop ½in. long wired across the pins 1 and 5 of a octal valve bases of the type used in metal valves; type 6H6, 6SH7, etc.

The "cut and try" coil winding method adopted was first to wind a former full of 30 s.w.g. enamelled copper wire and then remove turns experimentally using the g.d.o. and a wavemeter which was adjusted to 1·75Mc/s, the vanes of VC1 in the g.d.o. being fully enmeshed. Immediately the signal due to the g.d.o. was detected, the turns left on the coil were counted and these were found to number 76.

This coil was then made L1 and, with the vanes of VC1 opened, a check was made with the wavemeter to find the high frequency point. For L2 slightly over half the number of turns used for L1 were wound on. The wavemeter was then set slightly l.f. of the highest frequency reading found with L1 and VC1 readjusted to full capacitance.

Again a few turns were removed until the wavemeter gave an indication whereupon VC1 was reset to the opposite end of its travel to find the high frequency point for the coil. This procedure was adopted until all coils showed overlapping frequency characteristics although as yet no actual calibration had been attempted. Windings were then sealed and doped.

If no wavemeter exists, a communications receiver could be employed or the oddment of circuitry shown in Fig. 5 used in conjunction with a signal generator. Here, socket SK1 is the generator output socket and *L* is a coil of some eight turns of

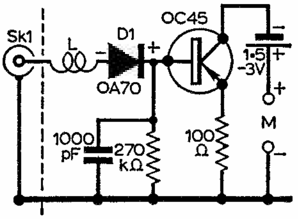


Fig. 5: How a signal generator may be utilised for coil checking in conjunction with an additional oddment of circuitry.

enamelled copper wire about 1in. in diameter. A meter with a full scale sensitivity of around 1mA is connected at the *M* terminals or the workshop testmeter suitably adjusted may be used.

If the g.d.o. coil is brought close to *L* the current reading due to the signal generator and seen on the meter connected to terminals *M* will increase. Immediately the g.d.o. is tuned to the same frequency as the signal generator a violent kick will be indicated by the pointer of the externally connected meter.

Calibration

Before attempting calibration, the perspex cursor plate and the scale should receive attention along the lines shown in Figs. 6a,b. The perspex cannot be placed in position until calibration has been completed so care must be taken to ensure that the line scribed on it agrees exactly with that drawn on the card scale.

A piece of stiff white card is then placed across the g.d.o. scale cut-outs and fixed with sellotape in such a way that one edge occupies the position later to be taken by the scribed line.

Using a pin-sharp pencil point, calibration marks are made lightly on the scale, the final marks being filled in later in Indian ink with a mapping pen. Calibration up to 30 Mc/s is easily accomplished using a communications receiver and cross checking with a crystal marker. The signal generator method previously mentioned may also be employed with rather less accuracy perhaps but may be necessary in any case for the highest frequency ranges. Any crystals that are around can also be made use of, as may MSF and other similar transmissions.

★ components list

Resistors:
R1 47kΩ
R2 22kΩ 1 watt
VR1 2kΩ potentiometer

Capacitors:
C1 100pF silver mica
C2 100pF silver mica
C3 1000pF ceramic
C4 1000pF ceramic
VC1 2 x 75pF (see text)

Valve:
V1 6C4

Meter:
0-500μA miniature plastic-type panel meter.

Miscellaneous:
Tuning drum 2¾in. diameter, closed circuit jack socket, B7G valve holder, preferably ceramic, I.O. valve holder, Control knobs (2), 3-core mains type lead, On/off toggle or slide switch—250V d.c., oddment perspex, wire for coils, bases for coils (see text), 16s.w.g. aluminium, paxolin or plastic tubing, etc.

Extras to include P.S.U. item:
Miniature transformer—mains a.c. input. Secondaries: 0-200V at 25mA, 6·3V at 1A. Half-wave rectifier, Electrix contact cooled type 250V d.c. at 50mA. Miniature tubular electrolytic, 16 + 16μF, 275V wkg. One 1500Ω resistor, 1 watt.

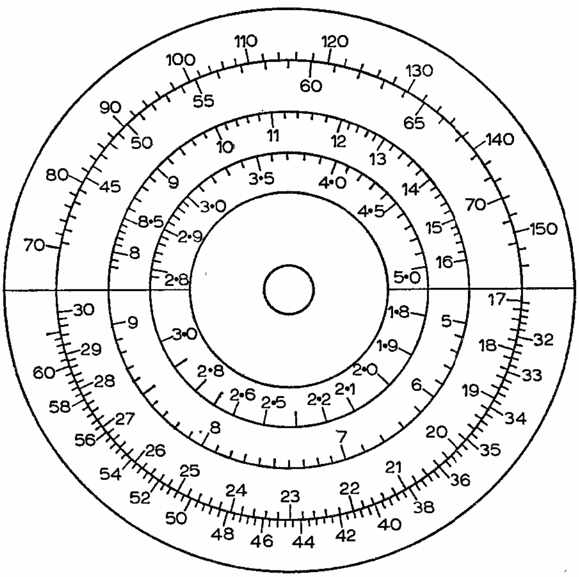


Fig. 6a (above): The calibrated scale. Note that the low frequency scaling is close to the shaft whilst the outside compartments are reserved for the higher frequencies. This scale must not be taken literally; it is merely a guide, and in any case the rotors of the tuning capacitor used were capable of a 360° movement!

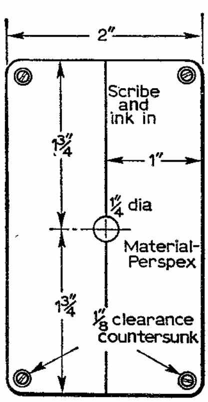


Fig. 6b (left): Dimensions of the perspex cursor.

Finalising the Unit

If a self-contained unit is required, the circuitry and components of Fig. 7 may be inserted, these being placed inside the casing beneath the meter. The sides are easily filled in using expanded metal speaker fret, the edges of which are folded to give increased strength. The casing may then be lacquered or spray painted to taste, after which suitable legends may be applied, preferably through

—continued on page 189

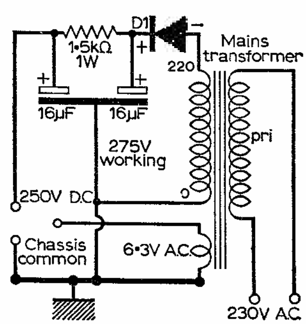
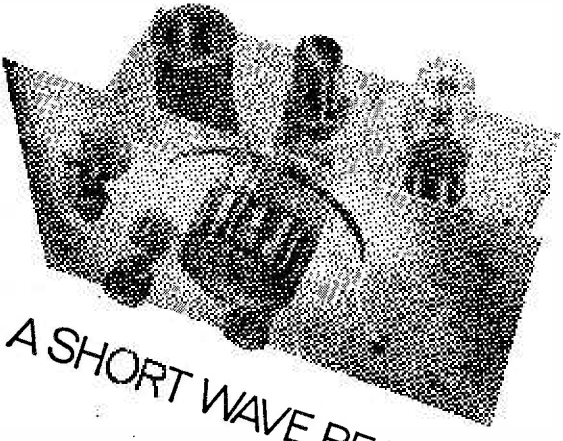


Fig. 7: A suitable power circuit that can be included if required.



A SHORT WAVE RECEIVER FOR THE YOUNG CONSTRUCTOR

for the BEGINNER

BY H. WEBSTER

THIS simple short wave receiver has been designed specifically for the young and relatively inexperienced constructor. The author has memories of his own schoolboy experiences, which in retrospect appeared to consist of recurrent financial crisis which more often than not coincided with an item of more than particular interest in these pages! His own interest in amateur radio was sparked off by the description, in an extremely early edition of *"Practical Wireless"*, by an article entitled "The Solo Knob Three". As its name implies, the receiver controls were compounded into a single knob! Although the present day reader may smile at this description, the receiver certainly met with an enthusiastic reception. Unfortunately, due to the then relatively high cost of components, the author's receiver never quite got off the stocks!

Bearing these nostalgic recollections in mind, the author has endeavoured to keep the cost of the receiver described in this article down to an absolute minimum. Although the simplest materials have been employed, the performance of the finished receiver is extremely pleasing.

The total building cost of the receiver is roughly £4 to £5.

Circuit Description

The circuit diagram of the receiver is given in Fig. 1. For the benefit of the young reader a fuller description than usual is given of the functions of the various components employed in the circuit. V1, which is a 6SH7 pentode, functions as a grid leak detector. The coil, L2, in conjunction with the tuning capacitor, VC2, constitutes the tuned circuit. Radio frequency energy from the aerial is fed via VC1 to the coupling coil, L1, which is inductively coupled to L2.

The purpose of the variable capacitor, VC1, in the aerial lead, is to enable the aerial coupling to be varied. At the same time it helps in the elimination of dead spots. These so called dead spots are caused when the aerial absorbs energy from the tuned circuit. When this occurs, regeneration, on which the leaky grid detector is dependent for its sensitivity, is difficult to obtain. Regeneration is obtained by feeding back energy in the correct phase to the grid circuit—an example, incidentally, of positive feedback. The magnitude of this effect depends chiefly on the size of L3 and C2, the proximity of L3 to L2, and the gain of V1. In the receiver the gain of V1 and hence the degree of feedback, is controlled by varying the screen voltage by means of the potentiometer VR1.

After rectification the signal is fed via C6 to the volume control, VR2, and then on to the grid of

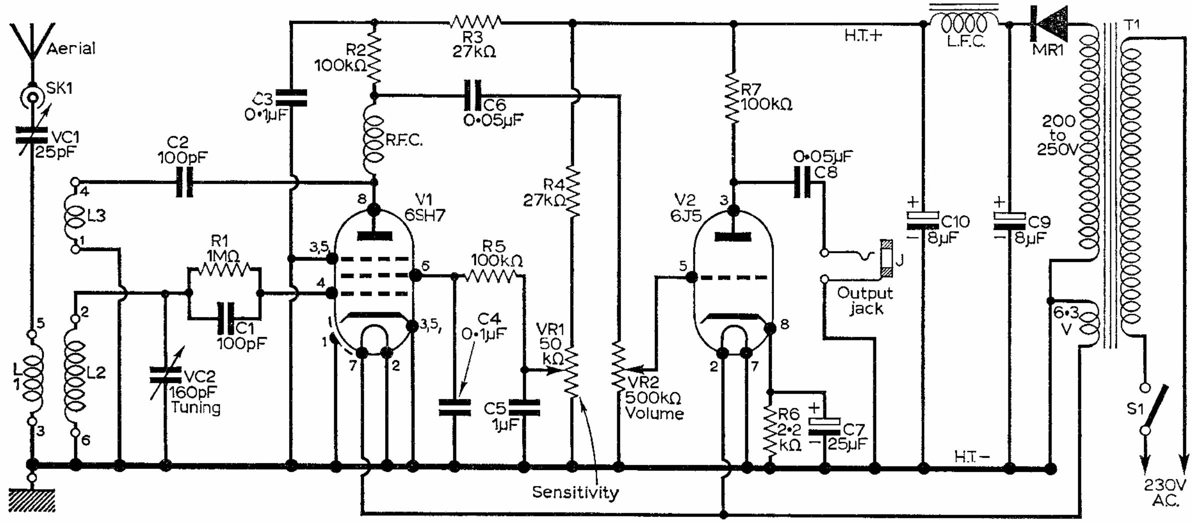
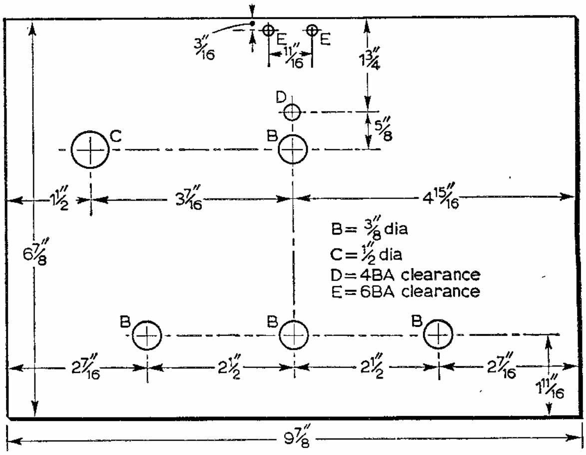
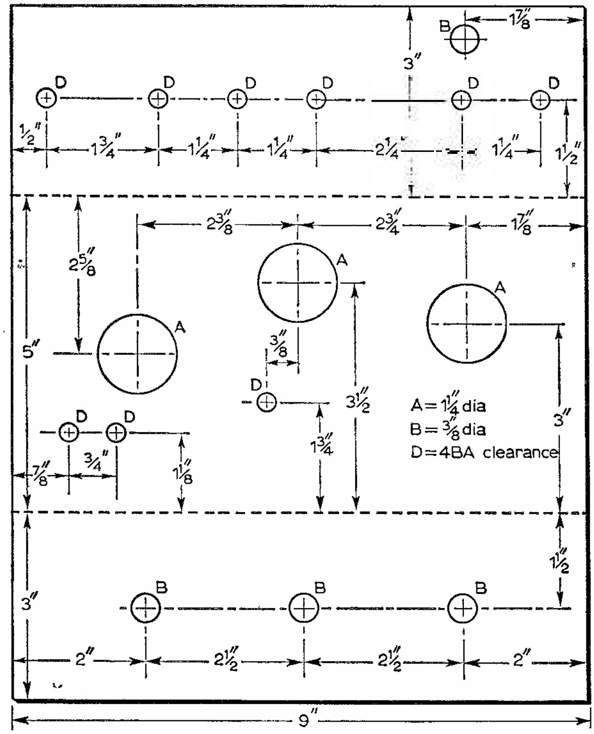


Fig. 1: Circuit diagram of complete receiver and power pack.

Fig. 2 (right): Drilling dimensions for chassis (shown folded flat for clarity).

Fig. 3 (below): Drilling dimensions for panel.





V2 which is a medium impedance triode. The amplified signal developed across the V2 anode load resistor, R7, is fed to the high resistance headphones via the coupling capacitor, C8.

Power supplies for the receiver are derived from a simple half wave rectifier circuit. Since the current demand is quite modest, a midget type of mains transformer may be used. Complete wiring details of this unit are given in Fig. 8.

Construction

The prototype was constructed on a 9 x 5 x 3in. universal chassis. The front panel is a nominal 10 x 7in. chassis top plate from the same chassis range. The main drilling dimensions for the chassis and panel are given in Figs. 2 and 3. Note that the panel drilling details are only applicable to the specified dial. When the valve holders are mounted make sure they are orientated correctly as shown in Figs. 4 and 5. Similarly ensure that the 6 pin coil holder is mounted with pins 1 and 4 pointing to the rear of the chassis. The correct mounting of VC1 on the front panel is of some importance. It will be seen in Fig. 3 that the mounting hole for VC1 is larger than that required for VC2. This is to enable VC1 to be mounted so that it is insulated from the panel. Two fibre washers are used for this purpose, one on each side of the panel as shown in Fig. 4. If this precaution is neglected, no signals will be obtained, since the aerial input will be effectively shorted to earth via the rotor shaft of VC1.

Although wiring of the receiver is quite straightforward a few tips concerning wiring techniques are given to help the absolute tiro. For successful soldering a really hot iron is essential and each soldering operation should be conducted as quickly as possible. Where-ever possible keep the leads short and stiff to minimise the effects of vibration. Of course don't carry this to extremes and cut the component leads too short, or damage to the component may result during the soldering operation. As an example of the correct technique to adopt, consider the wiring of the 7 way tag strip at the rear of the chassis. It will be seen that R2, R3 and C3 are soldered to one tag as shown in Fig. 6. Do not solder each component separately to the tag, instead thread the three leads through the tag hole and solder all three simultaneously. As a guide, the lead lengths of R2

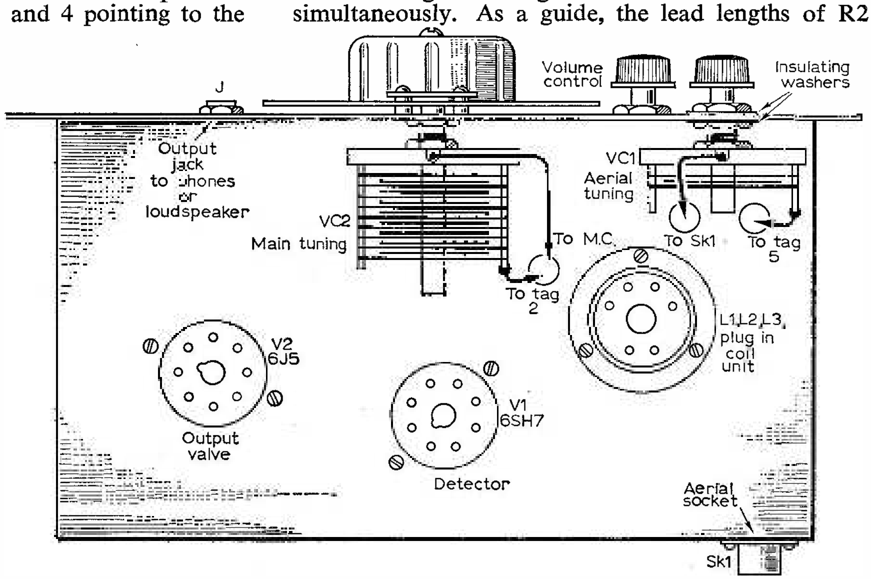


Fig. 4; Layout of components on top of chassis.

and R3 can conveniently be about ¾ to 1 in. Although the method may appear obvious it is surprising how many constructors make a multi soldered joint (no pun intended!) out of such an operation. The general outcome is an unsightly blob of solder. The same remarks apply to all joints where two or more wires are joined to the same tag.

When soldering the electrolytic capacitors C5 and C7 into circuit ensure that the correct polarity is observed. This type of capacitor is generally marked at the positive end, either with a red spot or a + symbol.

The radio frequency choke in the anode circuit of V1 is connected at one end to tag 4 of the V2 valveholder. This tag is merely used as an anchorage point since V2 has no internal connection to pin 4.

Coil Winding

The receiver covers the h.f. band 2—30Mc/s in three ranges. The coils are wound on Eddystone 6 pin formers as shown in Fig. 7. The required number of turns for each range is given in the table. Begin by winding on L2, and in the case of range 1 ensure that sufficient space is left at the top of the former for the aerial coupling winding L1. When winding the coils, keep the wire reasonably taut on the former so that the resulting coil is rigid. A sloppy winding will result in poor frequency stability. Take care that the reaction winding, L3, is wound in the correct sense as shown in Fig. 7. On ranges 2 and 3 the aerial coupling coil is interwound at the earthy end of L 2.

Before winding any of the coils work out the approximate space occupied by each winding and then drill the holes in the former so that when the wire is subsequently threaded through the holes it takes the shortest possible path to the pins. Avoid any criss crossing of wires inside the former.

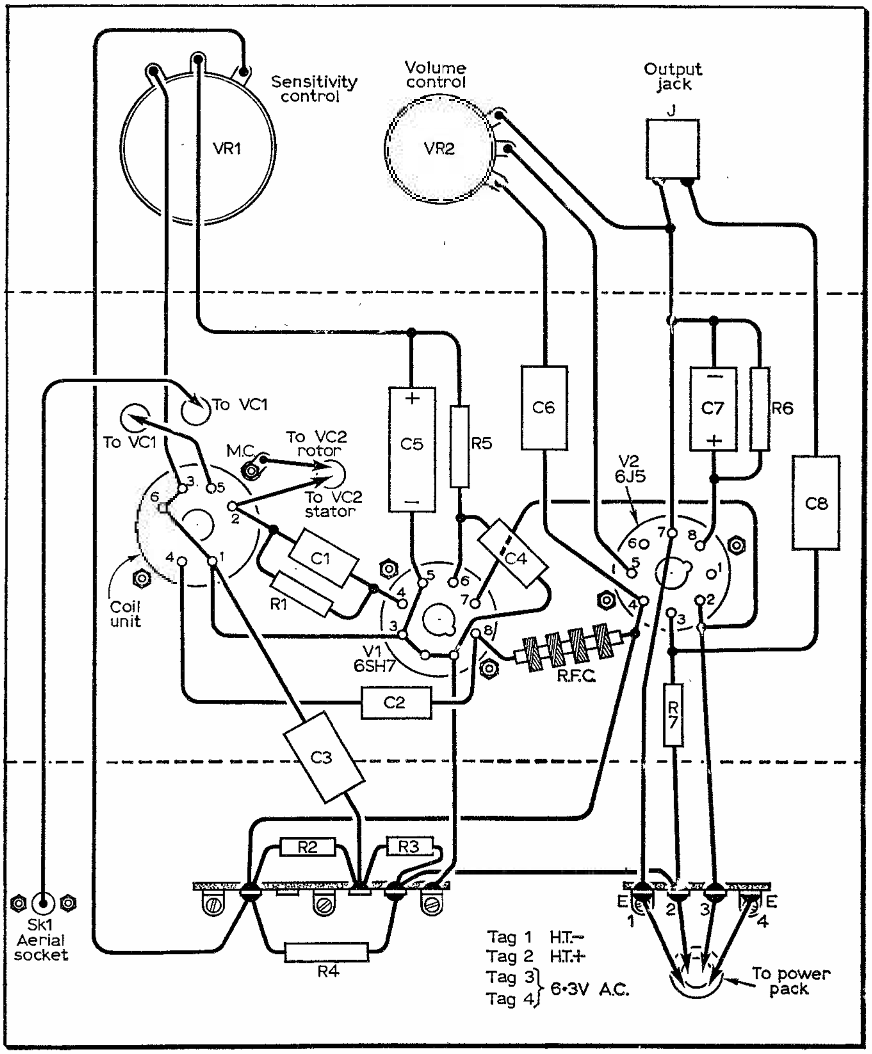
Power Pack

This unit is built on a 4 x 3 x 2in. deep aluminium chassis as shown in Fig. 8. The mains transformer should be an upright mounting type delivering about 200-250 volts at 20-30mA and 6·3 volts at 1 ampere. A small midget choke used in conjunction with C9 and C10 ensures a hum-free d.c. output. The metal rectifier is of the half wave type. Almost any type is suitable, provided that it is rated at 250 volts and is capable of passing a few milliamps. The wiring details given in Fig. 8 are self explanatory.

Testing

When the receiver has been completed a few simple tests should be carried out prior to connecting the receiver to the mains supply.

If the constructor has access to a meter the



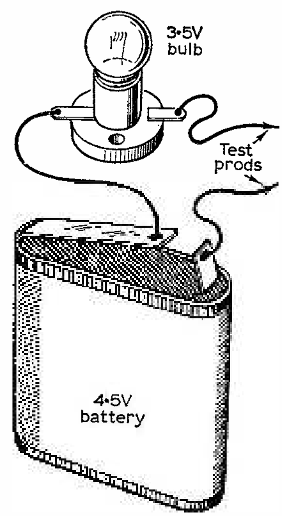


Fig. 6: Simple continuity test.

Fig. 5 left: Wiring of receiver, below chassis.

★ components list

Resistors:

R1	1MΩ	R3, R4	27kΩ
R2, R5, R7	100kΩ	R6	2·2kΩ

All 10% ½W

Potentiometers:

VR1	50kΩ wire wound
VR2	500kΩ carbon, log.

Capacitors:

C1, C2	100pF silver mica
C6, C8	0·05μF tubular 350V
C3, C4	0·1μF tubular 350V
C5	1μF electrolytic 350V
C7	25μF electrolytic 25V
VC1	25pF Wavemaster
VC2	160pF Wavemaster

Valves:

V1 6SH7, 6AC7 V2 6J5, 6C5

Miscellaneous:

Coil former, plain, type 537, Stratton. Coil formers, threaded, type 538, Stratton (2 required). Coil holder, 6 pin, type 964, Stratton. International octal valve holders (2). Tag strips, 7 way (1), 4 way (1). Aluminium chassis, universal type (Home Radio), 9 x 5 x 3in. Aluminium panel, 10 x 7in. Dial drive (Jackson 4489). Jack socket (Bulgin). Jack plug (Bulgin). Headphones (high resistance type). R.F. choke, type 737 (Stratton). Transformer, 200/250V, 40/50mA, 6·3V 1A, R.C.S., Croydon. Smoothing choke, 10H, 30mA. 8+8μF electrolytic capacitor (C9, C10) 450VW. Metal rectifier, 250V, 40/50mA. Screws, wire, etc.

resistance between HT+ and the earth line of the receiver should be measured. It should be roughly 75kΩ. Also check the heater circuit. The valves must not be fitted for this test as their heater elements are of low resistance and thus, leaks will not show up. If no meter is available a few rough and ready tests may be carried out with a 3·5 volt flashlamp bulb and a 4·5 volt battery as follows.

Connect the lamp and battery in series across the receiver HT+ line and earth as shown in Fig. 6. If all is in order the lamp will remain unlit. Naturally this test will only show up a dead short or a resistance of a few ohms. The same test may also be applied across the heater leads. If the lamp lights up in either of these tests it is imperative that steps are taken to find out the cause of the short circuit.

The power pack may also be tested in a similar manner by connecting the tester across the HT+ and HT− leads. If these tests are satisfactory the receiver may now be put into operation. Plug in the range 2 coil (on which there is a good deal of activity) and the two valves. The headphones are plugged into the jack socket at the front of the panel.

Connect the power leads to the appropriate terminals on the power pack, connect the mains supply, and the valve heaters should light up almost immediately. A slight background noise should also be heard in the phones. Advance VR2 to maximum and then slowly advance the regeneration control from its minimum position until the receiver is just on the verge of oscillation. Tuning may now be done with VC2. The constructor will find that the position of the regeneration control will not remain constant over any given frequency band but will require adjustment from time to time. Always work with the regeneration control set so that the receiver is just on the verge of oscillation. The receiver is then in its most sensitive condition. ■

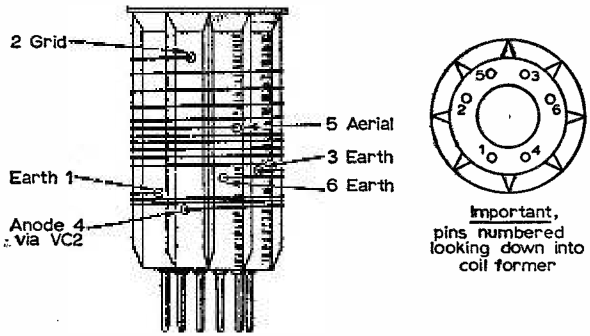


Fig. 7; Method of coil winding and table of data.

Range	L1	L2	L3
2·0/5Mc/s.	6t close wound *	40t close wound 26 s.w.g. enamelled	5t close wound spaced $\frac{3}{16}$in. from L2
5·0/12·0Mc/s	3t interwound at earthy end of L2	15t wound 14 t.p.i. 18 s.w.g.	1½t close wound spaced ⅛in. from L2
12/30Mc/s	2½t interwound at earthy end of L2	4t wound 14 t.p.i. 18 s.w.g.	23t close wound spaced $\frac{3}{16}$in. from L2

* This coil wound on Eddystone plain former type 537. L1 wound at aerial end of L2 and spaced ⅛in. from L2.

Remaining coils wound on Eddystone threaded former type 538.

L1 and L3 on all coils wound with 26 s.w.g. enamelled wire.

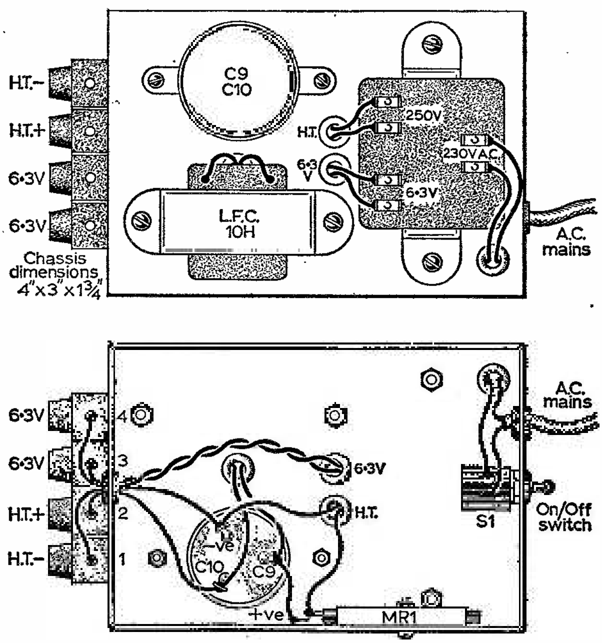


Fig. 8: Construction of power pack.

ELECTROSTATIC RECORDING

K. T. WILSON

SINCE every magnetic effect has an electrostatic counterpart, it is rather surprising that electrostatic recording has been so neglected, compared to magnetic recording. Indeed, it is only recently that serious attempts have been made to develop the techniques and to devise a theory of the recording mechanism.

In conventional magnetic recording, we use a magnetic tape and record by modulating the current through an electromagnet, the recording head. In electrostatic recording, we use a dielectric tape and modulate the voltage on an electrode.

In magnetic recording, we can eliminate to a very great extent the effect of the nonlinear shape of the magnetisation characteristic of the tape by high-frequency bias; and a similar effect is found with electrostatic recording.

In both systems, the high-frequency response is dependent on the construction of the recording heads, but the electrostatic system has advantages at the low-frequency end of the scale.

A typical electrostatic recording system is shown in Fig. 1. The tape is drawn between two knife-

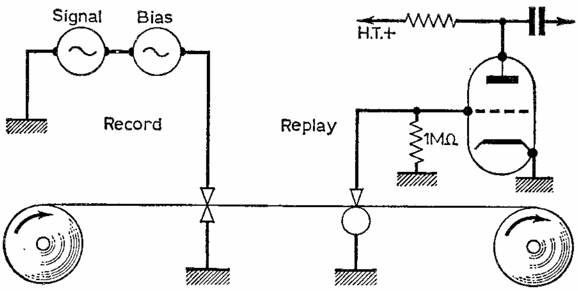


Fig. 1: Typical electrostatic recording system.

edges, one earthed and the other connected to the signal and the bias source in series. The bias is of the order of 100 volts at 350 kc/s.

For replay, the tape is again drawn past a knife-edge, this time connected to an amplifier. The output is considerable by magnetic recording standards, some 40 mV for an input resistance of one MΩ.

Even with such a crude system, and using d.c. bias instead of the a.c. bias system shown, quite reasonable results are obtainable, certainly better than can be obtained with magnetic recording using a permanent magnet bias system. D.C. bias should be about 1kV, and a circuit of a suitable system is shown in Fig. 2.

The frequency response of this system is rather restricted, however, and for a more ambitious

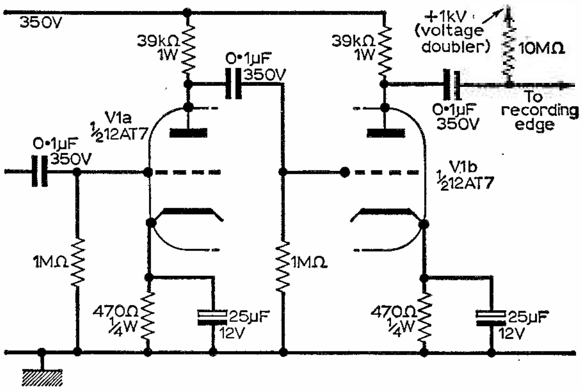


Fig. 2: Simple electrostatic circuit using d.c. bias.

system, a.c. bias must be used, preferably with the refinement of shielded heads.

The construction of heads for electrostatic recorders is very much easier than the corresponding task for magnetic recorders, and much remains to be discovered about the best way of making such a head.

For the simple system, the best possible electrodes are razor-blades; there are few sharper edges available to anyone. Many of the modern stainless-steel razor-blades are coated with p.t.f.e. (Polytetrafluoroethylene), a plastic with excellent insulation properties, and they can be used to construct a more advanced type of head, the sandwich type shown in Fig. 3, which will give a frequency response second to none.

This head consists of three blades clamped together, the inner one being insulated from the outside two. The signal is fed to the inner blade and the outer two are either earthed or connected to a separate bias supply (in which latter case no bias in series with the signal is needed). When the outer blades are connected to earth, they act as shields to prevent the charge spreading on the tape, and hence the high-frequency response is improved.

The use of the two shield electrodes to carry

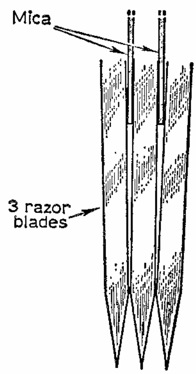


Fig. 3: Electrostatic head made from razor-blades.

the bias supply is a very recent innovation, and is almost an exact electrostatic equivalent of the "cross-field head" for magnetic tape recorders. The cross-field head, invented in the United States and used on several professional-quality tape recorders, the Japanese Akai models in particular.

The use of the shields greatly increases the capacity of the head, and a suitable driving circuit must be used. A cathode-follower is not wholly suitable; the capacity of the head is so high that the cathode-follower ceases to follow on negative-going signals due to the valve cutting off.

This could be overcome by using a power valve and having a very high standing current. Another, better, method is to use the circuit sometimes referred to as the "super cathode - follower", shown in Fig. 4. Since one of the two valves must be driven on at any given time, irrespective of the polarity of the input signal, the output impedance remains low at all times.

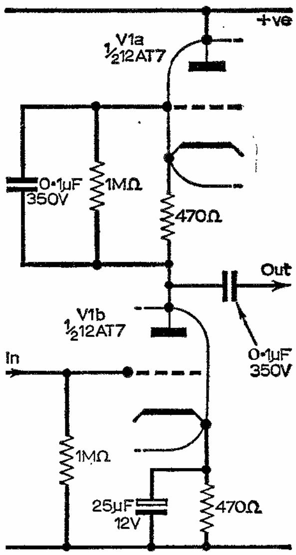


Fig. 4: Super cathode-follower.

The shielded head should not be used for replay, as the high capacity causes a considerable loss of signal at high frequencies.

Some notes on the construction of the shielded head may be of interest. Some selection of razor-blades may be necessary to find three which will not short to one another when glued together. If the blades available have a poor coating, a very thin mica shim may be used as a spacer at the blade end in addition to those used further up.

Mica sheet is very readily split into very thin portions, and with some practice, shims of 0·0001in. can be produced. The best technique of producing such shims is to use a sharp needle to split a piece of good-quality mica at one edge. A drop of water should then be run down the needle into the split.

The water will spread between the natural layers of the mica and assist in the splitting operation. The use of water in this way also helps to prevent trouble caused by the needle crossing between layers. The mica sheets should be gently slid apart when the needle has been passed between them all over the area of the sheet.

The mica shims should be well dried before use, as they tend to retain water. The mica used must be clean and fresh; mica from an old electric iron element is useless, as it is brittle and cannot be worked readily.

The contacts to the blade should be soldered on before assembly. Stainless steel is difficult to solder, and a very hot iron is essential. The outer blades are connected together, and the inner is kept separate; remember to check the insulation between outer and inner after assembly.

The glue used should be good quality polystyrene cement, although "Araldite" is more suitable if the blades can be kept in a suitable clamp while the adhesive sets.

Any normal tape drive from a magnetic recorder is suitable but the tape must press only very lightly against the blades, for obvious reasons. Uncoated tape is available from any manufacturer of magnetic tape (to special order) or from British Visqueen Ltd. (Acetate tape) or Dupont (Mylar tape).

Some recent work has indicated that the permanence of the recordings can be improved by neutralising the excess charge on the tape by passing it through a "bath" of positive ions. This is done by creating a corona discharge near the tape after it has passed the recording head, although other methods such as a radioactive source can be used.

A needle held in a block of rubber and connected by suitable e.h.t. cable to a power supply (such as the e.h.t. generator of a TV set; an old set can be bought for far less than the price of building an e.h.t. supply) of at least 10kV will give a sufficiently brisk corona for this purpose. ■

GRID DIP OSCILLATOR

—continued from page 181

the medium of transfers. Finally, the pencilled calibration marks may be erased and the perspex fixed with PK screws.

Uses of the G.D.O.

The uses of these devices are already well known but, briefly, the unit may be used for setting up the tuned stages in either transmitters or receivers, etc., without even having to switch them on! The g.d.o. is merely brought close to the circuit being checked and carefully tuned until a sharp current dip is noted on the meter.

If no dip occurs, the coil in use is the incorrect one or inadequate coupling is taking place. Immediately a dip is noted, the g.d.o. is withdrawn and carefully retuned until only the merest detection of dip is possible. The scale is then read.

As a signal generator the unit may be placed close to the aerial lead of a receiver and if a modulated signal is required, the output from an audio generator may be injected at J1 and will be heard when the receiver is suitably tuned. Harmonics of the signal generated by the g.d.o. will also be tuneable and can also be made use of if required.

The g.d.o. may also prove useful for making c.w. or s.s.b. transmissions intelligible on a receiver not fitted with a b.f.o. No physical connection between receiver and g.d.o. is necessary to do this. Nor is modulation required: the g.d.o. is tuned close to the frequency of the signal sought and front-end injection results.

The g.d.o. may also be used to check the resonance points of aerials. Removing the h.t. supply to the g.d.o. as mentioned earlier enables the device to be used as a 'phone monitor or as an absorption wavemeter or r.f. indicator. In these cases radiated radio frequency is detected.

In conclusion it can be fairly stated that this g.d.o. is well worth the trouble entailed in its construction; it will, quite definitely prove an attractive addition to many stations. ■

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequences in kc/s

THE BROADCAST BANDS by JOHN GUTTRIDGE

Albania: *Radio Tirana* (Rue Ismail Quemal, Tirana) has been reported with English at 0000—0030 on 7,265; 0230—0300 9,520; 0630—0700, 2000, 2200—2230 7,265/9,390. One report says the 2000 TX is on 7,150.

Algeria: *Radiodiffusion-Television Algerienne* (21 Boulevard des Martyrs, Algiers) has English from 2200—2230 over 890/1,304/6,175. Arabic is now being carried in the afternoons over 9,510.

Brazil: *Radio Bandeirantes* (Casillon Postale 372, Sao Paulo) is reported drifting around 11,917.

Colombia: *Voz Bogota* (Aereo 13018, Bogota) has been heard at 0045 on HJCF (5,960).

Clandestine: *Radio Espana Independente* can be heard between 1600—1700 on 17,695 in Spanish. Some reports say this station is located in Rumania. Has anyone any further details?

Congo: *Radiodiffusion Ufac* (Boite Postale 97, Elisabethville) has moved to a new frequency of 5,033.

Czechoslovakia has, according to the International Short Wave Club, stopped jamming. Countries still engaged in jamming and to whom the club's anti-jamming campaign applies are Bulgaria, China, German Democratic Republic, and the U.S.S.R. occasional jamming by Hungary, Portugal and Spain.

Holland: *Nederlansche Radio Unie* (P.O. Box 150, Hilversum) is reported to have started a new home service transmission, Hilversum III on 1,250.

Radio Nederland Wereldomroep (P.O. Box 222, Hilversum) has produced an English-Spanish DX vocabulary to assist Dx'ers listening and reporting to South American stations. It is obtainable free on writing, as is the printed material for the latest Dutch by Radio course. Lessons are broadcast during English transmissions on Wednesdays. The English beam to West Africa from the Bonaire relay in the 19 m.b. is now at 2130—2220. The European relay of the 1430—1520 and 1900—1950 English transmissions is now on 6,020. The 2000—2050 English transmission is now aired in the 25, 31 and 49 m.b. and the 2100—2150 English transmission is in the 19 and 25 m.b.

Monaco: *Trans World Radio* (Rue de la Poste 5, P.O. Box 141, Monte Carlo) is now using 5,955 for its 1145—1215 French transmission. There is bad interference with Radio Liberty which also uses the same channel.

Peru: *Radio Cuzco* (Montero 114, Cuzco) has been heard at 0015 on the new frequency of 6,250.

Poland: *Radio Warsaw* (Warsaw) has made frequency changes in the following English transmissions 1930—2000 1,502/5,995/6,135/7,125; 2230—2300 1,502/5,995/7,270; 2303—2330 818. The multilingual concert programmes at 1500—1630 and 2330—0100 are now on 1,502/5,995 and 1,502/7,125/7,270 respectively.

Portugal: *Radio Portugal* (Rua do Quelhas 2, Lisbon) has made frequency changes in the following transmissions: 0730—0900 21,495/17,740 or 17,880 or 17,890 or 17,895; 2015—2100 6,025/7,285; 0300—0345 5,985; 0400—0445 6,025/6,185.

Rumania: *Radio Bucharest* (P.O. Box 111, Bucharest) gives date and frequency details on its QSL. The 1500—1530 English transmission beamed to Asia is now on 15,250.

Switzerland: Swiss Broadcasting Corporation (CH 3000, Bern 16). has reintroduced its evening English transmission for the U.K. It is from 1845—2015 on 9,665/7,110. The morning transmission from 1145—1315 remains on 9,665/11,865. Other English transmissions affected by recent schedule changes are 0115—0245 6,120/9,535/11,715/11,775; 0415—0545 9,535/11,715/11,775; 0700—0830 9,595/11,775; 0845—1015 15,305/15,430/17,830; 1330—1500 11,855/15,305/15,395/17,830; 1515—1645 11,880/15,255/15,305/17,830.

Uruguay: *Radio Sarandi* (Corporacion de Publicidad SA, Enriqueta Compte y Rique 1282, Montevideo) has been heard over CXA68 11,885 around 2215. Identifies "Noticia Radio Sarandi" every quarter hour.

U.S.S.R.: *Radio Vilnius* (Lietuvas TSR Radijas, ul Kanarskio 49, Vilnius) broadcasts in English on Mondays and Fridays at 2100 on 665/1,106/1,554 and 2230 on 665/1,106/1,554/5,900/7,200/7,400. The North American English service of Radio Moscow is relayed daily from 2300—2330 over 7,185/7,300.

Venezuela: *Radio Juventud* (Apartment 567y 576, Barquisemeto) can be heard around 2230 over YVNK, 4,900. *Ondas Populares* (Apartmentado 2057, Caracas) can be heard at 0035 over YVKF, 4,880. *Radio Cultura* (Apartmentado 1931, Caracas) can be heard around 0030 on YVKD 5,050. *Radio Nacional* (P.O. Box 3979, Caracas) can be heard on YVSC, 9,640 at 2400.

Reporters this month were D. Kennedy, D. A. Lavender, Middlesbrough High School S.W. Club, B. Burling, D. Mines, G. Roberts, and G. Lamb.

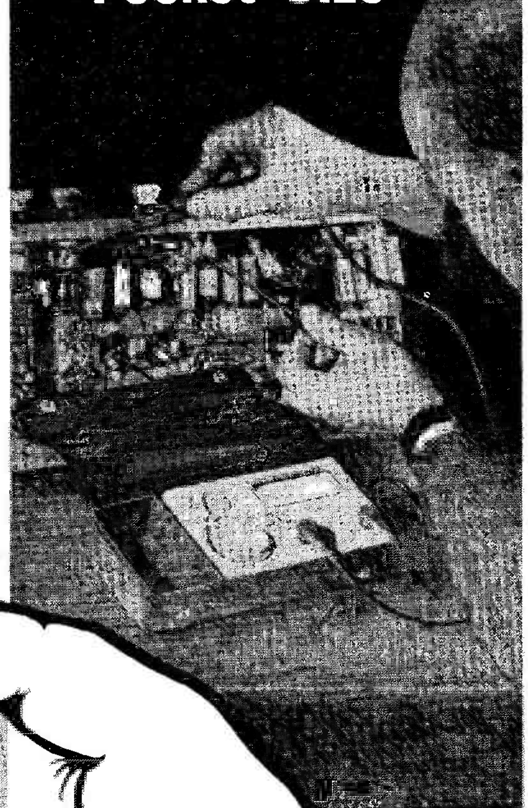
AVO MULTIMINOR *Mk4*

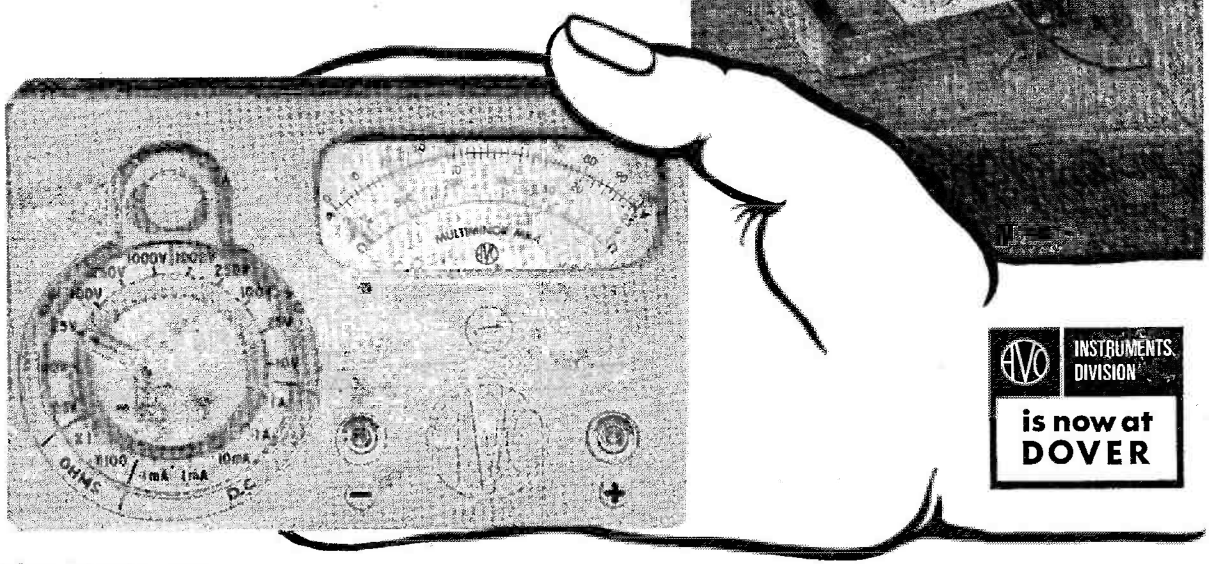
Inexpensive
Easy-to-use
Pocket Size

The Avo Multiminor Mk4 is the latest version of this well-proven multi-range measuring instrument. Designed and assembled to high standards of reliability, the Avo Multiminor offers simple yet instant range selection with a single rotary switch. There is only one pair of sockets for all measurements, and the scale plate is clearly marked for easy reading.

Accuracy is within the limits laid down in B.S.S. 89/1954 for up to 3¼″ scale length industrial portable instruments.

Panclimatic construction enables the Multiminor to be used in all types of climatic conditions. The instrument is supplied in an attractive black carrying case, complete with interchangeable test prods and clips, and a multi-language instruction booklet.





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MM 19

A PATCHY period for the Amateur Bands this month, with conditions varying quite a bit at times. All the top band sleuths appear to have hung up their trusty headphones in spite of the DX still popping up on this band. Even a simple t.r.f. raked in GM, GW, and quite a few Europeans and these with only 20 to 30ft. of 32 s.w.g. enam. wire for an aerial.

At the other end of the spectrum the 10 metre band has stirred a bit more and was open for some eight consecutive days. In a couple of years I prophesy this band will hold more DX than 20, and most probably on phone too. Just ask anybody who remembers the last sunspot max. on ten.

Fourteen and 21 megs. still provide most of the more exotic stuff. Twenty metres at the time of writing, wakes around 0800 and still has activity at midnight. Fifteen metres usually peaks between 1400 and 2000, though it's always worth a listen just in case.

Eighty and 40 don't have such a good following. Most people who listened reported G's and EU's with some W activity between 3·8 and 4·0Mc/s. The DX is comparatively easy on 20 and 15 but just try the l.f. bands and see how you really rate as an SWL.

Low Frequencies

No reports for 1·8Mc/s this month (one minute's silence please with heads reverently bowed). Eighty not much better. **Francis Breame** (Liphook) 19 set, 50ft. l.w. reports numerous G's, DJ, DL etc., **J. Hutchison** (Blackpool), CR100, PR30, a.t.u. 40ft. l.w. also reports most of Europe including DJ, DL, EA4, ON, OZ, VO1DN, VE1AOL. On 7Mc/s **L. Jackson** (Manchester) R1155B, 120ft. l.w. logged LZ2KLC, KP4TIN, K3MTK, K3UKZ, UF6LA, VE1OU, VP7NQ, W1ZW, W2LXK, WA4NXC, all c.w. between 0025 and 0235. **E. Goonan** (Manchester) 19 set, 50ft. end fed, heard most of Europe on 7Mc/s, including a W1 calling "CQ 10." (Yes, I wonder, too !) the best for the session was CR4AB on c.w.

Fourteen and Twenty-One

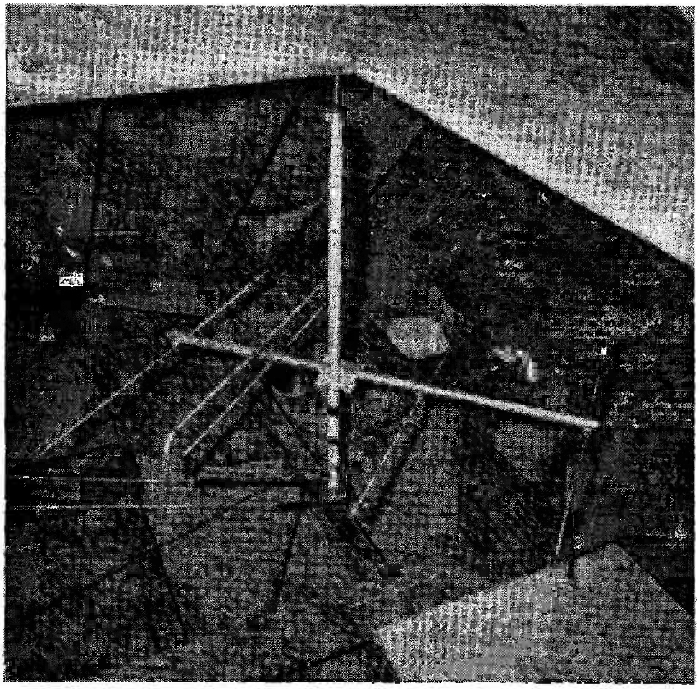
All sorts of gear pulling in all sorts of stations, those two bands are a hive of activity. If you only hear Europe on these bands—take up knitting! And as I cast off the last row of a jumper, let's see what the "sharp of ear" have been up to. **Chis Claydon** (Fife) 84OC, 60ft. end fed, 20 metres—CE3UT, CO6PH, CP5AQ, EA8EY, HC2SB, HK7UL, HP1BR, K7UW, KZ5LC, LU8O1, OA4NVE, TI2PZ, VE5US, VE6AAA, VK3AHQ, VK5TG, VP9FX, 6Y5AR. 15 metres—EA9AD, FL8MC, HM1DR, JA- 1LPZ, 2HO, 3EGE, 4BJO, 6TL, 9AMJ, KICAU/KG6 (Guam) PY7AC/Ø, UAØLL, VK2EO, VK6RU, VP7NN, VS6FK (Hong Kong), VU2FN (India), VU2GC, YN6BF (Nicaragua ZS3XG, 6O6BW, 6W8DD, 9L1HL, 9M2BM, **Dave Skidmore** (Belper) HE4O, 20 metre dipole, 20 Metres—CN8MD 58, CR6CN 56, EA6AR 59, EP2AX 58, HR1SO 59, HS1AK/P 58, IS1VAZ 59, KP4AST 58, KR6UL 57, KX6BQ 56, LA3JM/P 59, MP4BFU, OHØNJ 59, OX3LP 59, OD5EE 58, OY7S 44, TF3UA 57, UA9EU 58, VE1AED/SU 57, VE1ADL 58, VP7NA 58, VP9BN 58, XW8AZ 58, YN1RA 58, ZB2AO 59, ZD8J 57, ZS1TZ 58, W5HWR/VP9 58, 4X4FQ 58, 5AITS 59, 5A3TB 59, 5A5TJ 59. On 15 metres Chris heard CN8FF 59, CX5AAN 57, HK8DQ 58, IT1GAI 59, KH6FBG/3 58, KP4MXN/MM 58, KV4CX 59, LU8AEF 57, PY1PAD 58, PY2AHM 58, SV1BH 59, YV5BPJ 58, 7X2AH 59, 9Q5DA 57. The two numbers after each call are the standard RST code to give an indication of how these signals are arriving at the earphones. In the log for 15 which follows the G calls logged are DX! The receiver is a 1950 Pye radiogram, the aerial is 50ft. end fed, and the QTH is South Africa—CR6HH, CR7IZ, DJ8WP, G30AW, G3SMH, G8WPP, I1BVZ, IT1JR, K2LBB, MP4BBA, W8HRV, W9MOD, VK6QL, ZE1BP, 5N2FEL, 5R8AL, 7Q7LC, 9Q5WO. Tnx **P. Elliott** for the report. **Steve Wilson** (Ossett) CR45 t.r.f., 130ft. l.w., reckons twenty is bursting, he reports good sigs from—BV1USA, CR6UL, CR7IZ, CR9AM, EA8AM, EP2AX, ET3USA, HS1AK, JA1SBF/MM, JA5CC, JA6BEE, KR6QW, LA2IK/P (Jan Meyen Is), MP4BCC, OA4RQ, OD5LX, PJ2ME, PY's, PZ1K, SVØWJ (Crete), SV1CC, T12MY, UAØKAE, VR4CN, 4X4QI, 5A1TZ, 9K2AM, 9J1AB, 9M4LP. Not bad for a t.r.f.? Wait till you see the 15 metre log—CM1AR, CN8MI, CR4BB, CR6FE, CX9AAN, ET3USA, FS7RT, EA8ER, G3BID/CN/M, HK2AG, KP4BFF, KV4CK, KZ5SN, MP4BBA, OD5EL, PZ1BE, PY2AIR, FG7XX, SV1AB, SVØWJ, WA4PXP, WA5KKM, WN2TIB, YV7AJ, ZC4GB, ZE8JV, ZS1FT, ZS5AK, ZS6MM, 4X4QW, 5A1TZ, 5A3CAA, 5N2AAF, 5R8CR, 6W8DD, 6O6BW (Somalia Rep.), 9H1AD, 9J2IE, 9G1FL. Anthony Watts (Tenbury Wells), 9J21E, 9G1FL.

Ten Metres

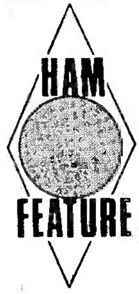
Paul Baker again, reports CF7FR, F9DL, many G's, LU2ADP, W's, ZC4TX, ZS1BV. **Chis Claydon,** too heard ZC4TX, ZS6AAC, ZS6DF, 7Q7RM, 9Q5LG, 9V1LP. **C. Clarke** (Farnham), 12 valve hombrew plus panoramic adaptor, folded ground plane, logged CE3PT, CN8MI, CR4BC, CR6AN, CR7IZ, ZE—2JA, 2JE, 3JO, 8JJ, ZP5KT, ZS—1BV, JA, JH, 2OM, 4OI, 4PU, 6AYI, 6DK, 5A3TX, 5H3JJ, 5X5JK, 7Q7RM, 9J2—DT, RO, VX, WR, 9Q5—HD, JW.

Next Month

VR6TC (Pitcairn) 15 metres is around but takes a bit of catching. VK9GN is in New Guinea with the Wycliffe Bible Translators. He runs 150w. c.w. to a ground plane. (We know he's real too—Chris Claydon has a QSL from him). VK9PL (Papua) has been coming through in UK at 5 and 9 plus on 15 metres. Congrats to G3DYY for winning the fourth RSGB 7Mc/s DX Contest with a score of 2,342 points on c.w. Congrats for winning the phone section to GI3CDF who notched up 2,350 points. Contests for June include 4—5th National Field Day, 19th D. F. Qualifying Event, July 3. Fourth 144Mc/s Contest (portables). Deadline for this month's logs is June 26.



A VHF BEAM ROTATOR FOR THE LOFT



ALAN J. TURNER
G3UFP

ONE great advantage of the v.h.f. bands is that aerials are small yet highly directional and efficient. To make best use of these aerials it is desirable that they be made fully rotatable so that they can be turned to increase the strength of the station being received or to eliminate unwanted signals.

However, if the aerials are placed on an outside mast they become difficult to rotate as a fairly powerful motor is required and the mast must be strong and well guyed, all of which adds considerably to the expense.

In order to keep down the cost while retaining the facility of rotation, the author decided to place the aerial in the loft. Although the signal strength is reduced, no new mast is required and a simple rotator suffices.

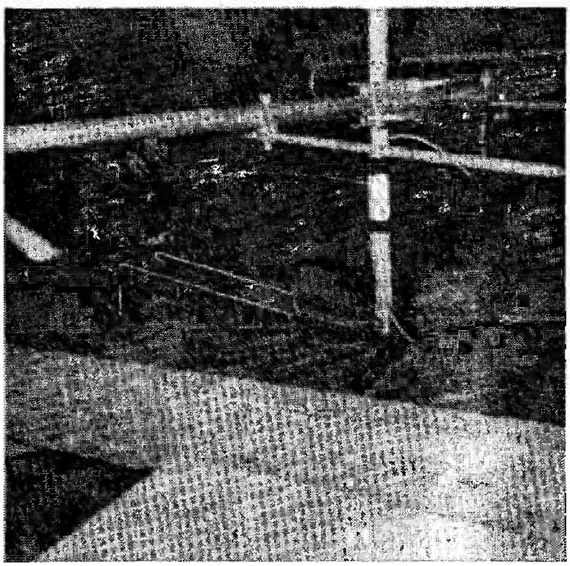
The first attempts at a system for use in the loft were not very successful. Several motors were tried, which either failed to turn the beam or turned it too fast. Power supplies also had to be found for the low voltage d.c. types. As no indication of the beam's direction could be simply obtained, the idea of a motor-driven system was abandoned in favour of the system described.

No motor is employed, the beam being turned by a single continuous belt which passes through two $\frac{1}{8}$in. dia. holes in the ceiling. The advantages of this system, beside minimal cost, are variable speed so that the beam may be quickly turned and yet accurately set, and simplicity in indicating the beam's direction.

The beam is supported on a 1in. dia. wooden pole sold as a broomstick, between two convenient joists. The bearings at both ends consist of pieces of $\frac{1}{4}$in. dia. brass or steel rod. These are drilled and countersunk (see Fig. 1), and set in the joists.

The other part is formed by $\frac{1}{4}$in. rod ground to a point. This is set firmly in the broomstick by drilling $\frac{1}{4}$in. holes in the ends and making two cuts at right angles to enable the wood to be squeezed on to the rod with a Jubilee clip (see Fig. 2).

A bicycle fixed-wheel sprocket is fitted to the $\frac{1}{4}$in. rod and this is driven by a chain attached to the belt. This is the only difficult part of the job, the part which calls for ingenuity on the part of the individual constructor, as the sprocket must be fixed concentrically to the $\frac{1}{4}$in. spindle. The problem is that the size of the hole in the sprocket is much larger being $1\frac{3}{8}$in. diameter.



Close-up of author's two-metre rotating aerial.

The best solution is to have a suitable adaptor made, but there are many small engineering firms who will undertake such work. However, the author was able to improvise a connector using an old loudspeaker magnet.

This was just the right size to fit the flange on the sprocket and the polepiece drilled to accept a ¼in. shaft. The shaft was threaded and two nuts used to clamp the magnet. This is shown in Fig. 3, and Fig. 4 shows a suitable connector to have made up.

No doubt other possibilities will occur to readers but the solution offered, although crude, works perfectly. A different type of cog could be used provided it can be positively driven and this would eliminate the problem.

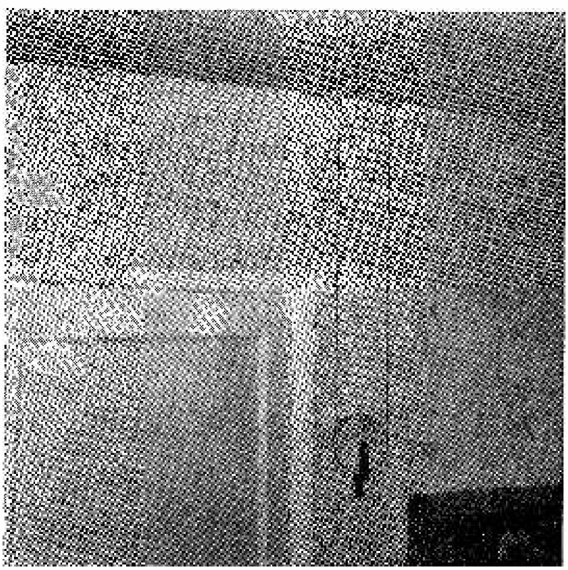
Two small pulleys are supported above the holes in the ceiling by a board between the joists, for the belt to run over (see Fig. 5).

In the shack, the belt runs around a large drum of the type used as a slow-motion drive cord drum. A large one is required to enable the beam to be swung through 360 degrees. The author's is 4½in. dia. This is fixed to the wall by a suitable bracket (see Fig. 6). The scale indicating direction is fixed to the drum.

The belt is best made of nylon cord of the type used for curtains, as this has great strength and will not stretch. The overall length of the belt should be kept as short as possible. If a long length is required in the loft it will be necessary to use extra pulleys to prevent the chain slipping off the cog.

A large spring is incorporated to keep the belt tight. This is best placed between the chain and belt as it then provides a convenient way of shortening the belt by hooking it on another link of the chain.

The author has used this arrangement to turn a four-element beam for two metres. This it does easily and could obviously turn a larger array if required, the maximum size being governed most of all by the space available in the loft. ■



Part of pulley which projects beneath the ceiling.

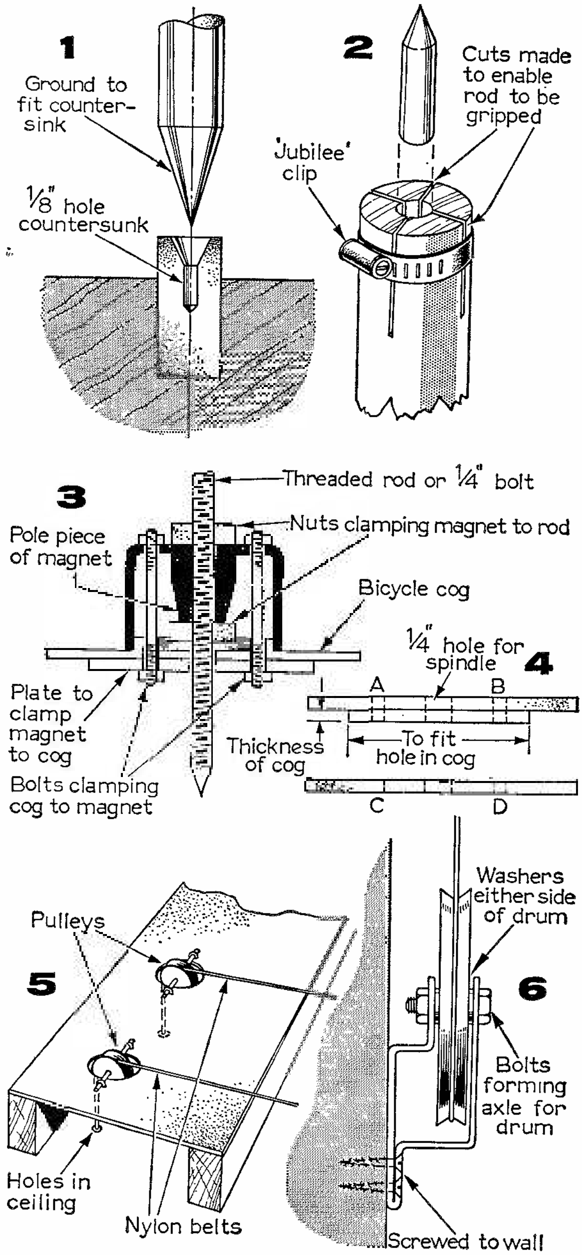


Fig. 1: The fixing ends for the centre rod which carries the full weight of the aerial.

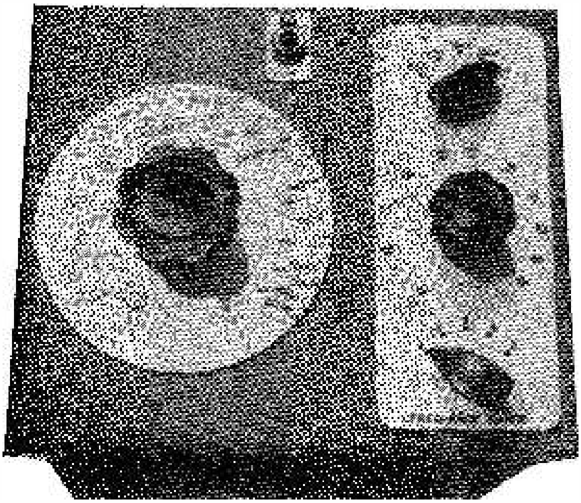
Fig. 2: A method of securing the brass or steel rods to the ends of the centre rod.

Fig. 3: Author's method of fitting the sprocket to the metal rod at the lower end of the centre rod.

Fig. 4: Enlarged view of the clamping plates for the sprocket.

Fig. 5: Two pulleys attached to a sheet of hardboard for guiding the Nylon belts through the ceiling.

Fig. 6: Lower pulley, showing the fixing arrangements.



WIDE RA

BY R. LEYLAND

WITH its five ranges, this transistorised oscillator tunes from 5c/s to 75kc/s by variation of the resistances and capacitances of a Wien network. This form of tuning has insufficient selectivity for the suppression of distortion unless the amplitude is closely controlled, and this function is taken over by a sensitive thermistor which maintains a constant amplitude and the maximum output is at a level of 1 volt r.m.s. independent of frequency.

Scales

Linear potentiometers if incorporated for the fine tuning produce a crowding of readings at the high frequency end of the scales and the tuning becomes correspondingly more critical in setting. This is satisfactorily overcome through obtaining ganged potentiometers wound to an inverse semi-log characteristic, and the result is an approach to an ideal frequency scale on which octaves are represented by nearly equal distances along the scale.

A simple form of transparent cursor is employed on the tuning dial, its straight edge serving as a ruler for initially marking in the frequency divisions, and subsequently as an indicating-line sweeping the five scales, but a hair-line cursor could easily be substituted if preferred. Two limit positions are first marked on the dial, which is temporarily secured in place with a few spots of adhesive, and act as reference points for aligning the cursor when the knob is being refitted.

The cursor is fastened on the knob by a 1in. aluminium disc countersunk for the three 8BA screws, and there is a thin washer underneath, on the $\frac{1}{4}$in. shaft, preventing contact with the dial. The small clearance between the cursor and dial avoids scratches and does not introduce any appreciable parallax in readings.

After calibration in pencil, the dial is removed for inking-in, and is covered with a clear plastic material. Then it is replaced and cemented permanently in position. Small countersunk screws could be used instead, but if any of the paint situated beneath the dial is affected by the adhesive, it can be scraped off and more adhesive successfully applied.

The dial and escutcheons are of aluminium to which drawing paper is bonded with adhesive; the circles, etc., for the scales having first been inscribed with Indian ink. On completion of the scales, some preliminary experiment is advisable before proceeding to cover the dial with the clear plastic. A clear adhesive is spread thinly with a circular motion and allowed to become almost dry before pressing the plastic material down on top.

Circuit Description

The oscillator circuit uses p-n-p transistors throughout and consists of a feedback loop around transistors Tr1 to Tr4. The fifth transistor Tr5,

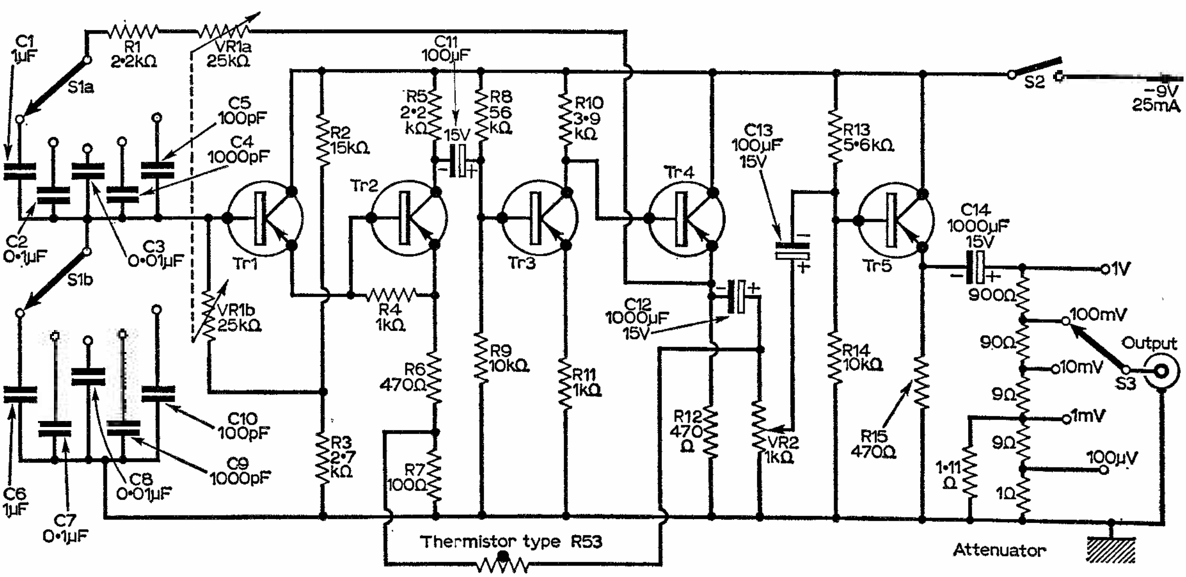


Fig. 1: Theoretical diagram of the audio oscillator.

NGE A.F. OSCILLATOR

an extra stage to feed the step attenuator, increases the total battery current to 25mA at 9 volts. The circuit works on battery voltages up to 12 volts, at which the current is about 35mA. When the voltage falls as low as 6 volts there is a tendency towards distortion.

Oscillation is at the frequency of zero phase shift in the Wien network, which delivers one-third of its input votage to the base of Tr1. However, the actual input to Tr1 and Tr2 is reduced by feedback via thermistor type R53. The thermistor keeps the output across VR2 close to 1 volt r.m.s. by controlling the amount of negative feedback. Any excess of output above 1 volt r.m.s. is transferred by the thermistor to R7 where it becomes negative feedback to reduce the input to the amplifier.

Although power-actuated, the thermistor is effectively a voltage-controlled resistance with a gradual response to changes in the r.m.s. value, and it takes over the task of keeping the output at a constant level. Its response, too slow to cause distortion even at the lowest frequencies, cannot cope immediately with transients such as that caused by switching on, and it therefore takes a moment or two to settle down.

Direct current is kept out of the thermistor by feeding it from the output side of C12. The emitter of Tr4 is also a low-impedance driving point for the Wien network and is able to preserve a constant a.f. voltage across it, despite large changes of network impedance with tuning as the ganged potentiometers are varied between their minimum and maximum value. High values of capacitance for C12 and C14 provide a low coupling impedance down to subsonic frequency, but except for C11 the positive feedback loop is direct-coupled, and C11 feeding the high input impedance of Tr3 need not be so high in value.

To avoid loading the Wien network, the amplifier has a very high input impedance, produced by the emitter-follower, Tr1, which feeds Tr2, which also has its input impedance raised by the emitter resistor R6. The bias resistors R2 and R3 are in

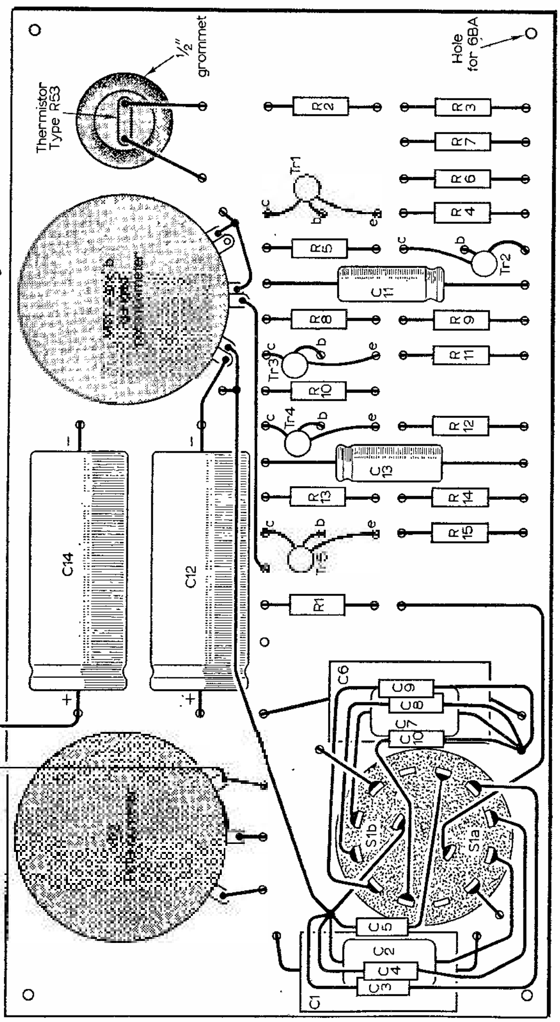


Fig. 2: Oscillator chassis (lower side).

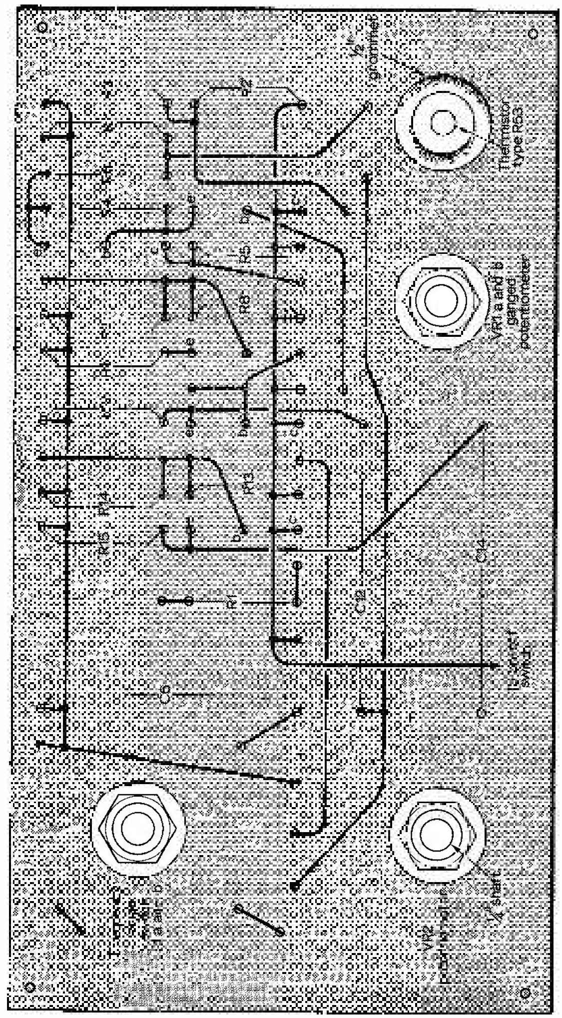


Fig. 3: Oscillator chassis (upper side).

effect part of VR1b and do not shunt the input impedance of the transistor stages. An adequate current in Tr1 is ensured by an emitter resistor R4. This cannot be omitted altogether, but in the more usual arrangements R4 would have a much higher value and would be connected to the +ve line instead of to the emitter of Tr2. It works quite well as shown however, with high gain transistors.

The amplifying stages Tr2 and Tr3 have negative feedback applied locally by the emitter resistors. There is also the overall negative feedback via the thermistor, which is cancelled out at one frequency by positive feedback from the Wien network. The amplification is adequate to maintain the stabilised output up to about 80kc/s on range 5 at which point oscillation ceases. A small capacitor across R11 would maintain the oscillation right up to the end of the scale on range 5, but this shifts the calibration, and it seems undesirable to impair the performance in order to extend the coverage above 80kc/s in an oscillator that is intended primarily for audio frequencies.

Tr4, an emitter-follower output stage, must have the full signal-handling capacity, so it is biased to midway between zero and the -9V supply line, and as it has a low emitter load resistance, it will take a current of some 10mA. A further output stage, Tr5, is included to feed the switched attenuator without appreciable loading on VR2.

Attenuator

Accurate attenuation is less important than that it should be independent of frequency, because in measurements on the gain of amplifiers, it is probably better to rely upon an a.f. voltmeter of the thermionic or transistor type, with its own multi-range facilities.

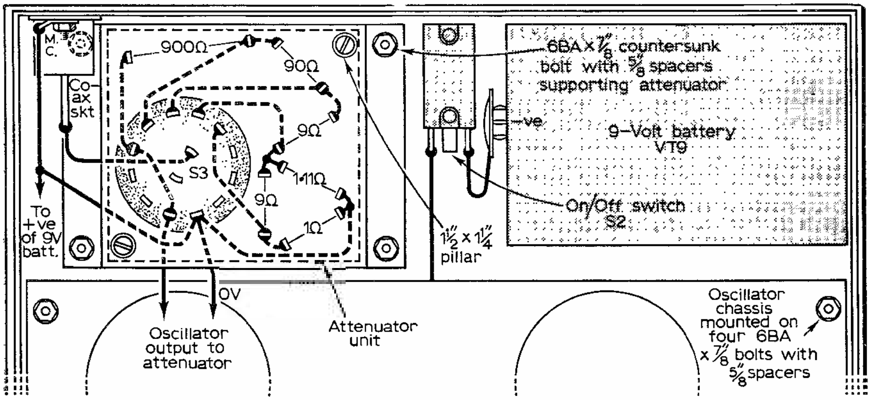


Fig. 4: Interior view of attenuator and battery compartment.

The continuously variable attenuaton of VR2 can be calibrated at 50c/s using a rectifier voltmeter of fairly high impedance, and does not appear to be quite linear. The rectifier voltmeter was carefully checked against an accurate moving iron type supplied from a transformer, using low resistance potential dividers to obtain smaller voltages.

For larger attenuations there are fixed steps. Ideally the step attenuator should possess a constant output impedance, so that the insertion loss on connecting a load remains the same at every step. The impedance should be unaffected by the output transistor, which must therefore offer low output impedance. However, it is equally possible to utilise a very high output impedance, which is available at the collector.

Instead of a constant impedance, the attenuator shown in the oscillator circuit, Fig. 1, has a low impedance, about 80Ω at the 100mV step and less at the other steps. At the 1V position of the attenuator, loads of resistance less than 1kΩ should not be connected if distortion is to be minimised,

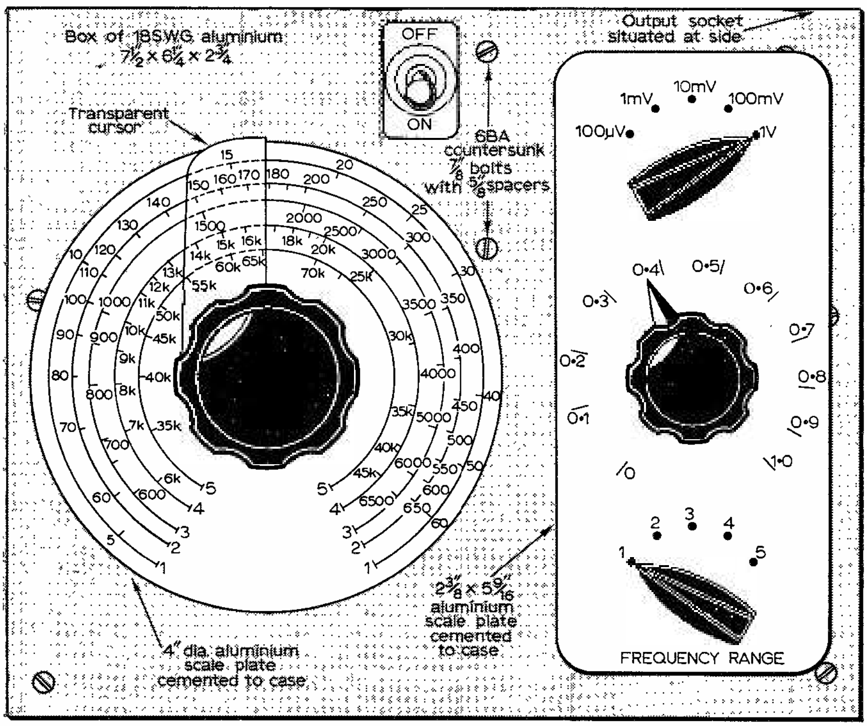


Fig. 5: View showing the front panel layout.

but at the other attenuator steps, any value of load can be connected.

The low resistance attenuator elements had to be constructed by winding them on cards. These are of 0·024in s.r.b.p. sheet, which can be cut with scissors, and the edges are smoothed with emery cloth. The resistances, of the non-inductive type, are made by winding two wires simultaneously in opposite directions on the card, exchanging the bobbins between hands at each half turn. The card is mounted vertically, and connections are made as in Fig. 8. One resistance wire is adjusted to twice the resistance value. Then the other is connected and adjusted to give the correct value. One of the resistors has the value 1·11Ω, which in parallel with 10Ω yields a value of 1Ω.

To protect them against damage, a box of insulating material is fitted over the resistances, and fixed to pillars with 6BA screws. The entire attenuator is constructed as a separate unit from the oscillator chassis, although mounted beside it. Data for the wire-wound resistances is as follows:

Resistance	Wire (Constantan)	Lengths	Card Size
1Ω	30 s.w.g. d.s.c.	Two 36cm.	1 x ⅝ x 0·024in.
1·1Ω	30 s.w.g. d.s.c.	Two 38cm.	1 x 11/16 x 0·024in.
9Ω	38 s.w.g. d.s.c.	Two 74cm.	1 x 11/16 x 0·024in.
90Ω	44 s.w.g. d.s.c.	Two 2m.	1 x ⅞ x 0·024in.
900Ω	47 s.w.g. d.s.c.	Two 8·5m.	1¼ x 1⅜ x 0·024in.

An appreciable amount of work is involved in the construction and adjustment of these resistances, and a very adequate alternative form of attenuator can be made as in Fig. 7, using high stability resistors of 5% tolerance. These are made in preferred values, and the values selected give the attenuator a constant output impedance of approximately 95Ω with the same attenuation ratios as before—i.e., 10:1. Altering the voltage across a load impedance by a factor of 10 alters the power by a factor of 100 (or 20 db), so these can also be described as 20 db steps.

Construction

The oscillator chassis consists of a piece of 7¼ x 3¾ x 1/16in. paxolin, suitably drilled to take push-fit eyelets, and the case is made from 18 s.w.g. aluminium.

The larger capacitors are secured on the chassis by soldering their leads into eyelets. Smaller capacitors, mounted around the miniature wavechange switch S1 are connected to two junction points formed by soldering short pieces of wire vertically into eyelets. (See Fig. 2). Interconnections on the reverse side of the oscillator chassis only require sleeving where they cross as shown in Fig. 3.

The oscillator chassis is mounted on ⅝in. spacers with 6BA countersunk bolts, ⅞in. long, through the top of the metal case. Shakeproof washers are placed under the 6BA nuts on the chassis. The attenuator is mounted in the same way.

★ components list

Resistors:

R1	2·2kΩ	R8	56kΩ
R2	15kΩ	R9	10kΩ
R3	2·7kΩ	R10	3·9kΩ
R4	1kΩ	R11	1kΩ
R5	2·2kΩ	R12	470Ω
R6	470Ω	R13	5·6kΩ
R7	100Ω	R14	10kΩ

Capacitors:

C1 1μF 125V polyester
C2 0·1μF 125V polyester
C3 0·01μF 125V polyester
C4 1000pF tubular ceramic
C5 100pF tubular ceramic
C6 1μF 125V polyester
C7 0·1μF 125V polyester
C8 0·01μF 125V polyester
C9 1000pF tubular ceramic
C10 100pF tubular ceramic
C11 100μF 15V electrolytic
C12 1000μF 15V electrolytic
C13 100μF 15V electrolytic
C14 1000μF 15V electrolytic

Transistors:

Tr1-Tr5 OC45 Mullard

Miscellaneous

Thermistor type R53 (S.T.C.)
VR1 25kΩ dual-ganged potentiometer, both sections inverse semi-log. Reliance type TW.
VR2 1kΩ non-inductive potentiometer. Reliance type TW.
S1, S3 2 pole, 2 way rotary switch.
S2 On/off toggle switch. Flush coaxial socket.

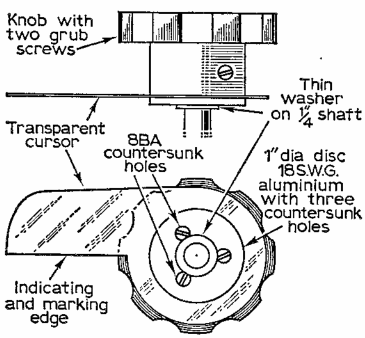


Fig. 6: The tuning knob and cursor.

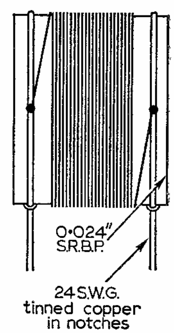


Fig. 7: Wirewound attenuator resistance.

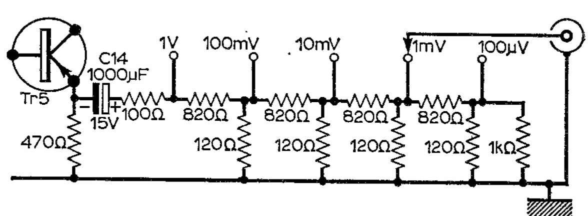


Fig. 8: Alternative form of attenuator.

Frequency calibration of the oscillator by using an oscilloscope is greatly facilitated by temporarily setting up an auxiliary oscillator. Next month details will be given of a special form of auxiliary oscillator which produces an elliptical trace.

Ex Service Equipment

No doubt many readers will have experienced difficulty and sometimes frustration in trying to undo nuts and screws fitted to this equipment. These parts are usually varnished around the nuts and screw ends and it is almost impossible to remove them in the normal manner without breakage.

It has been suggested that a hot soldering iron applied to the nut will do the trick, but this method is clumsy and not entirely satisfactory.

The best way I have found is to dissolve the varnish by applying a little cellulose thinners, and after a few minutes, the nuts can be easily removed with a suitable box spanner. Moreover, they can be used again and there is no risk of damage to any components that one wishes to salvage.

F. B. Poppitt.

Bearsden,
Dunbartonshire.

Single Circuit Panels

Mr. R. G. Young's letter in the June issue of Practical Wireless referred to my article "Single Circuit Panels" and asks why I assume that copper cladding has to be used.

I do not. The idea of using wire for panels of similar purpose was fully described in my article "Bread-board Wiring" published in the January 1965 issue.

W. Groome.

Halesowen,
Worcestershire.

Add-on B.F.O.

I have just fitted an "Add-on BFO" as described in your October 1965 issue to my transistor set (Lasky's Radio Skyrover with extra audio stage). I found that in order for the circuit to operate correctly, it was necessary to wire a 0·01μF capacitor across the 10kΩ, R1 resistor.

M. J. Draycott.

Hitchin,
Hertfordshire.

Anyone a Genius

With reference to the letter from Mr. Wright in last month's Practical Wireless I have an idea which may perhaps interest this gentleman and other readers.

I also became interested in the "fuzz box", but did not really take to the idea of distortion. I found that instead of this a relatively high frequency tremolo unit gave a similar effect.

The transistor tremolo is simply a pre-amplifier with its source of power fed from a multivibrator circuit at 5-15c/s. This uses discharge capacitors of about 2μF. If these were decreased to say 0·5μF-1μF and the rest of the circuit correspondingly a suitable frequency would be obtained.

M. Gilbert.

Crayke,
York.

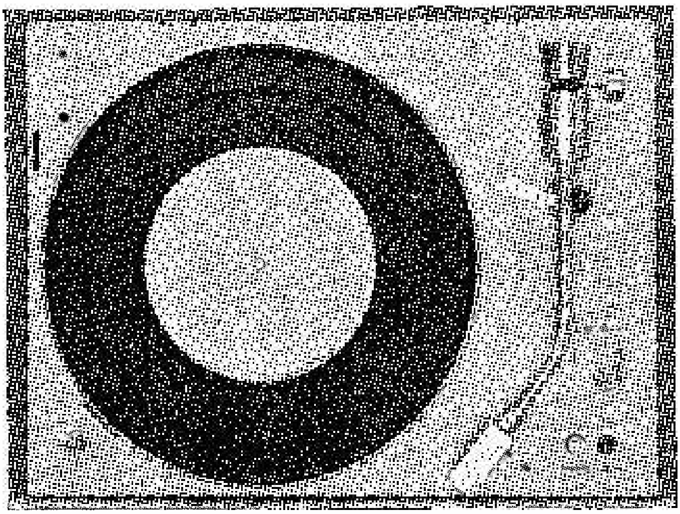
NEWS AND..

U.S. SHOWCASE IN BRITAIN

The American stand at the Instruments Electronics and Automation Show, just ended at Olympia, London, represented the biggest ever export promotion undertaken by the United States' electronics industry in Britain. The stand was also the largest single display at the exhibition, showing products from some 72 of America's leading manufacturers in the field.

America's space programme has given her electronics and computer industries fresh impetus during recent years and many of the exhibits illustrated the commercial and industrial applications which have resulted from equipment and techniques developed during space research.

GERMAN HI-FI EQUIPMENT



The turntable shown above, complete with stereo pick-up, is made by the German firm of Braun A. G. and costs £187. It is part of Braun's new Studio 1000 range of hi-fi equipment, which also includes tuner unit (£338), stereo control amplifier (£345) and speaker system (£523).

All these units have been designed and manufactured to the highest standards to achieve faithful sound reproduction. The tuner (CE 1000) and the amplifier (CSV 1000) are both transistorised. The tuner covers l.w., m.w., s.w. and f.m. and incorporates switchable a.f.c. which is automatically turned off when the hand touches the separate f.m. tuning knob. There is also a built-in tuning meter.

The control amplifier, which includes a separate preamplifier within the same cabinet, provides 55W per channel continuous output with distortion below 0·3% at 1kc/s. There are more than the normal number of controls and the five inputs feature variable sensitivity.

The L 1000 speaker system was designed to meet standards set by the German Institute for Radio Technology. In one enclosure Braun house three woofers, eight mid-range speakers and two tweeters.

The turntable (PS 1000) operates on four speeds although a fine-speed control permits exact settings, helped by a built-in stroboscope. The pick-up arm is balanced by two adjustable counterweights and turntable shut-off is achieved by a photo-electric device.

Fi-Cord International are the U.K. agents for all Braun equipment which, by the way, includes many more moderately priced hi-fi units.

RADIO SOCIETIES AMALGAMATE

On June 1st, the South London Mobile Club, Wimbledon and District Radio Society and the Purley and District Radio Club merged to form a new association. Hon. Secretary of the new Southern Amateur Radio Association is B. Negri, G3LXN.

...COMMENT

PHILIPS' SUPER-PORTABLE

Philips recently unveiled some 30 new products—radios, radiograms, television receivers and record players—at a trade fair in Brighton, Sussex. As with each of these categories, radios on show ranged from the economy class to high quality; from the "Popmaster" pocket portable at £7 19s. 6d., to the FM-AM De Luxe at...... well, first see what you get.

It covers seven bands; l.w., m.w., four s.w. and f.m., plus an extended long wave band which permits reception of beacon transmitters, weather forecasts and time signals and trawler band coverage which picks up marine broadcasts. Adjustable a.g.c. on s.w. and a.f.c. on f.m. improves reception, as does the d.c. tuning meter. The 1W output comes via a 5in. x 7in. speaker and the transistorised circuit operates from six 1·5V cells although it can be connected to a main unit. Outdoor aerials for a.m. and f.m. can be connected, but apart from the normal ferrite aerial, in-built frame and telescopic dipole antennae take care of s.w. and f.m. reception. Gramophone and tape inputs, built-in earphone, illuminated dial, world-wide time map, treble and bass tone controls and azimuth ring for navigation, sum up most of the "extras", although there are more. And the price for this 14½in. x 10in. portable?—just 100 guineas.

JUDGEMENT ON RADIOS

In the April issue of "Which?", the Consumers' Association journal, 25 portable radios are candidly assessed for quality, operation and value. Laboratory tests and listening panels produced a revealing set of results on radios costing from £3 9s. 6d. to £11 11s.

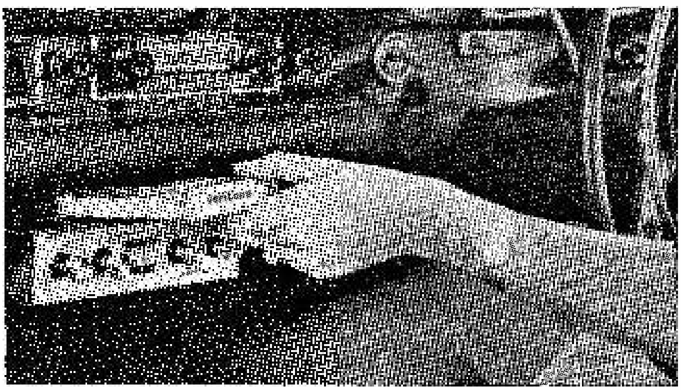
R/Ts FOR P.C.s

"Beat" constables in six divisions of the Metropolitan Police District are now equipped with portable two-way radio telephones.

The introduction of "mobile" communications to the Force followed some months' trial with standard equipment. The design which evolved from these tests consists of a main receiver/transmitter unit and a microphone/loudspeaker. Except when in use, the whole equipment is concealed in the policeman's uniform and the makers overcame a major obstacle by incorporating the aerial in the flexible lead joining the two units, thus obviating an inconvenient rod aerial.

The new equipment will eventually put all London's pedestrian police officers in close contact with master stations in sub-divisional headquarters and mobile R/T vehicles.

STEREO TAPES FOR MOTORISTS



The new Veritone tape-player for cars and boats operates automatically when pre-recorded tape cassettes are inserted. The main unit fits beneath the dashboard of a car as shown above, and provides over 30 minutes of stereo sound from two or four speakers.

Apart from a whole library of jazz, pop and classical music, taped language lessons are also available. Cassettes cost £2 10s. each and tape-player and two speakers, 48 guineas. Veritone Limited, are the U.K. distributors.

S.W. Broadcast Stations

Again your magazine prints information on the stations Radio Moscow, Radio Pekin, Radio Berlin International, Radio Prague and Radio Sofia, Bulgaria. Are you and Mr. Guttridge unaware of the amount of deliberate interference caused by these stations which insist upon using 98% of all the available channels in the broadcasting bands from 16m to 75m.

They do not seem to be only satisfied with ordinary a.m. but also use distorted modulation and buzzing noise transmitters and they now have the nerve to operate a.m. and noise producing machines in the amateur 20 and 40 metre bands. I think that these stations should not be mentioned in Practical Wireless and when they see that they are losing support, perhaps they will do something about the interference they are causing.

N. D. Mugford.

R.A.F. Episkopi,
B.F.P.O. 53.

We would be interested to hear what other readers may have to say on this rather controversial point—Editor.

Tapespondent Wanted

I should like to tapespond with any person of similar age to myself (16) who takes an interest in SWL radio in general, tape recording, special effects amplifiers, music ("pop", electronic or otherwise) or any associated subject.

I am at the moment studying for the R.A.E.

P. C. Underhill.

Pant Mawr, Harlech,
Merioneth, Wales.

4 Metres

I read in the April 1966 issue of Practical Wireless a letter from F. G. Rayer concerning v.h.f. coils. The one he described was to tune the v.h.f. f.m. station at Wrotham on 3·1 metres. Quote: "but three turns about ⅝in. diameter, ⅝in. long self supporting". I myself would be interested in application to 4 metres etc. and would therefore like to hear from other readers interested.

R. A. Adair.

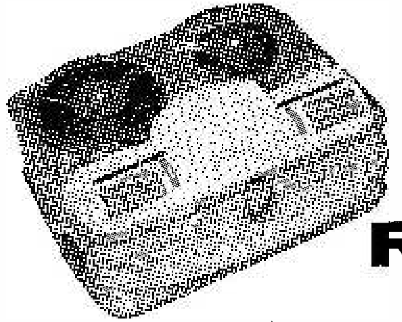
13 Seaview Terrace,
Holywood,
Co. Down,
N. Ireland.

Correspondent Wanted

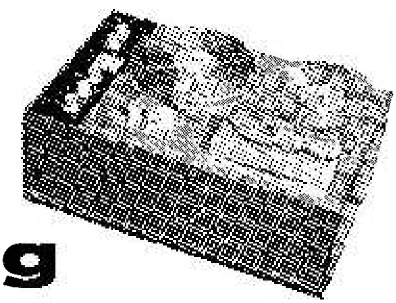
I would like to correspond with anyone of my own age (15) who has built the "Versatile Gramophone Amplifier" on page 336 of the August 1964 edition of P.W.

A. Kenward.

289 Longford House,
Uxbridge Road,
Hampton Hill, Middx.



AGC in Tape Recording



by H. W. HELLYER

FIRST, let's get rid of one misconception. Automatic control of recording level is not a new technique. Many of the older dictating machines and one or two portable tape recorders employed signal-operated gain control circuits. These were, of course, intended for speech reproduction, where intelligibility is more important than absolute fidelity, and some frequency compression can be tolerated.

Lately, the leading tape recorder manufacturers have brought out models which are "automatic", but which sacrifice nothing in terms of quality. These have raised howls of protest from the tape recording enthusiasts, who regard the loss of a manual recording level control in much the same light as the motoring *aficionado* regrets the absence of a gear-lever in a car with automatic transmission. As a peace-offering, the manufacturers now provide an "over-riding" switch to allow either automatic or manual control.

Quite Simple

The principle of a.g.c. is quite simple. In its essentials it consists merely of a bias applied to a controlled amplifier stage, or stages, in proportion to the level of the incoming signal. The greater the signal, the greater this bias, and the more the overall amplifying system tends to return to a steady state—predetermined by a delay applied to the bias line.

Complications ensue when we apply the bias to different stages, as in a television receiver or a quality radio; then these delays differ, and extra circuitry is needed to prevent interaction between stages. We are not concerned with these factors at present, and reference to Fig. 1 is sufficient to illustrate the principles of a.g.c.

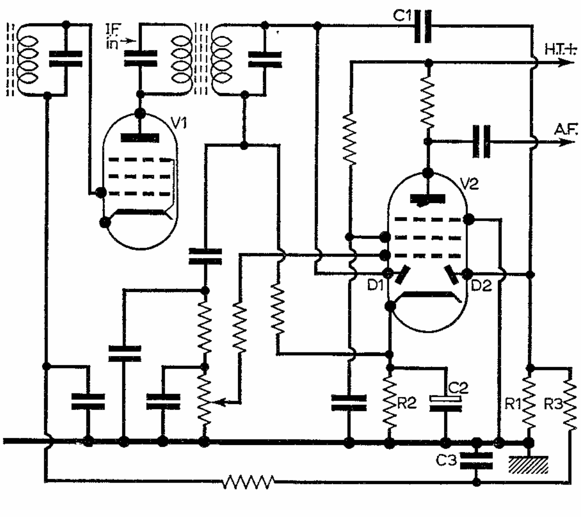
This is part of the circuit of a conventional radio receiver. The i.f. signal, after amplification by V1, is applied to the detector diode D1, rectified and passed, as an audio signal, to the a.f. amplifier V2.

Part of the i.f. signal is tapped off via C1, applied to the second diode, D2, rectified and applied via filter circuits as a varying d.c. bias to the grid circuit of V1. R1, the a.g.c. diode load, is returned to chassis, and the cathode of the double-diode triode valve is self-biased by R2, decoupled by C2.

But the bottom end of the a.f. detector load is returned to the cathode directly. Thus, the a.g.c. rectifier has to overcome the bias of the valve before it can begin to conduct. This provides the "delay"—which is a delay in voltage, not time. The a.g.c. does not come into operation until a certain minimum level of signal is reached.

The components, R3, C3, filter the a.f. component from the bias, and the long time constant ensures a steady bias, proportional to the average variations in signal level. The overall time constant of the circuit is an important consideration during design—taken for granted by those of us that use and repair the receivers.

For audio circuits, the time constant becomes even more important, and it is this fact that makes tape recorder a.g.c. difficult to design. Obviously, a bias voltage exactly proportional to the signal would be the same as a simple reduction in gain. (In this, and the following discussion, the term bias refers to the



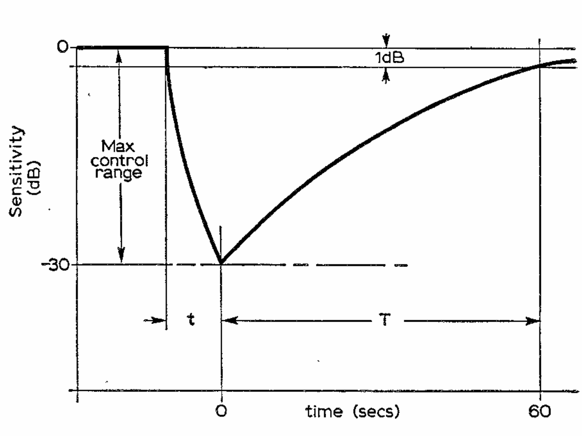


Fig. 1: (on the left) shows a conventional radio a.g.c. circuit and Fig. 2: illustrates the control range of the a.g.c. circuit.

a.g.c. voltage, and not the recording bias, with which we are not at the moment concerned.)

Similarly, a circuit with the same "averaging" characteristic as the radio circuit would be useless. Consider a passage of music which starts with a loud chord, or clash of cymbals. The opening high-level signal would set the bias circuits in operation and determine the level of bias, which would then die away as no further loud signals sustained it.

But the period of time over which it dies away could include several quiet sounds, which would be recorded *even more quietly* despite the fact that they would not normally be great enough in signal level to produce an appreciable bias. This is more clearly seen if we study a diagram of the effect of tape recorder a.g.c. on a signal, and note the time factors.

Fig. 2 shows the control range of the circuit. This is actually the curve of the a.g.c. circuit of the Philips EL3552. The vertical axis shows the sensitivity, measured in dB, and the horizontal axis represents time, in seconds.

This machine has a maximum control range of 30dB, which is quite sufficient for normal purposes. When a loud sound occurs, the control circuit comes into operation and almost instantaneously the attenuation from 0 to —30dB occurs.

At this point, if no further loud sounds occur, the circuit begins to recover, and the curve shows that in approximately one minute the original amplifier sensitivity is restored.

Effects of A.G.C.

The effect of the audio signal is shown in Fig. 3, also reproduced from the Philips data on the EL3552, which was one of the pioneer models of modern a.g.c. techniques.

The hard curve shows a passage of music with a pronounced peak at B. The chain-dotted line from point R indicates the level (0 dB, see Fig. 2) at which the control circuit comes into operation. Note the attenuation period, t.

The recorded signal is now reduced from its peak at B to the level of R, and then follows the curve of the dotted line. Note next that this is virtually a replica of the hard curve. The important relationship between variations of sound intensity is maintained; in other words, distortion is not introduced.

This may seem, at first, a contrary argument to the time-constant point that was previously discussed. To understand it more fully we need to consider the recording process. We need, in fact, to consider what we do when we set the tape recorder to its desired level by a manual gain control.

Suppose, for example, we record at a gain lower than we should. The tape will be undermodulated, and when we play this back it will be necessary to turn up the volume control to get the required output.

But this introduces noise, the inevitable problem due to electro-mechanical, and purely electronic limitations of the system. Tape hiss, input stage noise level, hum, etc., are more evident at high playback volume control settings.

Adjusting the Record Level

If, on the other hand, we record with the gain control too far advanced, the tape is overmodulated and distortion sets in. No matter what volume control setting we then use on playback this distortion will be present. The recording level indicator, be it neon lamp, meter or magic eye, is there for the purpose of warning us when we tend to overmodulate.

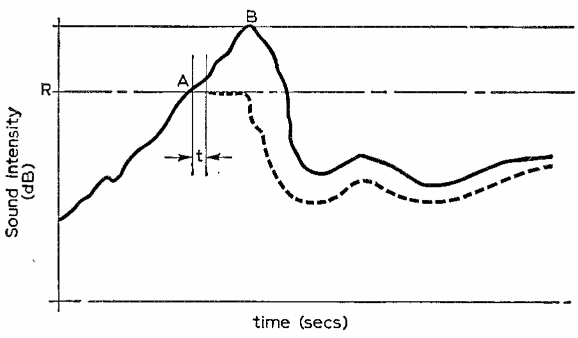
In other words, it is a peak-indicating device. We set our level so that the sounds being recorded do not overmodulate the tape on peaks and know that the rest of the sound is in proportion.

This then is precisely what the automatic circuit is doing. By setting the circuit to come into operation at the level R in Fig. 3 we are ensuring that no incoming signal will overmodulate the tape, and the short fall and slow rise of the curve then gives us a recorded signal at the correct level throughout.

The setting of the level R is determined during design, and preset controls are incorporated to allow for small variations. We shall come to the difficulty of adjusting these controls as we consider the circuits.

The circuit of Fig. 4, from an early version of the popular Grundig *Stenorette*, is very similar to the radio circuit we have already looked at. A double-diode-pentode valve is used, with diodes strapped.

The signal is applied via a 2,000pF capacitor from a tapping on the secondary of the output transformer to the diode anode, and the load is the 10MΩ resistor R1. Filtering is provided by R2, C2 and R3, C3, and the bias voltage is applied to the pentode section of the EBF80 and to the grid of the input stage.



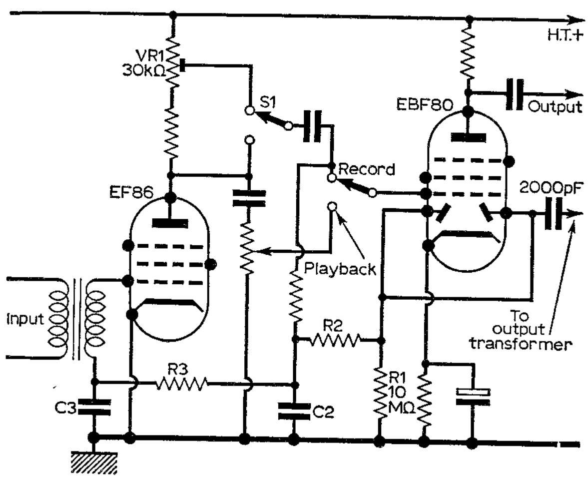


Fig. 3: (above) shows the effect of a.g.c. on a musical passage. R indicates the suppression level, "t" the fall time, and the dotted line an uncontrolled signal. Fig. 4: (on the right) shows the form of control used on dictating machines featuring two-position sensitivity switches for record and playback levels.

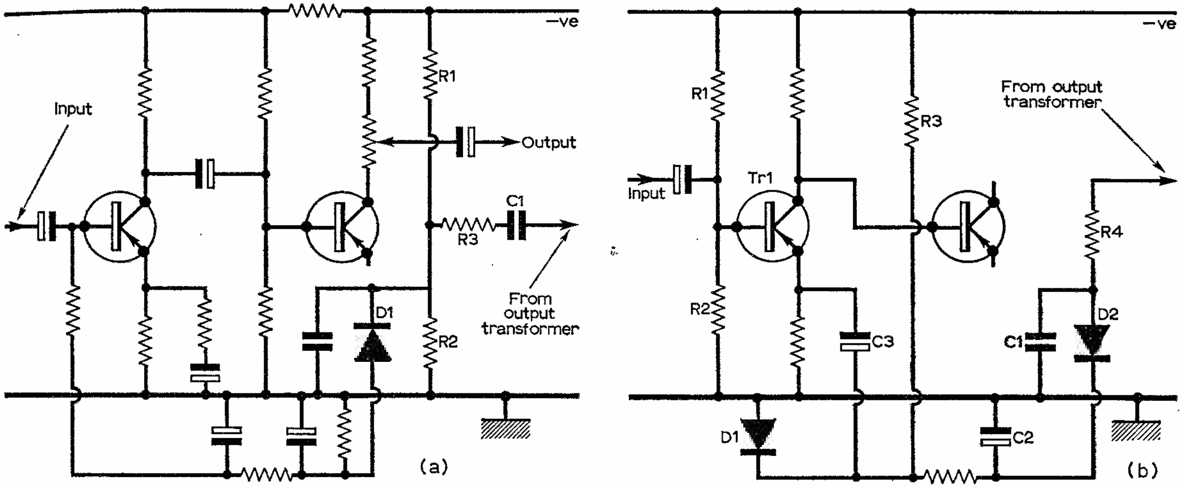


Fig. 5: The left-hand circuit (a) shows the automatic control section of a transistorised dictating machine. Part of the output is fed back to bias the first transistor. The other circuit (b) shows a different method, with the emitter voltage varied by a rectified signal voltage from the output transformer.

A feature of this circuit with some bearing on the operation of the automatic control is the two-position sensitivity switch S1. This selects the tapping position along the anode load of the first stage, from which the signal is taken to the second, and is made further adjustable by the preset resistor VR1.

Using Feedback

A variant of this circuit is used in the later, transistorised version of the *Stenorette,* as seen in Fig. 5a. Here, the audio signal from the output transformer is again used, causing the diode D1 to conduct.

The difference is that control of the base bias potential of Tr1 has to be effected without any alteration in the load impedance or other parameters. This is done by making D1 part of the stabilising circuit of the base bias circuit, feeding the stabilising voltage from the junction of R1, R2, which are across the negative to chassis potential of the instrument.

Audio is then applied to the diode via R3, C1, and as it conducts, the base potential of Tr1 changes, reducing its gain.

The circuit of Fig. 5b is a refinement of this, used on the *Stenomatic* dictating machine, also by Grundig. Although this machine is not typical, being mechanically very different from the tape recorder types, and using coated foil wrapped around a rotating drum instead of conventional spools, its circuitry is what concerns us here, and Fig. 5b shows it has two diodes, apparently in opposition.

Again, the prime aim is to control the bias of Tr1, but this time by altering emitter voltage. Normal d.c. stabilisation of the Tr1 base is by the potential divider R1, R2. R3 biases the diode D1 in a forward direction. When an audio signal arrives via the low-pass filter C1, R4, it is applied to the second diode, D2, rectified positively and used to counter the forward resistance of D1.

C2 is used to smooth out audio frequency variations of rapid periodicity and C3 is the charge capacitor. The reference level across C3 is used to alter the bias of Tr1.

Another transistorised circuit, but with more serious audio functions and therefore with a choice of both manual and automatic recording level, is that of the Fi-Cord 202, shown in Fig. 6. When the gain control is turned fully anti-clockwise the switch S2A opens and the transistor Tr2 is part of the collector load of Tr1. (Note that a fixed d.c. collector load, R4, is provided, or damage to the transistor would ensue during switching.)

When the machine is in the Play condition, Tr2 is shorted out. During Record, the emitter bias of Tr2 is set by the full resistance of VR1 (in its minimum position) and the base receives a rectified audio signal.

Varying the Impedance

This causes it to change impedance and act as a varying a.c. load to the first stage collector, giving an automatic control of volume. In fact, with a transistor connected in this way, its impedance varies inversely with the amplitude of the signal being fed back.

The circuit is very responsive to peaks, but the built-in delay of later machines to maintain regular balance between uncontrolled and controlled levels, as shown in Figs. 2 and 3, has not been given such weight.

The extra circuitry involved in obtaining this regularity for quality work can be seen by reference

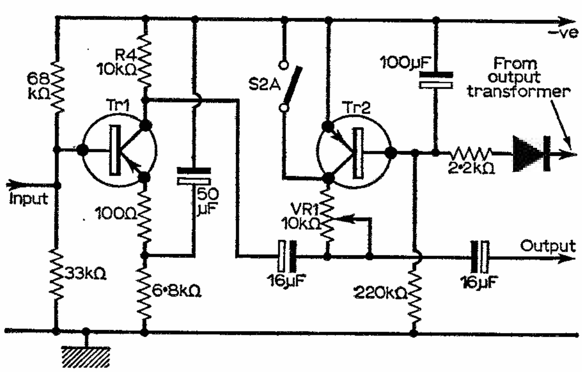


Fig. 6: In this Fi-Cord 202 circuit, a transistor is used as a varying collector load for the first amplifier: its impedance being varied by the feedback.

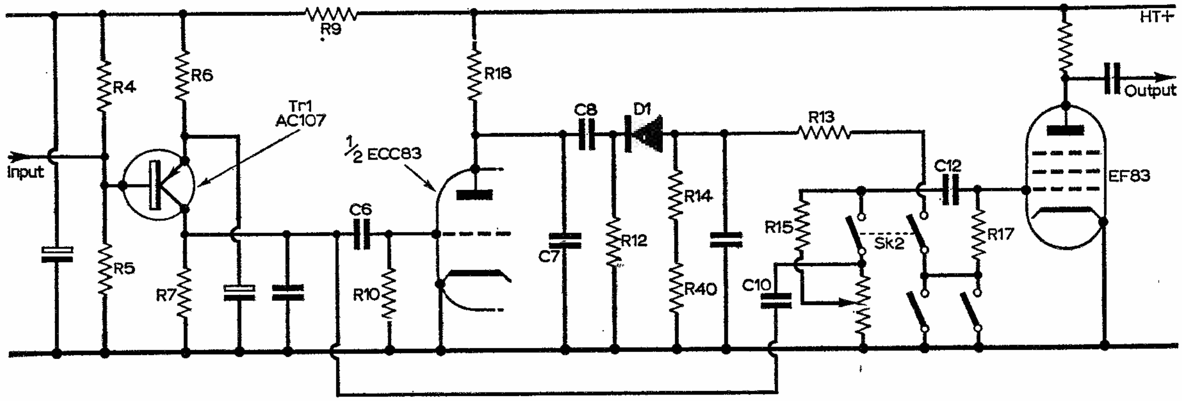


Fig. 7: Elements of the control circuit of the Philips EL3552. Component values are as follows; R4, 22kΩ: R5, 68kΩ: R6, 10kΩ: R7, 22kΩ: R9, 470kΩ: R10, 10MΩ: R12, 100kΩ: R13, 100 ohms: R14, 22MΩ: R15, 100kΩ: R17, 22MΩ: R18, 100kΩ: R40, 22MΩ: C6, 4·7kpF: C7, 390pF: C8, 33kpF: C10, 47kpF: C12, 10kpF.

to Fig. 7, which shows the portion of the Philips EL3552 circuit under discussion. It will be noted that a control triode is used as an amplifier, to obtain sufficient amplitude of signal from the output of the transistorised first stage, rather than tapping off a portion of the amplified output.

The controlled stage is an EF83, vari-mu valve whose grid circuit consists, during selection of the Auto function, of the load of the diode rectifier. The signal from the collector of Tr1 is fed to the EF83 grid via C10 and the manual volume control, for normal; i.e., " Manual " operation, but when the " Auto " switch is selected this part of the circuit is bypassed by Sk2 and the direct signal is via C10 and C12.

At the same time, the other section of Sk2 closes and the two series resistors R14 and R40 become part of the grid load of the vari-mu valve. The rectified output from the triode valve supplies the negative potential to control the gain of the valve and the exact choice of component values gives the delay, which is approximately one minute for microphone signals with this machine.

A similar principle is employed with the Elizabethan *Automatic* tape recorder (see Fig. 8). A control triode is used to amplify the signal for application to a rectifying circuit, providing a negative potential to the grid of a vari-mu valve.

The particular points to note about this circuit are the preset controls, VR2 to determine the output of the triode, and VR1 to set the recording level, and the voltage doubler circuit, D1 and D2, which gives both a larger and a better regulated bias voltage. The necessary long time constant is supplied by the combination of the rectifier reservoir capacitor, C6 (1μF), and the load resistor, R10 (80MΩ).

Adjusting the Charge Capacitor

Because of this long time constant it is necessary to use a little circumspection when testing and setting up automatic tape recorders. The charge capacitor C6 must be discharged between recording level settings if any alteration is made to the presets or quite misleading results can be obtained.

On the foregoing machine, with an input of 2mV at 1 kc/s to the microphone socket, and a valve voltmeter measuring the output at the anode of the stage subsequent to the controlled valve, the control preset must first be turned fully clockwise and then the record level preset turned slowly for a reading of 12V. Then the input is increased to 20mV and the control preset adjusted until this same reading is obtained.

If one is too ham-fisted, and the reading passes the necessary level, one must discharge C6 and start

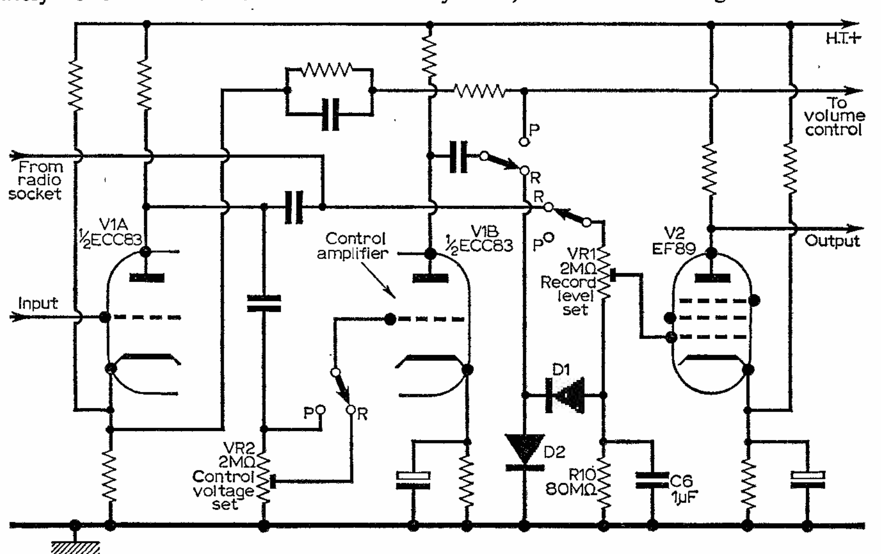


Fig. 8: Control circuit used by Elizabethan. Note separate control voltage setting and voltage doubler circuit.

all over again. As a check, increase the input to 100mV, when readings should be between 6 and 24V; reducing the input to 2mV and discharging C6 again should then give a reading of 8V or more.

Constant Record Level

Enough has been said to have emphasised the difference in automatic gain control circuits as employed in tape recording from the simpler circuits of radio and television receivers. The difficulty of ensuring a full dynamic range, even when fortissimo and pianissimo passages alternate in quick succession, requires quite stringent design limits and more care in setting up these machines.

Our final example, perhaps a classic of its kind, is the Grundig TK18, which, though not the first, was perhaps the most widely publicised when it was launched in 1963. The essentials of this circuit are shown in Fig. 9.

part of a potential divider across the h.t., to give better regulation of cathode bias voltage.

Because of this the cathode by-pass capacitor is rated at 70/80 volts working—a small point but one which may save a small explosion if it is overlooked!

The second triode acts as a cathode follower, and the signal is passed to its grid, while the lower end of the grid load returns to a tapping in the cathode network. This brings the bias point to the straight portion of the valve characteristic.

The rectifier MR2 handles the audio signal and charges the 10 μF capacitor C6. This is an MKT type, and not an electrolytic, and has to have a working voltage of 125 volts. The bias is fed to the grids of both the EF86 input amplifier and the vari-mu controlled valve, EF83.

The cathode of this valve is biased via the recording sensitivity control in the cathode of the first half of the ECC81. The shorter period of time constant during microphone recording, where staccato speech signals may be encountered, is

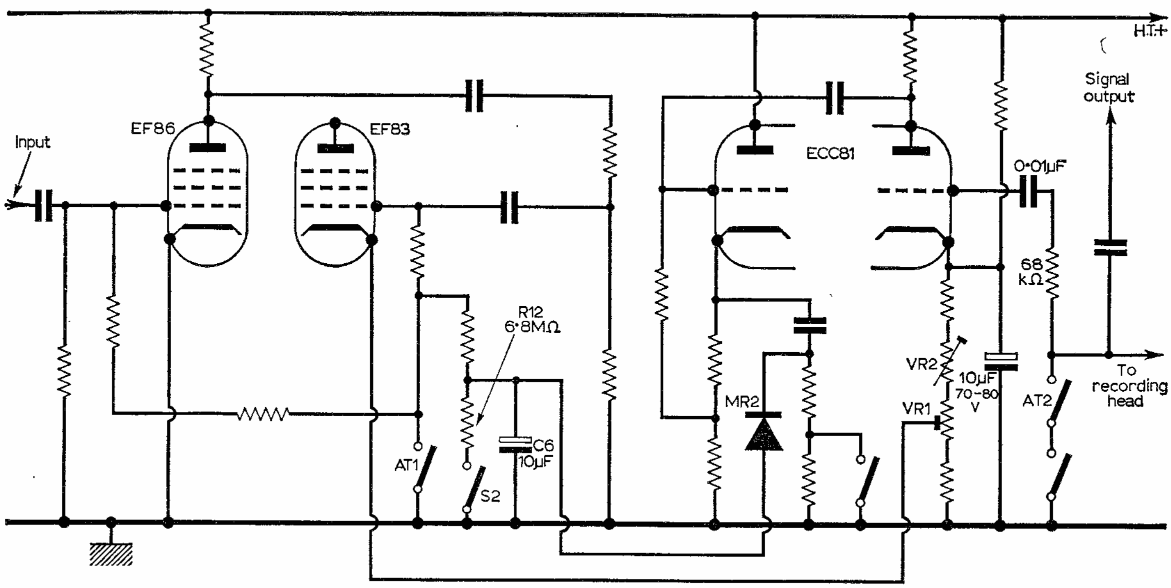


Fig. 9: Control circuit of Grundig TK18, with only the essential parts of circuit included.

The important points to note are that the delay period is as much as 15 minutes for a high level (radio or pick-up input) signal and 3 minutes for the microphone signals. The machine runs at maximum recording level until a strong input is applied, when the bias takes over.

The reason for the auto-gain control not coming in before a small signal is applied is to reduce the hum and noise at high level.

In this case, the control signal is tapped off from the same point as the feed to the recording head, via a 68kΩ and 0·01μF capacitor in series, and applied to the grid of the second half of an ECC81 double triode.

In the cathode of this valve there are two preset resistors, the Threshold VR2 and the Recording Sensitivity VR1 controls. These provide an overall setting of bias so that signals of more than 10 volts will be amplified, but not those beneath this level. It will be noted that the cathode circuit is actually

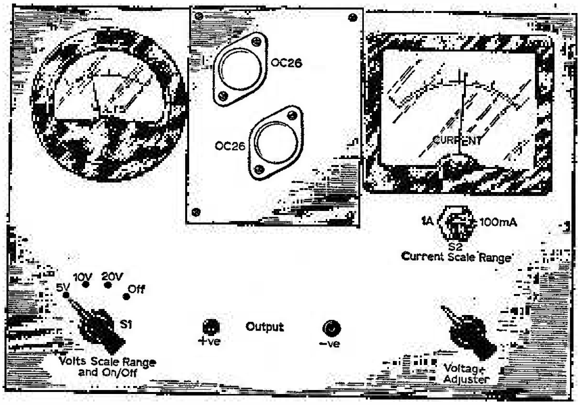
provided by switching a 6·8MΩ resistor, R12, across the leak circuit, by S2, the microphone switch.

AT1 and AT2 are parts of the Record and Start switch contacts and serve to mute the circuit when the machine is switched to neutral.

It can be seen that the setting of the Threshold control is vital for correct operation, and, as mentioned previously, care must be taken when adjusting not to over-run the right point.

Space limitation prevents a detailed description of the setting up procedure, which requires an audio generator, a valve-voltmeter, and various networks of resistors across which the readings have to be made. Readers who may require this information can obtain it through the Enquiry Service.

The prime purpose of this article has been to show the methods and techniques of control used in tape recording, and, while by no means exhausting the range, may have demonstrated that this is not such a simple matter as it may at first appear. ■



Reader's VARIABLE POWER SUPPLY

for driving experimental transistor circuits

By H. Wagner

THE variable power supply unit described here has been knocked-up by the author from his "bits box" to provide a d.c. source to help him when experimenting with transistor circuits. Meters for monitoring the output voltage and current are included in this transistorised unit, which has a continuously variable output from zero to 20V d.c. and will give about an amp on the lower voltages.

From the circuit it can be seen that the voltage control is achieved by varying the base potential of the series power transistor Tr1, which operates as a current limiting device. As the base/collector potential of this transistor falls, more current is allowed to pass and thus, the output voltage increases.

The base potential of the series transistor Tr1 is varied by the other transistor in the circuit, which can be considered as a variable resistor across the collector and base of the series power transistor Tr1. As the control transistor Tr2 conducts (its base/collector potential being reduced by the potentiometer in the base circuit), the d.c. resistance path from emitter to collector falls and at maximum conduction the emitter voltage is almost the same as that on the collector. Thus the collector/base potential of the series power transistor Tr1 is reduced to near zero, which allows maximum current to flow through it.

The current required for the control transistor is quite small. In fact it is so small, the author's unit utilises signal diodes (OA85) to rectify the output of a heater transformer. This part of the circuit makes use of a split capacitor arrangement to voltage double the output of the transformer before it is applied to the voltage adjusting potentiometer in the base of the control transistor.

The shunt resistor value has not been included as this will vary with the meter to be used, which should have a full scale deflection of 100mA. The easiest way to get the correct resistor is to put 100mA through the meter and then adjust the length of the shunt resistor wire until a reading of 10mA is obtained.

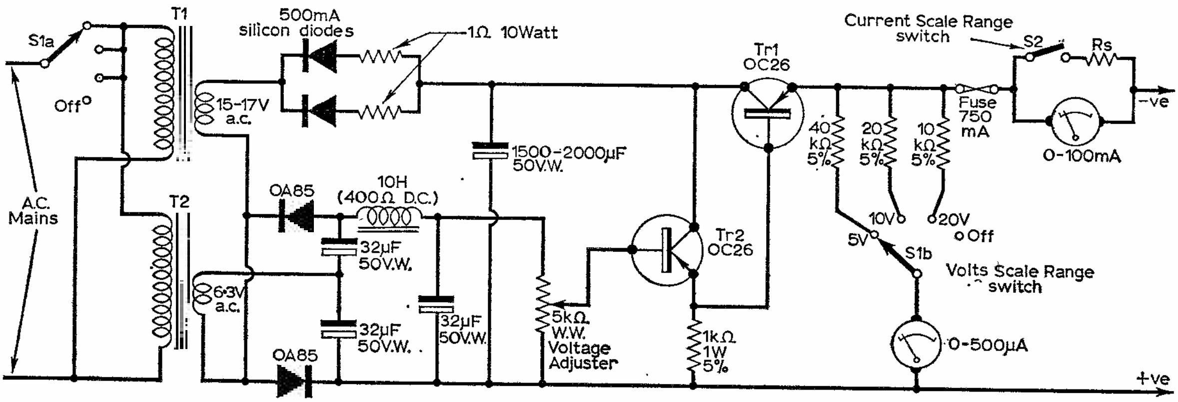
Precise construction details have not been included in this article as almost any type of meter and transformer can be used so long as the electrical specifications are similar to those given on the circuit diagram.

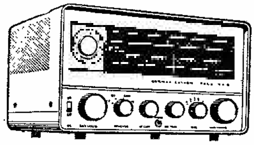
Some of the components used by the author can be substituted. For example, the smoothing choke in the control circuit supply could easily be replaced by a 470Ω ½W resistor.

As far as the metalwork is concerned, almost anything can be used. The author built his unit in a tin box that previously contained cream crackers. The lid was replaced by a piece of paxolin, which supports the meters, switches and some of the components.

Layout is not critical, but it should be remembered that the power transistors, especially the series transistor Tr1, should be mounted on a heat sink. Mica washers should be used when attaching the transistors to the heat sink which can be made from 16 s.w.g. aluminium sheet.

No protection facilities are provided on this unit, so it is important to avoid accidental shorting of the output which can result in permanently damaging the series power transistor Tr1. ■

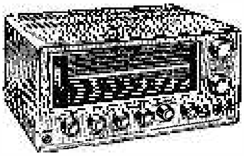




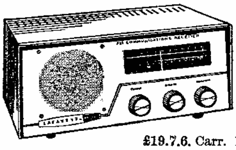
LAFAYETTE HA-63 COMMUNICATION RECEIVER

7 valves plus Rectifier. 4 Bands, 550 kc/s-31 Mc/s. "S" Meter—BFO—ANL—Bandspread Tuning. 200/250v. A.C. Brand New **24 Gns.** Carr. paid.

LAFAYETTE HA-230 AMATEUR COMMUNICATIONS RECEIVER



Supersedes model HE-30. 8 valves + rectifier. Continuous coverage on 4 bands. 550 Kc/s. 30 Mc/s. Incorporates 1 RF & 2 IF stages. Q Multiplier, B.F.O., ANL, "S" meter, Electrical bandspread. Aerial trimmer, etc. Supplied brand new and guaranteed. **£33.** S.A.E. for full details. Also available in semi Kit Form, **25 Gns.**



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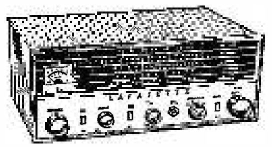
HAM-I COMMUNICATION RECEIVER



5 valve superhet receiver covering 550 kc/s—30 Mc/s on 4 bands. Special features include slide rule dial. Bandspread tuning. 'S' Meter. B.F.O. Built-in 4in. speaker. Operation 220/240 v. A.C. Brand New with handbook. **16 GNS.** Carr. 10/-. S.A.E. for details.

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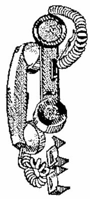

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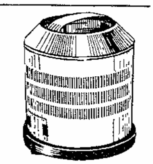

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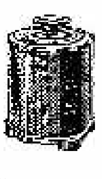

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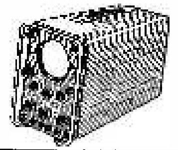
TEST EQUIPMENT

PORTABLE OSCILLOSCOPE CT.52



A compact (9in. x 8in. x 16½in.) general purpose 'scope T/B 10c/s-40 kc/s. Band width 1 Mc/s. Mullard DG 7/5 2¾in. CRT. For operation on 200/250v. A.C. Supplied complete with metal transit case, strap, test leads, and visor hood. Brand new, **£22.10.0** Carr. 10/-. Supplied complete with instructions.

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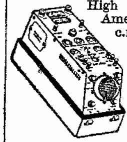

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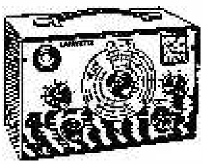
Time base 2 c/s-750 kc/s. Calibrators at 100 kc/s and 1 Mc/s. Separate Y1 and Y2 amplifiers up to 5.5 Mc/s. Operation 110/230 volt A.C. Supplied in perfect working order. **£27.10.0.** Carriage 20/-.



LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 PF—2,000 MFD, 2 ohms—200 Megohms. Also checks impedance, turns ratio insulation 200-250 v. A.C. Brand New **£15.** Carr. 7/6.

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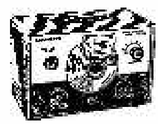

Accurate wide range signal generator covering 120 kc/s-260Mc/s on 6 bands. Directly calibrated. Variable R.F. attenuator. Operation 200/240v. A.C. Brand new with instructions. **£12.10.0.** P. & P. 7/6.

S.A.E. for details.

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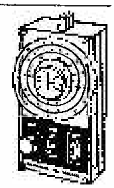

Compact, true one hand operation. Frequency range 1.7 - 180 Mc/s. 230v. A.C. operation. Supplied complete with all coils and instructions. **£12.10.0.** Carr. 5/-.

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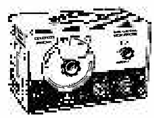

Square: 20 cps to 30 kc/s. Output impedance 5,000 ohms. 200/250v A.C. operation. Supplied Brand New and Guaranteed with instruction manual and leads. **£15.** Carr. 7/6.

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1-0-1mA	22/6	500mA	22/6	300V D.C.	22/6
1mA	22/6	750mA	22/6	500V D.C.	22/6
2mA	22/6	1A D.C.	22/6	750V D.C.	22/6
5mA	22/6	2A D.C.	22/6	15V A.C.	22/6
10mA	22/6	5A D.C.	22/6	50V A.C.	22/6
20mA	22/6	3V D.C.	22/6	150V A.C.	22/6
50mA	22/6	10V D.C.	22/6	300V A.C.	22/6
100mA	22/6	20V D.C.	22/6	500V A.C.	22/6
150mA	22/6	50V D.C.	22/6	'S' Meter 1mA	29/6

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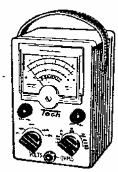

11 meg. input. 7 D.C. volt ranges. 1.5-1,500 v. 7 A.C. volt ranges. 1.5-1,500 v. 4,000 Peak to Peak. Resistance .2 ohm to 1,000 megohm. Decibels — 10db to +65db. Supplied brand new with instructions, leads and probe. **£12.10.0.** P. & P. 3/6.

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These are a 200/250v 50 c/s I/P, single channel crystal controlled Rx intended to work on any channel between 60 and 100 Mc/s, with suitable crystal. These are a double Superhat Rx employing 14 miniature valves as follows 6AK5x3, EF92x3, EB91x2, 12AT7x2, EF91, EL91, 6X4, QS70/20. They have a built in speaker and sks for H/phones and vol control for both. I.F. freq is 4.86 Mc/s and they have A.V.C. N.Lim, Control valve with relay, there is provision for wiring a tuning meter. These are supplied complete with crystal not to choice, but the Rx we have are tuned to freq in the range 70 to 85 Mc/s, supplied with mains and coax plug, circ diagram in New condition.

Price **£4.15.0** plus 8/6 carr.

R220 CABINET

These are aluminium cabinet with hinged lid and removable back and will take 2 R220 Rx, and are fitted with a 500 Ua meter that can be switched to monitor either Rx. Overall size 25 x 15 x 17" these would also accommodate any other Rx or Tx unit when the internal fittings have been removed. In New condition.

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Price **£5.10.0** plus 12/6 carr.

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I/P 115v 50 c/s, contains valves 6SN7x5, 6BA6, 6AU6, OB2x2, 5Y3, P.U. gives 350v at 100 Ma, 105 and 210v stabilised also A.F. trans Pria 30K ohm C.T. Sec 13.5K C.T. 14 conds block paper type, 30 c.p.s. Band pass filter. High grade U.H.F. coax relay with N. type connectors, number of other parts. New condition with circ.

Price **£4.10.0** plus 12/6 carr.

AN/GRD Aerial system new cond **£5** plus 12/6 carr.

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RF.32 TUNING UNITS

These tune 40 to 50 Mc/s, Ae, R.F. & Mix circs can all be tuned from front panel by 3 small slow motion drives. Valves SP61x3, 3 60 pf tuning conds etc. With circ, these are externally soiled.

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These comprise a 5 stage 7 Mc/s I.F. strip with Det & Vid O/P. Valves SP61x7, 5U4, 6X5, the RF.24.25.26.27 & 32 will plug into these. With circ, externally soiled.

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MAINS TRANS.

Pria. 200/250v, Secs 500-0-500 at 120 Ma, 4v 3.5a, 4v 2.5a, 6.3v 300 Ma. these are an enclosed trans. made by Parmeko in good condition.

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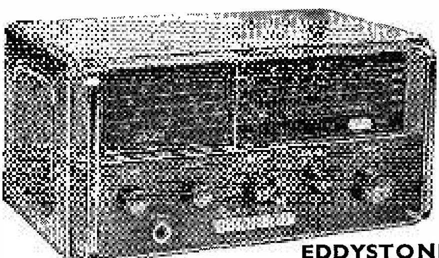

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BRITISH NATIONAL RADIO SCHOOL

practically wireless commentary by HENRY

No 23

Deadline Developments

NOT even the most gullible reader imagines this article was dashed off while the toast cooled this morning. Scenes of a copy-boy straining at the leash while the "star reporter" tapped out his world-shaking scoop are commonly regarded as fiction. Even the Night Editor's office of the great daily newspaper is less hectic than some playlets have made it appear.

Come on Henry !

When Henry announces an item of news, he has to face the disturbing possibility that in the meantime some clot will have superseded it, invented an alternative, elected a new Government or declared a revolution before the tit-bit appears in cold print.

This is partly the cost of electronic development. In one trade paper (mid-March) a correspondent recalled that in his day as an apprentice at an electrical accessories factory he was used to his foreman saying: "*In five years, what we are making will be quite out of date.*"

Nowadays, in the electronics and communications sector, five days seems to be more like it. Some call it progress. This correspondent is often tickled by the way apparent "breakthroughs" are based on the ideas of our illustrious predecessors. And not only in theory.

Hence the commentary last February, which mentioned a few of these curious throwbacks. Hence, also, this long delay in answering a criticism of that article, by John Niven Douglas, which appeared in the correspondence section of the April PRACTICAL WIRELESS. Between the first fine careless rapture of inspiration and the more careful perspiration that accompanies publication, there is a timelag.

This leads to a further shameful situation: the references that your columnist used may have been committed to that dusty limbo in the darkest corner of the workshop, or the magazines from which the reports were culled.

Since Mr. Douglas' polite reprimand was received, Henry has feverishly ransacked his back copies, but failed to turn up the news item about "mechanised h.f. systems". But this does not alter the basic argument.

Frequency synthesis, as Mr Douglas rightly points out, provides a system which "combines the stability of a crystal oscillator with the flexibility of a v.f.o.". It is indeed true that the frequency synthesiser is used by short-wave broadcast stations as the r.f. drive input to the transmitter. But this does not preclude its more sophisticated employment, even though attempts to limit the high cost have resulted in inferior units.

It is a fact that the principle has been allied to modular concepts and logic circuits to produce a system of lower cost and a high order of output purity. The Wadley system and the phase-locked loop system have affected receiver design, and constant development, using micro-miniaturisation techniques and computer channel selection, is already enabling the "constant-tuning-constant-lock" communications device to lend itself attractively to defence departments.

By using a pulse system of reference signals, both transmitter and receiver can be continually changing frequency—but precisely in step. To an eavesdropper, the frequency changes seem almost at random, and the whole point of the modern development is the speed of the switching and the maintenance of frequency accuracy.

Where's that quote ?

No, Mr Douglas, while Henry, in his ignorance, may have got hold of a wrong stick or two, he has this time grasped it by the right end.

Getting hold of the wrong stick is inevitable in this business of preparing a column some weeks before it will join the bills and the *billet doux* through the morning letter-box. The pace of electronic progress is such that predictions are outdated before they have left the pen. Jules Verne would have had a whale of a time in the nineteen-sixties.

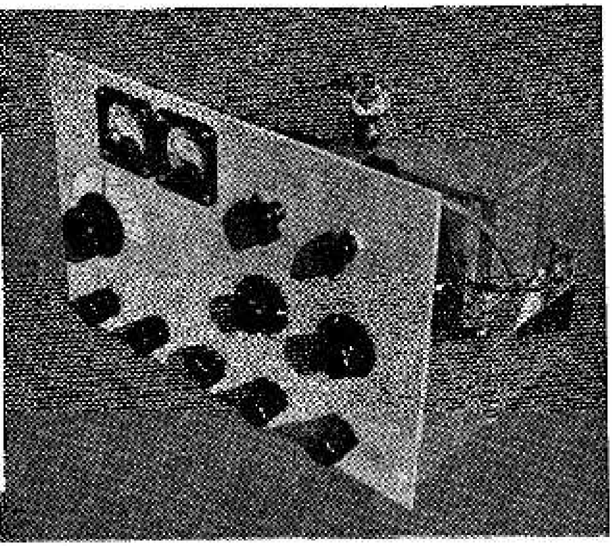
Yet there are certain lines of progress which seem inevitable, awaiting only the refinement of existing techniques, the advent of new materials and the release of classified information.

As I write, a report lies before me of a flat TV tube suitable for use in portable colour receivers. This news comes, of all places, from California. Yet I seem to remember Dr Gabor, now Professor at the Imperial College, putting forward his idea for this device a number of years ago.

Is this another example of the British hovercraft "complex", or are there still hopes that we might secure a small corner in the furthering of our own inventions?

THE 'IMPERIAL' 3-band transmitter

F.G.RAYER G3OGR



Part II

THE box for the v.f.o. is easily made from "universal chassis" sections. One section has its flanges cut so that it can be bent to form the front and inner side of the box, and the flat top plate is then bolted on. The v.f.o. is then completely wired. After wiring, bolt the half-completed box to the chassis. The v.f.o. and transmitter can be tested before enclosing the box. This is done by bolting on the outer side, then fixing on the small back plate with self-tapping screws.

To avoid difficulty in securing correct coverage, a Wearite PHF6 coil or equivalent is recommended. The smaller winding, or primary, must be taken off completely. Then carefully unwind 31 turns from the grid end of the secondary. The remaining winding is L1. No means of adjusting the inductance is provided, as it was felt this was best. Trimmer TC1 is fixed to a bracket and reached through a hole in the side of the v.f.o. box, and allows sufficient adjustment of band coverage.

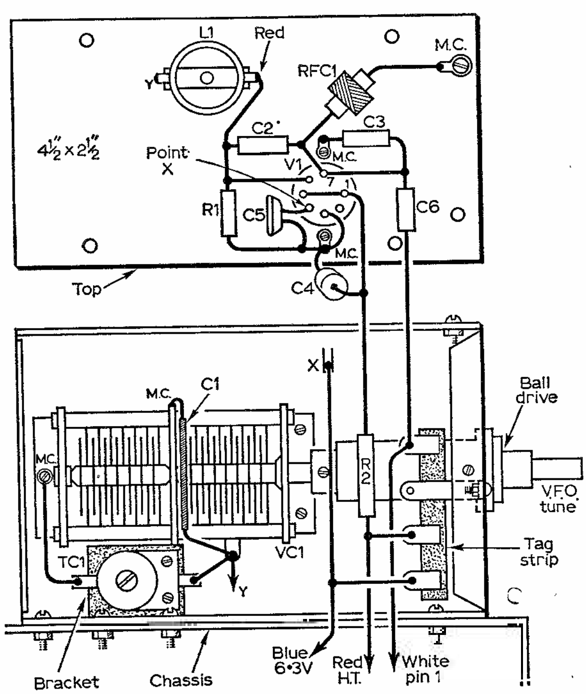


Fig. 6: Construction and wiring of the v.f.o.

VC1 should preferably have two bearings and must be free from wobble. A small surplus 2-gang capacitor was actually fitted and frequency control was very smooth and satisfactory. No temperature compensating capacitor is included, on the grounds that this may in fact only give disappointing results. The whole v.f.o. is subjected to little heat and drift from this cause is small, and much less than can possibly be read on the v.f.o. scale.

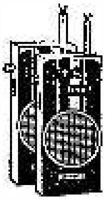
TUNING ADJUSTMENTS

A quick check of v.f.o. coverage can be made by taking R2 to a convenient h.t. supply, and listening for the carrier with a receiver. Adjust TC1 to give coverage from 3·5-3·8Mc/s, with a little to spare each end of the band.

When all construction is finished, and the v.f.o. box tightly bolted up, exact calibration can be undertaken. This is best done by using a crystal calibrator, or 100kc/s crystal marker, in conjunction with the receiver. The 3·5, 3·6, 3·7 and 3·8 Mc/s points can be marked, and the v.f.o. can be heterodyned against the crystal to note if there is any change in frequency with vibration, or drift. Neither of these should be troublesome nor very apparent.

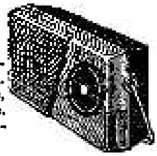
To simplify calibration, the same v.f.o. band was used for the higher frequency bands. This means that 3·5Mc/s on the v.f.o. is 7Mc/s and 14Mc/s. With the v.f.o. tuned to 3·55Mc/s, the transmitter output frequency is 7·1Mc/s or 14·2Mc/s, according to the band in use, and so on. That is, the v.f.o. scale

TWO-WAY RADIOS



Give communication over ½ mile. FULLY transistorised—crystal controlled, built-in telescopic aerial—press button operation—PP3 batteries—pair instruments complete and ready to use. **£7.9.6,** plus 5/- post and insurance. Not to be operated in UK.

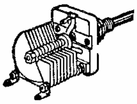
TRANSISTOR SET CASE



Very modern cream cabinet, size 5¼ x 3 x 1¾in. with chrome handle, tuning knob and scale. Price 4/6 plus 2/- postage.

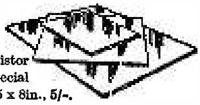
Printed Circuit Board TRF circuit 2/6, superhet 3/6, both with constructional data.

FINE TUNERS



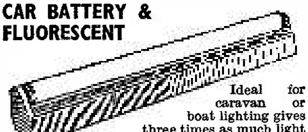
50 pf with long spindle as illustrated, **1/6,** or **12/-** doz. Twin 50 pf not quite such long spindle, **2/6,** or **24/-** doz.

Sheet Paxolin



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

CAR BATTERY & FLUORESCENT



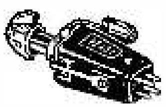
Ideal for caravan or boat lighting gives three times as much light for same current as three ordinary car lamps—use also to light advertising displays on vans and lorries. 12v. 2 amps d.c. complete with tube—white enamelled fitting as illustrated **£5.19.6** plus 8/6 post and insurance.

Mains operated fluorescent, also available complete as illustrated 2ft., 20 watt, **35/-;** 3ft., 40 watt, **37/6** both plus 8/6 post and ins. Also for callers only 4ft., 40 watt, **39/6;** 5ft., 80 watt, **49/6.**

DEAC RECHARGEABLE BATTERIES

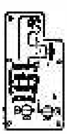
These nickel cadmium cells have negligible internal resistance. Will deliver current you require, reduce distortion and are completely reliable. They may be recharged indefinitely. Replacements for PP3, **37/-,** U7, **12/6,** U2 **32/6,** PP9 **125/-** or send for list.

ACOS GP73 TURNOVER PICK-UP CARTRIDGE



For Stereo—LP—and 78 records fitted with two Styli. Diamond for LPs, Sapphire for 78s. This is mounted and is standard replacement for most record players using Garrard—B.S.R.—Collaro, etc., etc. The regular price of this cartridge is 55/-. We offer these new and perfect for **15/-** (less than the price of styli), plus 2/- post and insurance.

Siemens High Speed Relay



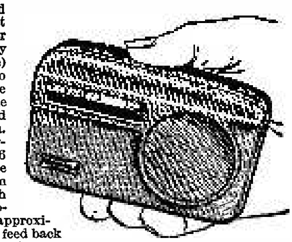
Two very sensitive ohm coils adjustable tension change over contact—plat. points. 100Ω plus 100Ω **7/6,** 1000Ω plus 1000Ω **10/-,** 1750Ω plus 1750Ω **12/6.**

Morganite Sealed Pots. Another batch of these has arrived and we can now offer quite a range namely: 5K, 50K, 100K, 250K, ½ meg, 1 meg, 2 meg, all at **6/-** per dozen per value, plus 2/9 post on first dozen, then 1/- per dozen. Less than one dozen price is 9d. each even this is only about 1/10 of the catalogue price and this is undoubtedly one of the best pots available.

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

Tuning Condenser. Bakelite type, 0.005 mfd for tuning or reaction ¼in. spindle, **25/-** per doz. or **3/-** each, post 2/9 per doz.

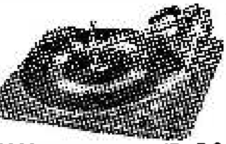
STUPENDOUS OFFER—£11 for £2



The Princess superhet described below is a very fine little set that has been carefully designed for high performance. Only recently (under another name of course) this was on offer in many radio shops, for £10.19.6. but we have been fortunate in obtaining the parts at a very low price and now pass this saving on to you. If you act quickly you can purchase this for only 39/6 plus 3/6 post and insurance. Note these features: ● Long and Medium Wave ● Long clear dial with travelling pointer and slow motion drive ● Push pull output approximately 350 m.w. ● A.V.C. and feed back ● Dust cored H.Q. I.F. transformers ● High selectivity ferrite aerial ● Six tested transistors ● Printed circuit board for fool-proof assembly ● Economy output circuit gives long life from PP3 battery ● Permanent magnet moving coil speaker ● Cabinet size 4¾in. x 3in. x 1½in.

You get over 100 parts (list value over £10). In fact everything you need and easy to follow wiring and aligning instructions. Don't miss this wonderful offer. Make up several while you have the chance. Use them as presents and you'll be loved for ever. Battery **1/9** extra. Data separately **2/6.**

WE ARE BEST FOR GARRARD



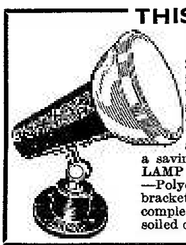
and because they have been making record players for so long GARRARD are your best choice—big range always in stock.

7/6 for post and insurance

1000 ...	... **£5. 5.0**	AT60 ...	... **£9.9.0**
2000 ...	... **£6. 9.6**	SP25 ...	... **£10.9.0**
3000 ...	... **£7.19.6**	LAB80	... **£25.0.0**

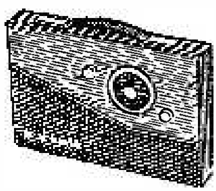
Complete with service sheet and template.

THIS MONTH'S SNIP



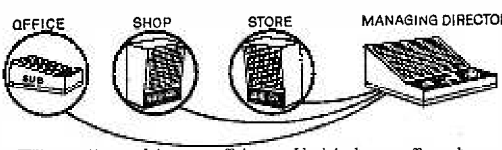
125 watt MERCURY VAPOUR SPOT LAMP In addition to the normal uses in photography and lighting generally you will find that a spot light shining over your shoulder is a great boon when working on intricate and micro-circuits. This month due to a fortunate purchase we are able to offer a complete 'Philips" outfit for about one fifth of its proper price thus showing you a saving of 80%. The outfit comprises 125 watt SPOT LAMP (gives approx. same light as 500 watt ordinary lamp)—Polyester filled choke-starter and adjustable mounting bracket, with lamp holder—listed at over £10 we offer the complete outfit in perfect order—unused but a little store soiled only **37/6** plus 6/6 post and insurance.

THE 208 BAND SPREAD PORTABLE



(sort out the pirates, even mum can do it). All the parts including tested transistor to make up this fine set described in May issue of P.W. with illustrated cabinet, tuner and knobs. **£4.12.6,** plus 7/6 post and insurance.

INTER-COM. BARGAIN



Will save time and improve efficiency. Ideal in home—office—shop—surgery, etc. Complete outfit comprises Master unit and three substations each of which can call the master and have full two-way working. No wiring problems as subs fitted with 60ft. twin flex and they plug into sockets. Also included is packet of staples—and battery. Nothing else to buy—**£6.9.6,** plus 3/6 post and insurance.
Originally sold for £18.18.0.

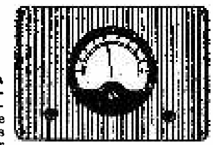
TOURMASTER CAR RADIO

Medium and long wave (push button change) perm. tuning—six transistors including power output—undoubtedly one of the nicest car radios available today—currently being sold at 14 gns. our price **£9.19.6.** Not a Kit but built and ready to use.

MULTI PURPOSE NEON TEST UNIT

Robust, useful and instructive—test insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and LT fault finder—kit comprises neon indicator, 4 way wafer switch, ebonite tubes, resistors, condensers, terminals, etc., with diag. **only 7/6** plus 2/6 post and insurance.

ENGINE REV. COUNTER or direct reading frequency meter



Employing a special frequency discriminator the instrument is just right for many of the jobs you have wanted to do—it can be permanently installed as a rev counter or as a portable instrument it will do such jobs as measuring frequency of time base—pulse generator—flip-flop etc., etc. Kit comprises: metal front panel all prepared and stove enamelled, moving coils meter, 4 specially tested transistor and diodes and all the necessary resistors and condensers and circuit diagram (separately 2/6) all for **39/6** plus 2/6 post and ins.

NOUGHTS & CROSSES MACHINE—an opportunity to make this very amusing item—described in *Practical Electronics.* Kit of 19 switches only **40/-** post paid.

Neons for panel Game Switch, etc.—not the midget type but possibly more suitable. 12 for **10/6,** post paid. Midget wire ended type, **1/3** (ex. equip.) or **1/9** new.

MAINS POWER PACK

MAINS POWER PACK designed to operate transistor sets and amplifiers. Adjustable output 6v.-9 to 12v. for up to 500 mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4 PP6, PP7, PP9, and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers, zener diode and instructions. Real snip at only 14/6. plus 2/6 post.

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Capstan Driven, 5 Transistors

SPECIFICATION:—200/7,000 c.p.s.—400 mW. output—double track—twin speed (3¾ and 7½) fast rewind time—5in. spool gives one hour playing with standard tape, weight 7 lb. Size 8 × 11 × 3in. Complete with batteries, microphone—tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop. Special Snip Price This Month £11.11.0. post and insurance 6/6.

THE "MINY"

Best of the spool driven machines, remote control on mike, battery operated £6.19.6 plus 5/- post and ins.

TWO OUT OF SEASON BARGAINS

1. 750 watt infra red silica gloss heater—wall mounting with pull switch. **32/6** plus 5/6 post and insurance.

2. Two heat electric blanket element. Two completely water proof elements each 13 yds. long connect both for full heat. 70 watt and one only for half heat temperature control by thermol balance. **10/-** post free.

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

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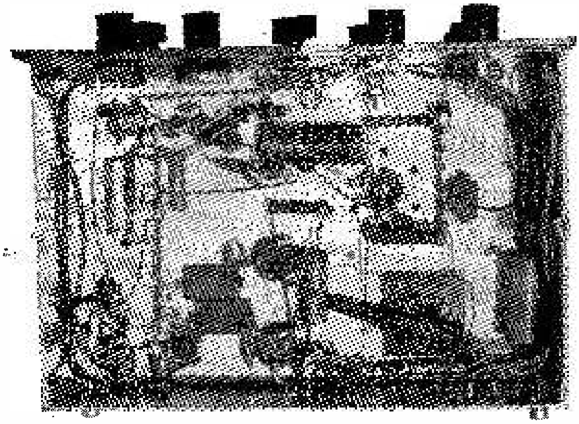
is multiplied by 2 or 4, for 40 and 20m bands respectively. These other frequencies can be calibrated throughout by tuning the v.f.o. against a 100kc/s crystal marker, noting that 3·5Mc/s corresponds with 7Mc/s and 14Mc/s, and so on.

If required, it is easy to open out the tuning on the h.f. bands, as described later. This has no actual effect on efficiency, but does simplify tuning. With a smooth ball drive and large knob, it may be felt this modification is not wanted.

TUNING THE EXCITER

H.T. must on no account be applied to the p.a. until grid current is available, and an aerial or other load must be connected. With S1 at 20, adjust the core of L2 for resonance at about 7·1Mc/s. Resonance may be found with a wavemeter, or by noting the grid current of V5, the net switch being closed. Also check that VC2 allows tuning L3 to 80, 40 and 20m bands. Tuning here is for maximum grid current, as shown by the grid meter, but this should be kept down to 2·5 mA maximum, by adjusting VR1 as required. V5 is normally operated with about 2mA grid current (44V bias across R10).

To test the transmitter, a 60 watt household lamp is convenient as a load. A first test is best on 80m. Set the exciter bandswitch to 80 and adjust VR1 for about 2mA grid current, with VC2 tuned for maximum grid current. If desired, a reduced h.t. voltage can be applied to the p.a., or a 100kΩ resistor may be temporarily connected in series with R11, to keep the input low. With VC4/VC5 closed, switch to "transmit" and quickly tune VC3 for minimum anode current. The input will be small, and is increased by opening VC4/VC5, at the same time always re-adjusting VC3 for minimum current. With normal screen voltage and a reasonably high anode potential, a 60W lamp can be lit brilliantly.



Underchassis view.

With a high voltage, V5 may be destroyed in a few seconds, if operated without grid drive, or off resonance. In these conditions, the input is much higher than normal, and is dissipated as heat in the valve itself. Typical ratings for the 6146 are 112mA anode current at 600V, or an input of about 67 watts, screen current then being 9mA at 150V, with 2·8mA grid current, and an output of 52 watts. The actual transmitter was, however, generally used with 100mA input, and 2 to 2·5mA grid current.

With high level modulation, results are satisfactory with a wide range of inputs and p.a. voltages. A 400V supply allows 40W input at 100mA, and this has proved to be very satisfactory. Typical circuit point voltages are shown in Fig. 1. These were taken with a 2kΩ/V meter.

When it has been noted how the p.a. tunes, there is no need to employ the reduced h.t. voltage, or additional resistor in series with R11. However,

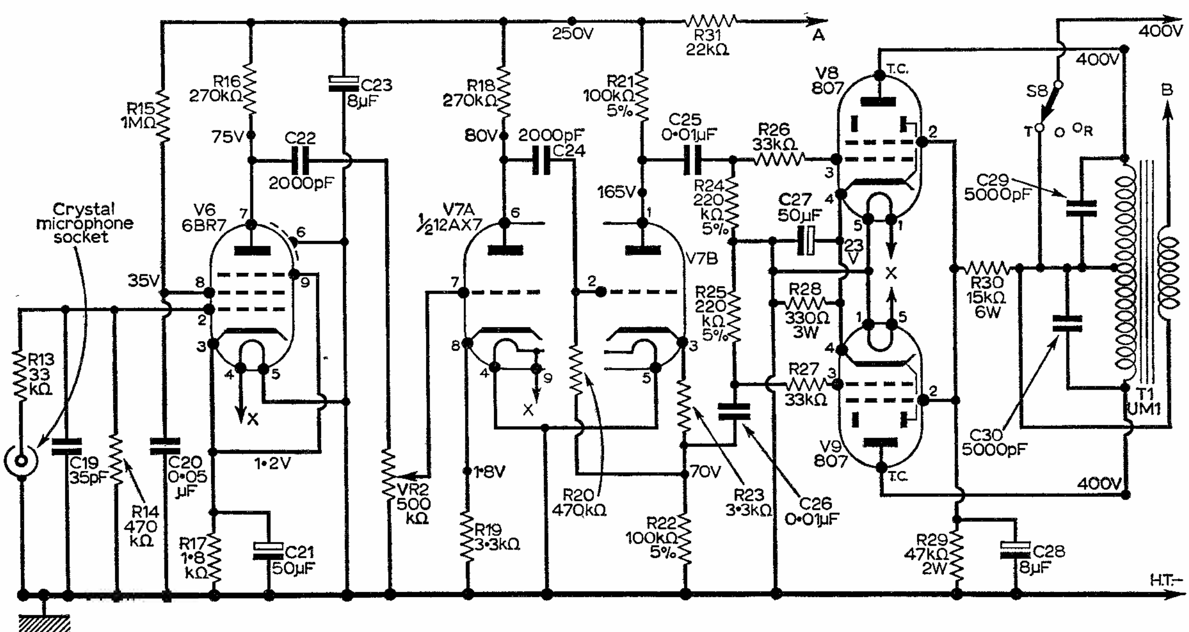


Fig. 7: Circuit diagram of the complete modulator.

rapid tuning of the p.a. is necessary. Tuning is more critical on 40 and 20. On the higher frequencies, anode tuning results in some change of grid current (this is usual with an un-neutralised power amplifier). The convenience of having separate grid and anode meters permanently connected is then very apparent.

Sufficient grid drive was obtained with a 250V supply to the exciter. The current drain is about 50mA. The second supply will normally be 300V or higher, to permit 30W or more input. It should be able to deliver 200-250mA. The screen voltage of the 807's should not exceed 300V. This means that R30 can be reduced with a 300V or similar low supply, but should be increased with a 500V or larger supply, so that the screen voltage is about 250-300V. With a 500V supply and 270 ohms cathode bias resistor, the 807's are rated to provide 32 watts output, which will easily modulate the p.a. With a 400V supply and 40W input, only about 20W will be required from the 807's. The modulator should not be operated with V5 withdrawn. Screening cans are used on all except the 6146 and 807's and regulator V2.

OPERATING THE TRANSMITTER

Brief operating details may be welcomed by anyone who is using this as a first transmitter. With a lamp load as described, speech should sound strong and distinct in a receiver. The receiver RF gain will probably need to be turned well back, and the receiver aerial input sockets may be shorted to chassis.

For normal operating, take a 75 ohms co-axial lead from the transmitter receiver aerial socket, to the receiver. Receivers with a 75 ohms input impedance will give best results with a dipole or other matched aerial. Interrupt one lead from the speaker transformer secondary to speaker, and take connections from here to the speaker muting sockets.

A dipole aerial can be used for any one band. It is usually about 128ft. for 80, 66ft. for 40, or 33ft. for 20. The transmitter should load without difficulty into such a dipole, on the band for which the dipole is intended. Occasionally, the position of the aerial may alter its frequency, so that its length has to be changed slightly.

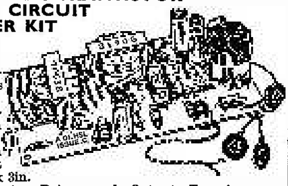
A balanced system, using 75 ohms twin-lead from a balun or tuner, is less likely to cause TVI than a co-axial fed aerial. An end-fed aerial generally requires a tuner, such as an aerial may be operated on all bands. The transmitter has been operated without TVI on the home TV receiver, with both dipoles and end-fed aerials, on 80, 40 and 20. This does not mean it will necessarily be free from TVI. in other circumstances, where the run of feeders, or other details, may be unfavourable.

The transmitter net switch allows the v.f.o. to be tuned to a clear frequency or to a received signal. After tuning for grid current, switch to transmit, and adjust loading (and grid current, if needed). This switch then provides complete control.

If it is wished to save a little on building costs, the surplus 807 may be used for p.a. The screen grid should receive about 250V and input is up to 100mA, 600V maximum. Grid current can run at about 3·5mA. No other changes are required.

C.W. and h.f. bandspread details next month.

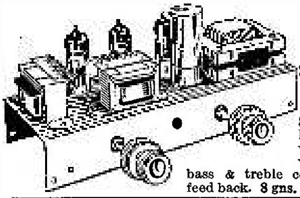
HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TAI



● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET 114 or 81 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, **52/6.** P. & P. 3/-.
A pair of TA1s are ideal for stereo.

STEREO AMPLIFIER

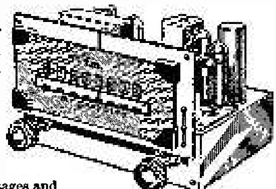
Incorporating 2 ECL82s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



ONLY **£4.19.6** P. & P. 6/6

Super De-luxe version with ECL86 valves sep. bass & treble controls, full feed back. **3 gns.** P. & P. 6/6

HARVERSON'S F.M. TUNER Mk. I



● F.M. tuning head by famous maker ● Guaranteed non-drift. ● Permeability tuning ● Frequency coverage. 88-100 Mc/s ● Balanced diode output ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier) ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. Set of parts if purchased at one time **£5.19.6**, plus 8/6 post free. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye. front panel and brackets, **£6.12.6.** P. & P. 8/6.
Mark III Version as Mark I but with output stage (ECL82) and tone control, **£7.7.0.** P. & P. 8/6.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PCC84 and PCF80 valves 34-38 Mc/s IF. Biscuits for Channel 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY **25/-** each. P. & P. 3/9.

GÖRLER F.M. TUNER HEAD

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

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 waveband transistor superhet. ● Printed circuit panel (size 8½ x 2¾in.). ● 3 pre-aligned IF transformers. ● High-gain Ferrite Rod Aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions All parts sold separately. Set of parts if purchased at one time ONLY **£4.5.0.** P. & P. 2/6 (Circuit diagram 2/-. Free with set of parts.)

35 OHM SPEAKERS

Suitable for use with above. 2in. Goodmans Ideal replacement for most pocket portables, **8/6**; 3½in. **12/6**; 7 x 4in., **21/-**; P. & P. 2/- per speaker.

Portable CABINET

Size approx. 9½ x 6¾ x 3½in. Suitable for above using. 3½in. speaker, **25/-**, P. & P. 2/6.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 IF transformers one oscillator coil one driver transformer and wound Ferrite aerial (med. long and car aerial coupling), **32/6** complete post 2/-. 6 transistor printed circuit board to match **8/6.** Post 1/-. Circuit diagram 1/6 extra.

MINIATURE PRECISION AIR-SPACED TWO GANG TUNING CONDENSOR. 176g + 176 p.F. size 1⅞"w x ⅞"d x 1⅜/l with vanes open. Built in trimmers **5/-.** P. & P. 1/-.

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, **13/6.** P. & P. 1/6.
TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price **13/6.** P. & P. 1/6.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 2½in. d. x 5½in. h. Ready built and tested. **PRICE 69/6.** P. & P. 4/9.
ALSO AVAILABLE mounted on board with output transformer and 6in. speaker ready to fit into cabinet below. **PRICE 89/6.** P. & P. 5/9.

QUALITY PORTABLE R/P CABINET

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.
Price £3.9.6. Carr. 7/6.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU/12	**£3.9.6.**	Carr. 5/6.
GARRARD SP25 De Luxe	**£12.10.6.**	Carr. 5/6.
B.S.R. GU7 with unit mounted pickup arm.	**£4.13.8.**	Carr. 5/6.

AUTO CHANGERS

Latest B.S.R. UA25 Super slim	**£6. 2.6**
GARRARD Autoslim (4 pole motor) plug-in hd.	**£5.10.0**
GARRARD AT6	**£9.10.0.** Carr. 6/6 on each.

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

BRAND NEW CARTRIDGE BARGAINS!

RONETTE STEREO 105 CARTRIDGE. Stereo L.P./78 complete with two sapphires. Original list price **67/9.** Our price **24/-.** P. & P. 1/-.
ACOS GP67-1. Mono complete. List price 21/-. Our price **13/6.** P. & P. 1/-.

BRAND NEW 3 OHM LOUDSPEAKERS

5in., **12/6**; 6½in., **15/-**; 8in., **21/-**; 10in., **25/-**; 12 in., **27/6**; (12in. 15 ohm. **30/-**). 10in. x 6in., **26/-**.
E.M.I. 13½ x 8in. with high flux ceramic magnet, **42/-** (15 ohm, **45/-**). P. & P. 5" 2/-, 6½" & 8" 2/6, 10" & 12" 3/6 per speaker.

E.M.I. PLASTIC CONED TWEETERS. 2¾" 3 ohm. Limited number **12/6** each. P. & P. 1/6.

BRAND NEW HEAVY DUTY 12in. SPEAKERS Response 45 c/s-13 Kc/s. 1½in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at **89/6.** P. & P. 5/-. Also 25 watt Guitar Model available at **£5.5.0.** And 35 watt Guitar Model **£8.8.0.**

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually 35/- yard. OUR PRICE **13/6** per yard length. P. & P. 2/6 (min. one yd.) S.A.E. for samples.

MAINS TRANSFORMER For transistor power supplies. Tapped pri 200-250v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6.3v at .5 amp for dial lamps etc. Drop thro mounting. Stack size 1¾" x 3⅜" x 3¼" **27/6.** P. & P. 4/6.

SMOOTHING CONDENSER. Suitable for use with above 4000 mfd. 40v. size 1½" dia. x 3½" high. **3/6** each. P. & P. 1/6 and 2800 mfd. 25v. 1¼" dia x 3" high **3/-.** P. & P. 1/-.

MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1¼ x 1½ x ⅞ in. Output trans. tapped for 3 ohm and 15 ohm output. **10/-** pair plus 2/- P. & P.

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

7-10 watt **ULTRA LINEAR OUTPUT TRANSFORMERS** to match pair of ECL 82's in push-pull to 3 ohm output. ONLY **15/-.** P. & P. 2/6.

BRAND NEW TRANSISTOR BARGAINS

GET 15 (Matched Pair) **15/-**; V15/10p, **10/-**; OC71 **5/-**; OC76 **6/-**; AF117 **7/6.**
Set of Mullard 6 transistors OC44, 2—OC45 OC81D matched pair OC81 **25/-**, ORP12 Cadmium Sulphide Cell **10/6.**

EDISWAN MAZDA

PXA101 6/6; XA103 6/6.

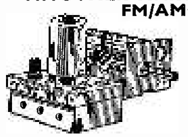
R.F.I. Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp. (Equiv. OC44 and OC45)	10/6
R.F. 2 Pack: 2—PXA101 I.F. 1—PXA102 Osc.1—PXA102 Mixer	12/6
L.F.6 Pack: Consisting of PXB113 Driver Matched pair. PX171 mounted complete with heat sinks (Equiv. OC81D and OC81)	12/6

ALL TRANSISTORS POST FREE.

HEAVY DUTY NON-INDUCTIVE D/P MICRO SWITCH. Conservatively rated 10 amps at 250v. Standard one-hole fixing. Body size 1⅜ x ⅝ x 1in. deep inc. terminals **3/-** each. P. & P. 1/- (6 or more post free).

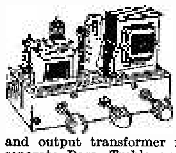
NEON A.C. MAINS INDICATOR. For panel mounting, cut out size 1⅛ x ⅝ x ⅝in. deep inc. terminal. White case with lens giving brighter light. For mains 200/250v. **2/6** each P.P. 6d. (6 or more post free).

ANOTHER HARVERSON SCOOP! FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer and Wadsworth Ltd. Supplied ready fitted with twin .0005 tuning condenser for AM connection. Prealigned FM section covers 86–102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at **27/6** each. P. & P. 3/-. Order quickly! Limited number also available with precision geared 3:1 reduction drive, **30/-.** P. & P. 3/-.

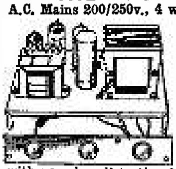
3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records. A.C Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.
The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 6/-.

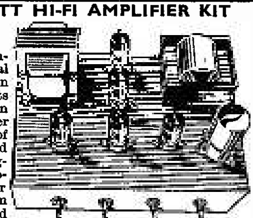
HSL 'FOUR' AMPLIFIER KIT

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



● Heavy duty double-wound mains transformer with electrostatic screen. ● Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss. ● Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor. ● Suitable for use with guitar, microphone or record player. ● Provision for remote mounting of controls or direct on chassis. ● Chassis size only 7¼in. wide x 4in. deep. Overall height 4¾in. ● All components and valves are brand new. ● Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ● Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy.) PRICE **79/6.** P. & P. 6/-.
Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).
This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

10/14 WATT HI-FI AMPLIFIER KIT



A Stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86, and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.) All parts sold separately. ONLY **£7.9.6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets, **£9.5.0.** P. & P. 8/6.
Carrying case for above **28/6.** P. & P. 7/6.

B.S.R. MONARDECK (Single speed) 3¾in. per sec., simple control, uses 5¾in. spools, **£6.15.0** plus 7/6 carr. and ins. (Tapes extra).

LATEST COLLARO MAGNAVOX 363 TAPE DECK DE LUXE. Three speeds, 2 track, takes up to 7in. spools. **10 gns.** Plus 7/6 Carr. & ins. on each (Tapes extra).

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

PORTABLE TAPE RECORDER CASE

Beautifully made and expensively finished in dark grey heavy grade rexine. Satin Chrome metal grille front and chrome fittings. Speaker aperture 9" x 4". Overall size 15¼" w. x 15" d. x 7¼" h. Will take any standard tape deck or single record player. Limited number only. Worth at least £5. OUR PRICE **49/6.** P. & P. 5/-. Brand new and unused.

Open all day Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.
170 HIGH ST., MERTON, S.W.19 CHErrywood 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

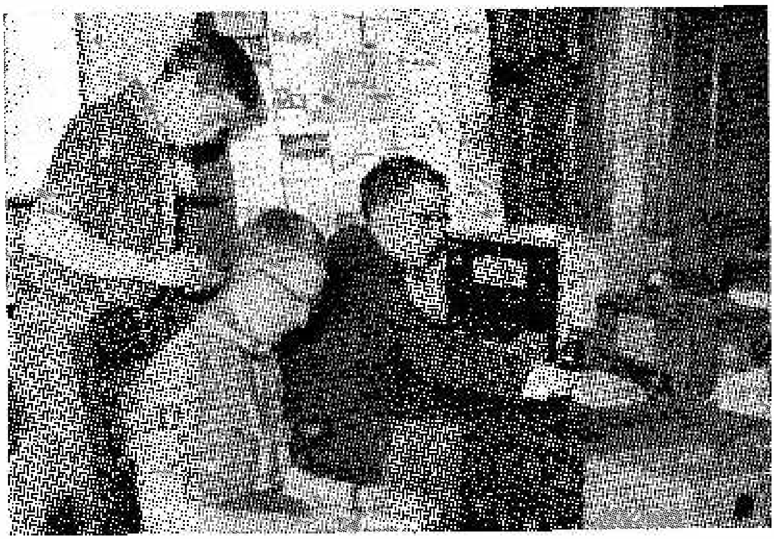
(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

CLUB SPOT No. 9 NORTHERN HEIGHTS AMATEUR RADIO SOCIETY G2SU

THE Society was formed after a meeting of persons interested on April 9th 1961. We were fortunate in having available for our fortnightly Wednesday meetings at the Sportsman Inn, Ogden, Halifax, a room at reasonable rent which is always comfortable and has such a fire in winter that we have no qualms about leaving our own firesides to attend a meeting.

Syllabus

A syllabus was arranged, an early item being a Junk Sale to help raise funds for the purchase of a communications receiver for the use of a patient in a local Cheshire Home. Another early item on the agenda was the first of a series of our highly successful "Pea and Pie Suppers"—which are even more popular than the Annual Dinner—if food is involved, the turn-up is amazing! The Manchester Society have always been our guests on these occasions, the association between the two societies being the outcome of a meeting of a member of the Manchester Society, under highly respectable circumstances, with a lady member of our Society, on the sandhills at St. Annes-on-Sea. The true and highly respectable story of this meeting has now been lost in the mists of antiquity and still grows more juicy with every telling, especially on the Lancashire side of the Pennines!



D. Garlick and scouts at G3MVH, Jamboree station of Halifax Boy Scouts Association (1962), operated by members of the Northern Heights Amateur Radio Society. The scout sitting is now G3TQQ.

Sufficient members wishing to take the R.A.E. were available for us to ask for a course at the local Technical College and this has since been supplemented by a course in Morse Code on another evening.

We have had visits to innumerable places of interest, thanks to the efforts of our indefatigable Secretary, including trips to radio and TV stations, TV studios, County C.I.D. H.Q., an atomic power station, radio, TV and audio equipment factories, Jodrell Bank, trade film shows and our annual marathon (overnight both ways) to the Radio Communications Exhibition in London.

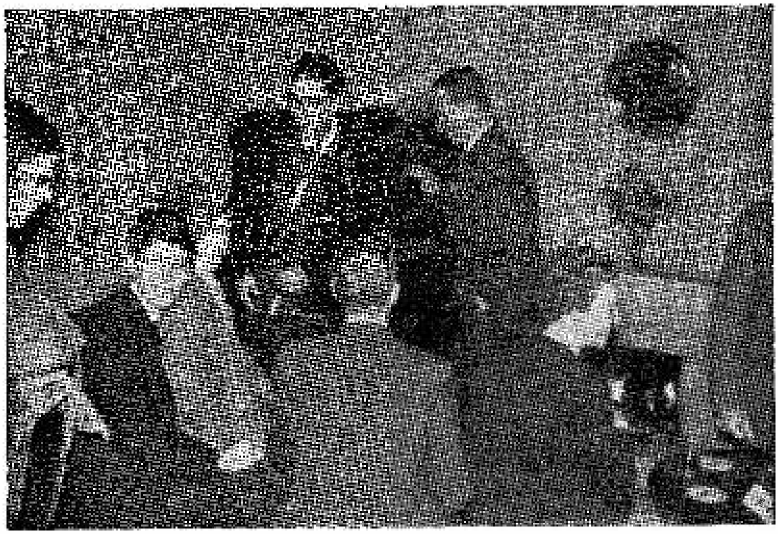
Society Lectures

We have had lectures, to name only a few, on subjects ranging from "Lightning" (complete with demonstration of 2 ft. spark of artificial lightning!), "Radio Astronomy," "Radio on Stamps," to "Fire Prevention," "Tape Recording," and our old friend, W1BB, on tape and slides on "160m. DX'ing"—which has subsequently been lent to a large number of other societies after three full houses at our own meeting rooms. This is to say nothing of the more usual selection of subjects heard at radio society meetings—lectures on antenna problems, TX construction, s.s.b., v.h.f., D/F test equipment, station layout and a most illuminating and entertaining evening on "How I became a radio amateur," given as a joint effort by three of our younger members and which really brought the house down. We have shown technical films, as well as slides of the Society's outside events—the incidents on some of these, especially Field Days, being too incredible to relate.

Every year we have operated the station G3MVH for the Scout Jamboree-on-the-Air and this event has been more successful in Scout contacts every year.

Twelve months ago our Society was granted the callsign G2SU, this being the callsign of the late Matthew Eskdale, a highly respected founder member of the Society and long-standing friend of many members.

This callsign was first used by the Society on a demonstration station at a local fete—one of several we run every year—a time of anxiety and heartache (to say nothing of all kinds of ache from the aerial rigging) for those responsible. Although we have now done the demonstrations many times on each site, every occasion produces its problems—dicey trees and dubious canvas on marquees to be climbed for aerial rigging, scaffolding supplied without clamps, officious officials, open wire P.A. equipment, the sewing machine demonstration ("absolutely free from *all* radio and TV interference, Madam"—"How interesting—in that case, would you like to come and listen to your sewing machines?"), the adjacent stand demonstrating the product of a small-time TV manufacturer where we had to go and connect up his aerials correctly for him in order to save our own reputations, power supplies which do not materialise at the time promised, gales, rain, storms (contact replies that the hail on our tent is "so 5 + 9" that he cannot hear our voices above it), working on live overhead cables protected only by very wet shoes and damp polythene sheet on wet trestle tables on a sea of mud, power failures, voltage regulation so bad that the rest of the lights on the ground dim when we switch to transmit, blowouts, aerials carried away—we've had the lot and yet have always been fortunate enough by some means to keep the station on the air. We have all learnt a lot in the process and as one of the team remarked on one occasion. "It's been a **** of a day, but I wouldn't have missed it for the world". It is these events which give an insight to up-and-coming youngsters on what happens (or fails to happen) amongst those wires stowed away at the back of the shack—many of these lads are now licensed themselves and we have the keenest and happiest crew of younger members one could wish for, and this fact, coupled with the experience of older members, is the lifeblood of any society. May we all go forward together for many more happy years in "our" Society. ■

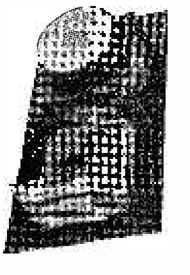


At this year's A.G.M. Richard, G3UGF; Mike, G3UBI; Phillip, SWL; John, G3SMS; Gilbert, G3TBC, seated with backs to camera, SWL, Dave Howell, and Mary, G3OMM.

208 BANDSPREAD PORTABLE

For correct working with the transistor type employed, the Weyrad RA2W aerial should have three turns removed from the base coupling winding on the m.w. section. This is done by unwinding three turns and re-soldering the wire to the original tag.

Fidelity Radio Ltd. ask us to mention that the P.W. 208 receiver described in our May issue has no connection or reference to their push-button LW, MW and Bandspread radio set named **The 208.** This popular receiver has been successfully marketed by Fidelity for the last 18 months.



Richard Allan HIGH FIDELITY Module

SPECIFICATION—**Bass Unit:** Natural resonance 40 c.p.s. Flux density 14,000 Gauss. Total flux 56,000 Maxwells. **Tweeter Unit:** Flux density 6,000 Gauss. Total flux 9,000 Maxwells. **Overall:** Height 11in. (28 cm), width 6½in. (16.5 cm), depth 2½in. (6.4 cm), weight 5 lb. (2.3 kg). Power handling 10 watts in recommended enclosure. Impedance 5, 8 or 15 ohms.

TECHNICAL DETAILS:

The unit is a compact and self contained loudspeaker system which only needs to be fitted into a simple cabinet of the recommended design to produce a high fidelity loudspeaker of the highest quality.

The unit consists of a 5in. bass unit, 4in. tweeter and crossover network mounted on a duralumin plate which forms the front panel of the complete enclosure.

The method of assembly of the module is unique in that the cone and synthetic rubber surround of the 5in. bass unit are mounted directly on to the duralumin front panel and the ceramic magnet is supported on substantial pillars attached to the panel. The conventional chassis with all its disadvantages is thus eliminated.

The tweeter is a special version of the 460T unit with a doped cambric surround and extremely light suspension system.

The crossover network is a five element circuit using ferrite cored inductors and reversible electrolytic capacitors mounted on a printed circuit board.

Free constructional details of the recommended cabinet are readily available from us.

Where larger power handling is required several units may be mounted in a larger cabinet, multiple units may also be mounted in a column enclosure to form a high power handling, high quality line source. The unit may also be mounted directly into existing equipment or in cavities in walls etc.

The unit forms the drive system of the 'Minette' enclosure, for details see separate leaflet. Patents applied for.

Price £8 plus £1.5.9 tax

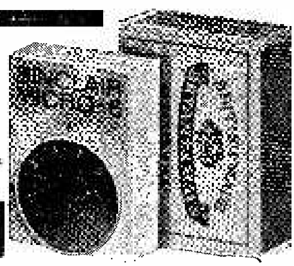
For further details contact:
RICHARD ALLAN RADIO LIMITED
Bradford Rd, Gomersal, nr Leeds, Yorks.
Tel: Cleckheaton 2442/3

Richard Allan

Build the smallest set in the world

—it's the inimitable

sinclair MICRO 6



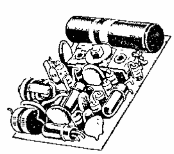
SIX STAGE POCKET RECEIVER

Anyone can build it in an evening

- **ONLY $1\frac{4}{5}''\times1\frac{3}{10}''\times\frac{1}{2}''$**
- **WEIGHS 1oz.**
- **FANTASTIC RANGE AND POWER**
- **PLAYS ANYWHERE**

MALLORY MERCURY CELL ZM.312 (2 required) each 1/11. Pack of Six 10/6

The wonderful Micro-6 brings in stations all round the medium waveband and has bandspread to bring in Luxembourg like a local station, yet it is actually smaller than a matchbox. Batteries and ferrite-rod aerial are contained within the minute white, gold and black case, and the set will play virtually anywhere. Building the Micro-6 is easy. When completed, it will delight and enthral you with its fantastic performance which brings an intriguing new approach to radio listening.



59/6

This wonderful set has two stages of R.F. amplification, double diode detector and 3 stages of audio amplification with powerful A.G.C. to counteract fading from distant stations. Slow motion tuning makes station separation easy. Kit complete with transistors, case, dial, lightweight earpiece and instructions manual.

FULL SERVICE FACILITIES AVAILABLE . ORDER FORM PAGE 223

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SINCLAIR RADIONICS
22 Newmarket Road
Cambridge 52731

How would you like to be an officer in the Royal Navy?

and then train to be a fully qualified Electronic Engineer?

Impossible?

Very possible!

Not many people know this: but it's possible to train to be a graduate member of the Institution of Electronic and Radio Engineers while you're an officer in the Royal Navy.

As an electrical officer, you are given a training that lasts 4 years and which costs literally thousands.

You then get the technical and administrative experience to qualify you for the standing of chartered engineer. Which is getting the best of both worlds: a commission and an excellent civilian qualification.

What of the future? The Defence Review has re-affirmed the world-wide role of the Royal Navy. The vital protection of our shipping remains its constant task. The most modern technologies of nuclear propulsion, guided missiles and electronics are developing, and Polaris will take over the deterrent role by the 1970s. Here's a career that offers you responsibility, rich opportunities—and real reward.

Entry – *Qualifications:* G.C.E. 'O' level in English, with (i) suitable O.N.C., or (ii) three further G.C.E. passes including 2 at 'A' level. (One 'A' level should be in an appropriate maths or physics subject.) Scottish or Northern Ireland certificates equivalent to the above. *Age Limits:* 17½-25. *Training Course:* 4 years. *Service Period:* 16 years (pensionable) with every opportunity to put in for a permanent commission.

For full details complete and send the coupon below.

You should apply before the end of July.

Royal Navy

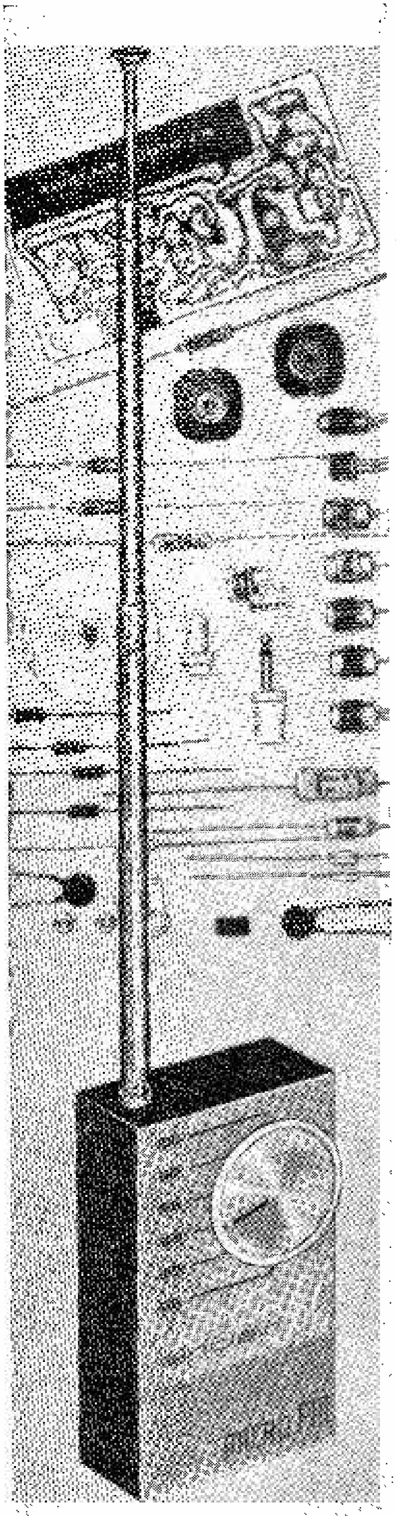
Captain J. H. F. Eberle R.N.
Officer Entry Section (830AU2),
Old Admiralty Building,
London S.W.1.

Please send me full details about the opportunities of training for a commission in the Electrical Branch.

NAME ______________________

ADDRESS ______________________

______________________ Date of birth ______________________



Build the World's most amazing FM tuner-receiver

The Sinclair Micro F.M. is **more** than an F.M. Tuner; **more** than an F.M. Receiver, for it combines the advantages of both with many other unique features to make it the most advanced set of its kind in the world. Anyone can construct it for, unlike other F.M. constructional kits, the Micro F.M. needs no aligning and is ready to work as soon as it is finished. Pulse-counting detection gives better audio quality than any other discriminator system. Excellent sensitivity assures good reception using no more than the set's own small telescopic aerial in all but the worst reception areas. When built, the Sinclair Micro F.M. has all the appearance of a professionally engineered set both inside and out. Its distinctive, elegant exterior makes it particularly pleasing to own and to operate whether as a tuner for amplifier or tape recorder or independently as a self-contained pocket F.M. portable.

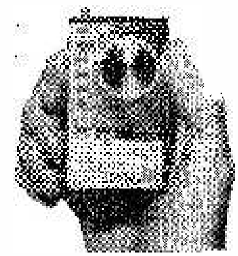
- **SUPPLY VOLTAGE**—9V from self-contained standard battery
- **CONSUMPTION**—5mA
- **SENSITIVITY**—Typically 3 microvolts
- **SIGNAL TO NOISE RATIO**—30dB at 30 microvolts
- **AUDIO FREQUENCY RESPONSE**—10-20,000 c/s $\pm$ 1 dB
- **A.F.C.**—for automatically locking on to each station tuned in
- *Inserting plug of earpiece or tuner lead switches set ON*

TECHNICAL DESCRIPTION

THE SINCLAIR MICRO F.M. is a completely self-contained double-purpose F.M. superhet housed within a case less than 3″ high × 1¾″ wide with a depth of ¾″. It uses 7 transistors and 2 diodes. The R.F. amplifier is followed by a self-oscillating mixer and three stages of I.F. amplification which dispense with I.F. transformers and all problems of alignment. The final I.F. amplifier produces a square wave of constant amplitude which is eventually converted into uniform pulses so arranged that the original modulation is reproduced exactly. A pulse-counting detector ensures absolute linearity and therefore better audio quality at the output stages. After equalisation the signal is channelled to one output for feeding to amplifier or recorder and to another in which the receiver's own audio amplifying stage enables the Micro F.M. to be used as an independent self-contained pocket portable. A.F.C. is used to lock the programme tuned in. The telescopic aerial included with the kit will be found sufficient in all but the worst signal areas

sinclair MICRO FM

7 TRANSISTOR—2 DIODE SUPERHET F.M. TUNER-RECEIVER WITH A.F.C. PULSE-COUNTING DETECTION AND TWO OUTPUTS



Complete kit of parts including telescopic aerial, case assembly, transistors, lightweight earpiece and instructions

£5.19.6

FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

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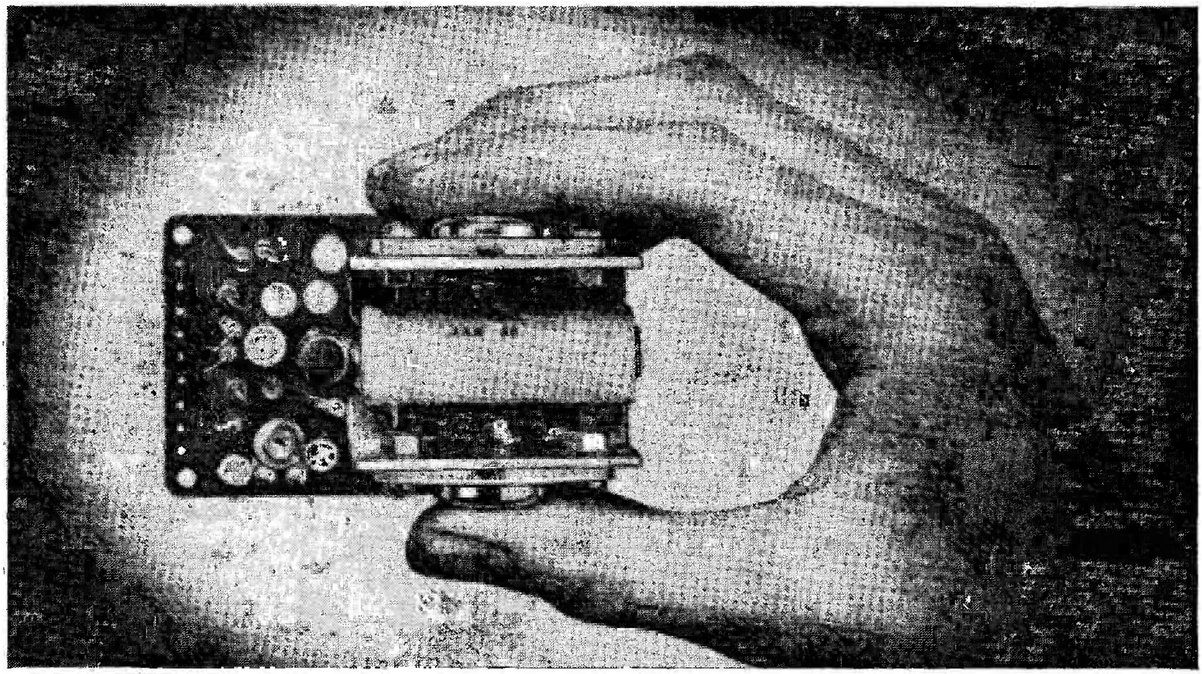

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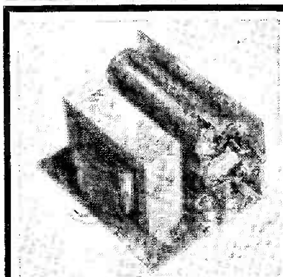

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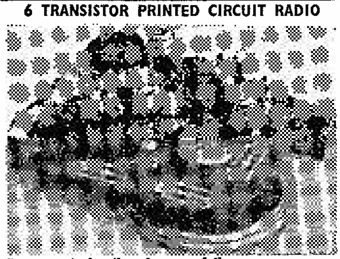

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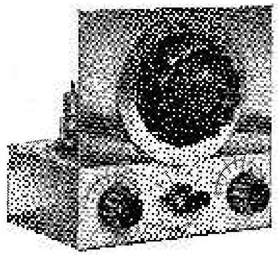

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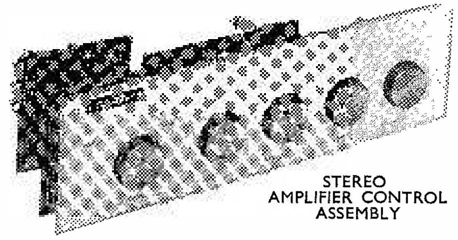

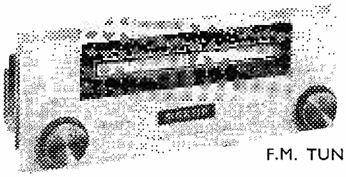

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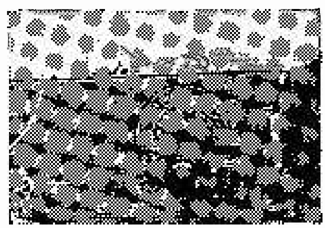

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PRACTICAL WIRELESS, JULY, 1966

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insulation in these couplers can badly upset the biasing of the output valves and cause distortion and overheating.

The driver stage has load resistors both in its anode and cathode circuits. This gives antiphase voltage swings to the control grids of the output valves, required for push-pull operation. The driver has less than unity gain (since it is a cathode-follower), the gain being contributed by the earlier voltage amplifier stages. Contact bias (or grid current bias as it may be called) is provided on the driver valve by the grid resistor, which is possibly in the order of 10 MΩ. Note that it is returned to cathode.

Unbalance in the output valves often causes trouble. It can arise from unmatched output valves or alteration in value of one of a matched pair of components, like R2 R3, C2 C3 or the primary of the output transformer. When the output stage is correctly matched d.c.-wise, a voltmeter connected between the two anodes of the output valves should read almost zero volts. Some amplifiers have adjustable bias on one valve to secure such a balance. This is normally done by fitting a variable resistor in the cathode circuit of one of the output valves—separate cathode biasing resistors for each valve being used with this arrangement. Excessive unbalance can cause a high content of harmonic distortion.

WATMOUGHS LIMITED, ENGLAND

PRACTICAL WIRELESS

circuit guide

3 Testing Transistor And Valve Circuits

*presented with the July 1966 issue

THE first and second booklets in this current series, presented free with the May and June, 1966 issues of *Practical Wireless*, dealt with circuit techniques employing respectively thermionic valves and equivalent solid-state devices. This final booklet of the series considers practical methods of testing in both valves and transistor circuits, with emphasis on circuits of the nature of those described in the previous two booklets.

R.F. Gain Test

Take a suspect v.h.f. amplifier, for example, we could feed a signal into it from a v.h.f. signal generator, take a note of the signal voltage applied and then measure the signal voltage at the output on some sort of calibrated receiver or signal strength meter. The basic set-up is shown in Fig. 1. At (a) the generator signal is first measured and adjusted to a level suitable for feeding into the amplifier and at (b) the signal level at the output of the amplifier is measured with the input adjusted as at (a). If the amplifier is working, the signal voltage at (b) will be somewhat above that at (a) by the gain of the amplifier. If at the test frequency the gain should be, say, 20d B (that is, a voltage ratio of ten times),

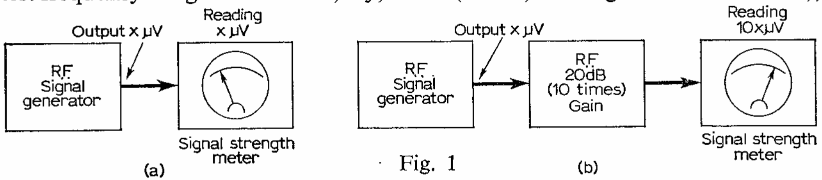


Fig. 1

"distributed load" technique where the screen grids of the output valves are taken to tappings on the primary of the output transformer instead of direct to h.t. positive. This endows the stage with compromise features between a pentode (or tetrode) stage and a triode stage. It is popular in hi-fi circuits for the improved quality that it provides, although there is a certain limitation in terms of power.

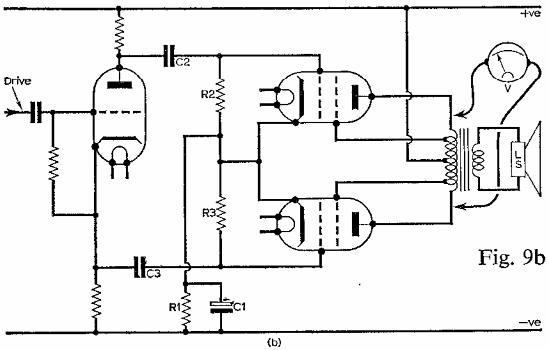


Fig. 9b

The output stage is biased by the cathode resistor R1 and bypassed to avoid degenerative feedback by C1. A short in C1 would thus cut off the bias and cause severe overheating of the output valves and consequent audio distortion. Open-circuit would result in reduced gain and impairment of the output damping factor across the speaker.

R2 and R3 are the grid return resistors for the bias, while C2 and C3 are the coupling capacitors (about 0·1µF). As in voltage amplifier stages, poor

R6 also aids with the thermal compensation of the output pair of transistors, and although only of a relatively small value (usually a matter of tens of ohms—or less) it does limit the emitter current under abnormal conditions and may save the transistors from damage.

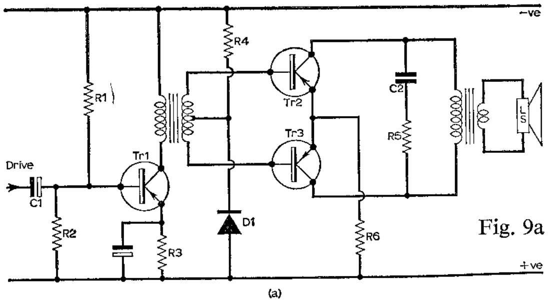


Fig. 9a

Tr1 is the "driver" stage, which is an ordinary voltage amplifier loaded at the collector by a transformer winding. The secondary of this transformer is centre-tapped and thus feeds antiphase signals to the bases of Tr2 and Tr3. Negative feedback is often applied from the secondary of the output transformer to the base or emitter circuit of an earlier stage.

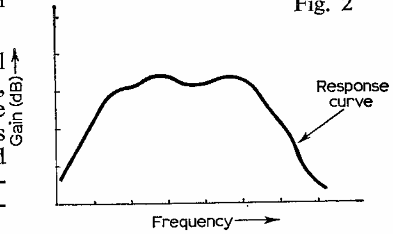
The biggest trouble in this type of circuit, then, is crossover distortion which is a function of stage balance and biasing, and tests should be made along the lines discussed above in event of the trouble.

Fig. 9(b) gives a circuit of a valve push-pull output stage. These are nearly always arranged as class A amplifiers, and the one shown adopts the so-called

then a signal input XμV should give an output of 10XμV, as shown in Fig. 1.

By adjusting the frequency of the signal input over the passband of the amplifier, keeping the input voltage constant, the gain of the amplifier at spot frequencies can be determined. This can be plotted against frequency to provide a diagrammatical illustration of the amplifier's response curve, as shown in Fig. 2.

Fig. 2



To the input of the amplifier should be connected the aerial and to the output the diode detector, as shown in Fig. 3. If the amplifier is wideband, a jumble of several local or high-power transmissions will be heard in the 'phones if the amplifier is working, while if the amplifier is tunable, it should be possible to select a local transmission for the test.

A very powerful transmission may induce sufficient signal into a good aerial to cause some response with the aerial connected direct to the diode circuit without the amplifier. This should be checked by connecting the aerial first to point "A" of the detector (Fig. 3). If the signal is non-existent or very weak with the aerial so connected, but loud (or louder) with the aerial connection to the input of the amplifier, then one can be sure that the amplifier has gain, at least.

Adjusting for Resonance

When building an r.f. amplifier, especially one tuned to a v.h.f. channel, it may be necessary to experiment with the number of turns on the coils and their spacing in conjunction with the value of the variable or fixed tuning capacitance to secure resonance at the required frequency or range of frequencies. With a signal generator and signal strength meter the problem is fairly easily resolved by applying a strong signal to the amplifier input, sufficient to give some sort of indication on the meter at the output, and then adjusting the coil and/or value of the tuning capacitance until the output peaks, keeping the input signal turned down to avoid overloading as the circuits approach resonance.

A local on-the-air signal can be used to supply the signal, while a detector and 'phones can be used as the signal output indicator, the idea being to adjust the tuned circuits for maximum volume of the signal in the 'phones. For example, the tuned amplifier input circuit may be a ferrite rod aerial, and the exercise may be to adjust the number of turns on this to tune, say, the Light Programme of the BBC on 1,500 metres at the approximate centre of the range of the tuning capacitor.

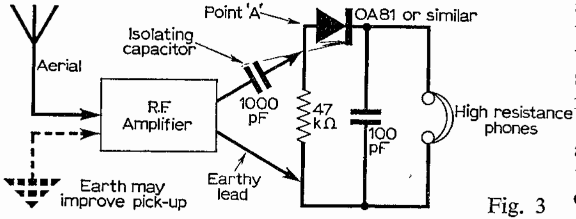


Fig. 3

Fig. 9(a) gives the circuit of a typical push-pull transistor output stage. To save on standing current, the stage is biased very close to class B. This means that only a little standing or quiescent current is taken under zero signal conditions. The current then rises correspondingly with the audio power fed to the speaker.

The push-pull pair bias is set by R4 and D1 forming a potential-divider across the supply. The resistance of D1, which is a special diode for temperature compensation, decreases with increase in temperature. This means that if the ambient temperature tends to cause the output transistors to pass an abnormally high current, the resistance of D1 falls, thereby pulling down the base bias and reducing the collector current of the transistor in a compensating manner. This technique also ensures that the biasing of the stage remains at all times towards class B, with a little collector current flowing to reduce an effect known as 'crossover distortion'.

This causes a nasty "rattle effect" in the speaker owing to the alternate switching of the output transistors on positive and negative cycles of signal. Provided the bias permits a small collector current, the switching effect is minimised. D1 thus ensures that this condition is maintained at all temperatures.

Unbalance in the output pair of transistors can also cause the trouble, as can an almost exhausted battery. The effect is further reduced by C2 and R5 across the primary of the output transformer.

negative feedback which, while cutting down the stage distortion, considerably decreases the effective stage gain.

The emitter/base bias of (b) is set by R2 R3, and this time the signal input is through an electrolytic C1. A high value is necessary with transistor audio stages owing to the lower impedance at the input relative to valve control grid circuits. R1 contributes a little towards the biasing, but here serves mainly for thermal stabilisation (see booklet No. 2). The output signal is developed across the collector load R4 and fed, again through an electrolytic C2, to the following stage.

The polarity of the coupling electrolytic capacitors is important, for reversed connection when replacing could lead to bias disturbance due to d.c. leakage. The insulation of these couplers can be tested as with valve circuits by noting any change in d.c. voltage across the emitter resistor R1 when the component is disconnected. When it is first connected again, a kick in emitter voltage is normal, owing to the charging current taken by the electrolytic. Negative feedback and reduced gain can also result from open-circuit or value reduction of C3.

Transistor power amplifiers invariably feature a push-pull output stage, using either a pair of p-n-p transistors or one p-n-p and one n-p-n arranged in a complementary pair, coupled to the speaker through an electrolytic instead of the conventional transformer.

The detector could be connected as in Fig. 3 and, with the approximate number of turns on the ferrite rod for l.w. response, the tuning adjusted until the programme is heard in the 'phones (note: to enhance the pick-up it may be necessary to couple loosely an external aerial to the rod by winding a few turns of the external aerial wire round the rod).

If the programme tunes (or approaches tuning) at full capacitance of the tuning capacitor more turns are required on the aerial winding proper. If the tuning occurs towards the minimum capacitance side of the tuning capacitor, then there are too many turns on the coil. Slight alteration in aerial coil inductance is obtained by moving the coil along the rod. At dead centre, the inductance is at maximum, and it falls as the coil is moved either side of centre towards one end of the rod.

D.C. Tests

We shall consider valve and transistor circuits side-by-side in terms of testing as we have done so far. The first logical step to take is to check the supply voltage. In valve equipment we have the heater voltage as well as the high tension (h.t.) voltage to consider. Heater voltage shows its presence by a glowing valve heater.

The anode supply of an r.f. amplifier is often fed through the winding of a coil, while the screen is fed through a medium to high value resistor (sometimes direct from h.t. positive, depending on the nature of the circuit). If we find that anode voltage is lacking (h.t. line voltage normal), a break in a coil is possible. Lack of screen grid voltage should lead (a) to a check of the feed resistor and (b) to a check of the insulation of the bypass capacitor to chassis. If this is shorting there would be no screen volts and the short-circuit current would be considerably limited by the highish resistance of the feed resistor, so this may not even get warm!

If anode and screen volts are present and the heater is glowing, the valve may not have emission. This can be checked *in situ* with a voltmeter simply by measuring the voltage across the cathode resistor. All the current taken by the valve flows through this resistor provided the valve has emission, and thus a voltage is developed across it of a magnitude depending on (i) the total screen and anode current and (ii) the value of the resistor. If the resistor is 1kΩ and 2V is measured across it, the current flowing in milliamperes (mA) is equal to the measured voltage divided by the value of resistance in *thousands* of ohms. Thus, 2mA would be flowing in the case cited.

If there is zero current, then the valve is faulty and should be replaced. If current is about normal, the dynamic parts of the circuit should be carefully re-checked, for it must be here where the trouble lies.

The base and the collector current flows through the emitter circuit of a transistor. Thus, if an emitter resistor is employed in the circuit, a basic assessment of the d.c. conditions of the stage can be gleaned by measuring the voltage dropped across the emitter resistor. The emitter resistor is the transitor's equivalent of the valve's cathode resistor.

The same law applies. That is, the current in *mA* is equal to the voltage across the resistor divided by its value in *thousands* of ohms Circuits (a) and (b) in Fig 4.

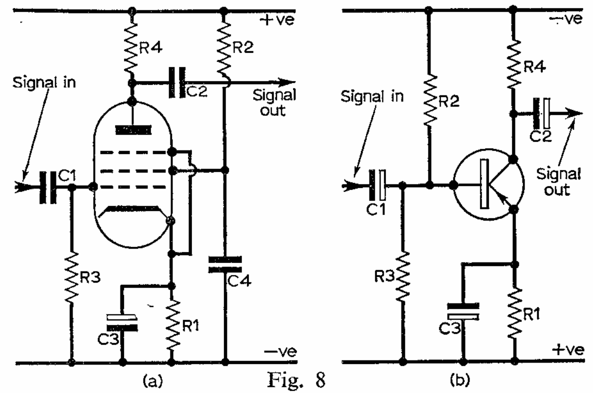


Fig. 8

across the anode load R4. R2 is simply a screen grid dropper and C4 its signal bypass capacitor.

Trouble can be caused by lack of conduction in the valve or by a faulty component. A simple test consists of measuring the voltage across R1, as for r.f. amplifiers. Bad distortion and/or lack of sensitivity can result from bias trouble. When C1 is connected from the anode of a previous stage, poor insulation in the capacitor can tend to neutralise the bias. This can be proved by connecting a voltmeter across R1, checking the voltage and then disconnecting C1. If the voltage falls, C1 is 'leaky' and needs replacing.

Low sensitivity results from C3 going open-circuit. This lets signal voltage develop across R1 which then appears antiphase at the control grid. This is aspect, we can analyse the circuits almost exactly as described for r.f. amplifiers. The fundamental difference being in the nature of the signal.

Of course, we rarely come across *tuned* audio amplifiers, though these do exist. Most audio amplifiers that we shall deal with have a relatively flat response over the audio spectrum, with extended responses into low audio and high audio (bass and treble) with hi-fi amplifiers.

As we saw in the previous booklets, these amplifiers are essentially for *signal voltage* or *signal power*—voltage or power amplifiers. The voltage amplifier lifts the level of the programme source signal sufficiently to operate the power amplifier which effectively translates the signal into audio power for operating the loudspeaker.

Voltage amplifiers are also integrated with equalising networks and tone controls, allowing the programme signals to be tailored as may be required by the nature of the programme source. The volume control is sometimes between the output of the final voltage amplifier and the input to the power amplifier.

A basic voltage amplifier is given in Fig. 8 for valve and transistor at (a) and (b) respectively. At (a) the stage is biased by the volts drop across the cathode resistor R1, the control grid being returned to the negative end of this resistor. Thus, the cathode is positive relative to the grid (making the grid negative relative to the cathode) by the amount of the voltage across R1.

The input signal is applied through C1, the signal being developed across R3. The valve 'boosts' the signal and it is re-developed in amplified form

show respectively the valve and transistor tests referred to.

Cathode current will flow only when the valve is conducting, and the valve will conduct correctly only when its grid bias suits the application. R.F. amplifiers are based to class A. If the grid bias is too negative—due, perhaps, to a fault condition—conduction will be suppressed, while if the grid is too little negative or, perhaps, a little positive, excessive conduction will occur, reflected by an excessive voltage across cathode resistor.

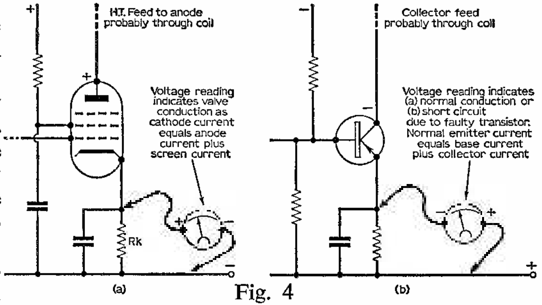


Fig. 4

Emitter current flows only when the base is biased for forward conduction in the emitter/base junction. The emitter current is composed both of emitter/base current (that is, current in the emitter junction) and collector current brought about by the 'transistor effect'.

Unlike a valve circuit, however, a transistor defect can sometimes simulate correct d.c. conditions. Of course, the circuit would not work from the signal aspect, but the voltage as measured across the emitter resistor may incorrectly give the impression that all is well with the conduction of the transistor.

The collector current of a transistor is stimulated by the forward current in the emitter/base junction. If for some reason this current fails, then the collector current (and hence the current in the emitter resistor) will collapse to a very low value equal to the collector leakage current, which may only be the matter of a few μA. No ordinary meter would show this current in terms of voltage drop across the emitter resistor.

Thus, we have two possibilities: one, a fault in the transistor giving the impression of normal conduction and two, lack of base bias showing as lack of conduction or voltage drop of any significance across the emitter resistor.

A third possibility is failure of one or both of the transistor junctions. If there is no internal short-circuit in the transistor, this trouble would also show as zero conduction.

Once we have established that the junction voltages are reasonable, we can make one or two tests to prove whether or not the transistor is working as it should d.c.-wise. Fig. 5 gives the basic transistor d.c. circuit (a) for p-n-p transistors and (b) for n-p-n transistors. These circuits show three tests for voltage. Test 1 checks the full supply voltage, test 2 the collector voltage and test 3 the base voltage. The tests should be made in order of number.

Test 1 is obvious and will indicate the supply voltage to the stage. The voltage at test 2 will depend on the resistance value of the collector load. In r.f. circuits, the load is often a coil of low d.c. resistance. Thus, almost the

More specialised oscillators, such as phase-shift oscillators, multi-vibrators, blocking oscillators and the like are not quite so easily tested. It is true that a change in d.c. conditions takes place when the oscillation is muted, but with this sort of oscillator the nature of the output waveform is often rather important.

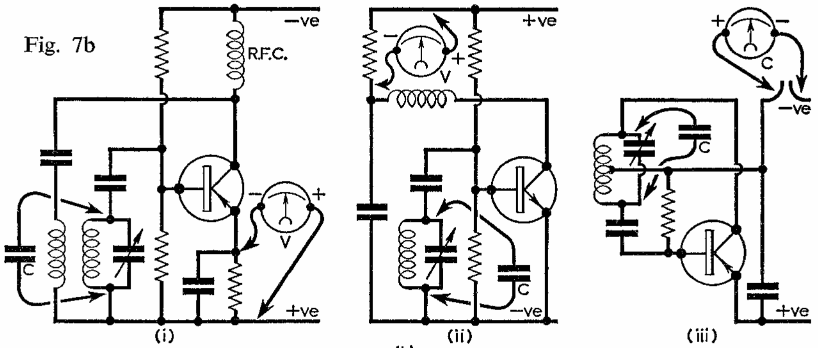
This means, then, that an oscilloscope is a useful instrument for testing in circuits of that nature. The actual waveform generated can be displayed on the screen and a few calculations based on the display give some idea of the repetition frequency and distortion content. It is not possible, of course, to detail tests of this kind within the small compass of this booklet, but interested readers are referred to *Radio and Television Test Instruments*, by Gordon J. King, Odhams Press Limited.

When a pulsed oscillator, like a blocking oscillator or multivibrator, for example, acts as a drive source for an output amplifier, the bias produced at the control grid of the driven valve shows whether or not the oscillator is working. Lack of substantial bias here (between the control grid and chassis or common point) makes the oscillator suspect.

Audio Stages

Audio stages, excepting certain output stages, are biased to class A conditions in a similar way to r.f. amplifier stages. The input and output loads are then either pure resistance or audio transformer windings. Thus, from the d.c.

Fig. 7b



(b)

C=Damping capacitor V=Voltmeter C=Milliammeter

is not told by this test, but often a knowledge of whether the stage is oscillating or not is sufficient.

This technique can be extended to most oscillators, including local oscillators of radio sets, erase and bias oscillators of tape recorders and oscillators used for test purposes and so forth.

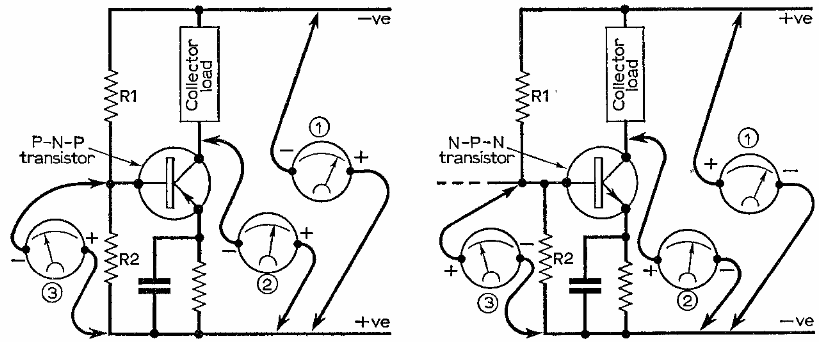


Fig. 5

full supply voltage will be indicated irrespective of how the transistor is conducting. If there is a resistor in the order of thousands of ohms also in circuit, the collector voltage may be considerably below the supply voltage, depending on how much current is passing through the collector resistor—the greater the current (hence, the greater the conduction of the transistor), the greater the volts drop across the resistor and the smaller the collector voltage.

The base voltage will be very small, often well below one volt. This is because the potential-divider R1 R2 taps off only a small negative voltage and because the emitter/base junction is always in forward conduction (by a matter of μA only—on small transistors, that is). A very sensitive, low reading meter will thus be needed for test 3. Indeed for all tests on the transistor electrodes and for voltage measurement across resistors (see Fig. 4 again), a low reading voltmeter is essential. A meter of not less than 20,000 ohms/volt is neccssary to avoid excessive shunting of the resistor on the low range. For base voltage measurements, a meter of 100,000 ohms/volt sensitivity is desirable.

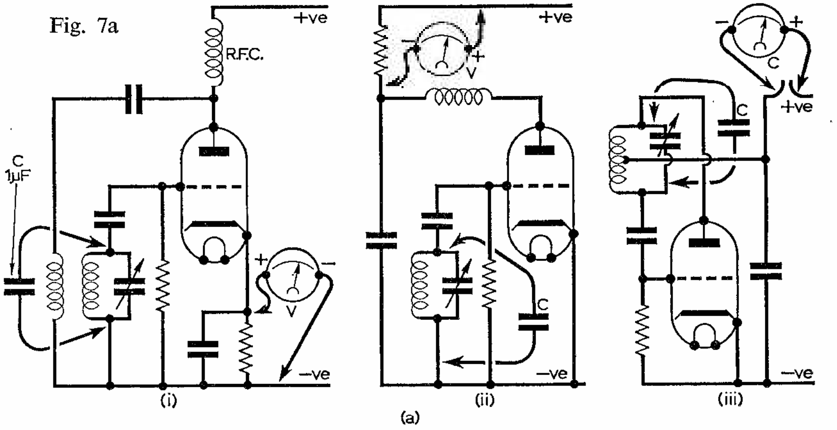
Now, tests to prove the goodness of the transistor are possible by changing the base current while observing the voltage across the emitter resistor. With the meter connected as for the emitter test in Fig. 4(b)—reversed polarity with an n-p-n transistor—R1 or R2 in Fig. 5 can be shunted with another resistor to increase or decrease the base current. It is best to decrease the current to avoid the possibility of transistor damage. This can be achieved by shunting R2 (a) or (b). So shunted, the emitter voltage should fall. If R1 is fairly high in value, R2 can often be shorted out to delete base current completely. This should—if the transistor is working—result in a substantial drop in emitter voltage.

Thus we can prove the d.c. conditions of the transistor, and if reactions here are positive, lack of operation of the r.f. amplifier should lead to a more detailed check of the signal or dynamic conditions.

I.F. Amplifiers

The tests so far dctailed apply also to i.f. amplifier stages as they differ from r.f. amplifiers essentially in terms of tuned frequency. The i.f. tuned circuits

Fig. 7a



A short-circuit can be applied across the oscillator tuning capacitor in some circuits, but in others a d.c. short-circuit may result, so in all cases it is best to use a capacitor to be always on the safe side.

If a distinct change in reading occurs when the oscillator is so damped, then one can be sure that the stage is oscillating. Of course, the frequency of oscillation link wire round the wire from the oscillator to the oscillator section of the tuning gang and several turns at the other end round the ferrite rod aerial.

It must be remembered, of course, that the local oscillator frequency is removed from the frequency (or wavelength) shown on the tuning dial of the set being tested by the i.f. The frequency may, in fact, be equal to the incoming or tuned frequency *plus* (sometimes minus) the i.f.

As already intimated, a change in d.c. conditions occurs when an oscillating stage is heavily damped so that oscillations cease. This is reflected in terms of a change in anode current of a valve or collector current of a transistor. To avoid disconnecting components to insert a current meter, however, the translated voltage change across the cathode or emitter resistor can be observed.

If there is no cathode or emitter resistor (some oscillators may not have these components), the voltage change can be registered across an anode or collector resistor.

If neither of these connections is feasible, a low-reading current meter can be connected at the "cold" end of the anode or collector circuit. These three conditions are shown respectively at (i), (ii) and (iii) at (a) for a valve oscillator and at (b) for a transistor oscillator, in Fig. 7.

Now, the voltage or current should be carefully noted with the stage operating without any damping, and then any small change in reading should be observed when the oscillator tuned circuit is damped with a fairly large value capacitor. A 1 or 2μF usually kills all signs of oscillation in most circuits.

are preset, adjustable either by trimmer or dust-iron core. If the d.c. conditions are normal, yet the stage is failing to pass or amplify a signal, attention should be given to the tuned circuit alignment. The idea then being to inject a frequency equal to the i.f. to arrange some means of detecting this (see, for instance, Fig. 3) and then to adjust the tuned circuits for maximum output.

Some i.f. stages have fed back to them as bias a potential derived from the detector or a.g.c. diode. Valve circuits have a negative bias that rises in value—and thus pulls back the stage gain—with increase in signal amplitude. Transistor circuits use a similar method, feeding back to the base a positively or negatively rising potential so as to reduce the conductivity of the transistor with rising signal amplitude. The d.c. conditions of these circuits should also be taken into account when analysing the stage from the d.c. aspect.

Lack of gain or reduced sensitivity of i.f. stages is sometimes caused by alteration in value of one or more of the fixed capacitors across the i.f. transformer windings. The "Q" or goodness factor of the winding may also deteriorate, especially if the set or circuit has been exposed to the damp for any period of time.

Frequency Changers

From the testing point of view, a frequency changer stage can be considered as an i.f. amplifier plus a local oscillator, the two functions happening in the one stage to provide mixing of the incoming signal with the local oscillator, the "difference frequency" being selected by the output tuned circuits (the i.f. transformers) for subsequent amplification.

Another type of frequency changer system features two separate stages, a mixer and a local oscillator. With this system the mixer stage is almost identical to an i.f. amplifier, though there are one or two differences in d.c. conditions to ensure optimum conversion efficiency. Nevertheless, the stage can be analysed, whether valve or transistor, along the lines already discussed.

The local oscillator stage can then be treated as any ordinary r.f. oscillator with arrangements for injecting an oscillator signal of suitable amplitude into the mixer along with the incoming signal. Oscillators are considered later.

The previous two booklets in this series have considered in some detail the circuits of the various frequency changers, and it is not intended to reproduce them here.

When the local oscillator is in doubt, the d.c. conditions should be checked. If these are reasonable, then some test should be set up to prove that a local oscillator signal is being generated. Being able to obtain some idea of the oscillator frequency is also desirable. A wavemeter or grid-dip oscillator is handy for tests of this kind, but few enthusiasts have such instruments. If they have, they will almost certainly know how to apply them for frequency checks.

Oscillator Checks

Most enthusiasts, however, have a transistor portable covering the range of frequencies covered by the suspect local oscillator, and this makes a good

'test set'. The idea is to loosely couple the oscillator signal from the suspect stage to the ferrite rod aerial of the test set and tune the set to pick up the oscillator signal. The oscillator signal, of course, is not modulated—it being just a continuous wave—so it may not be heard on the test set apart, perhaps, from a quieting of the background when the signal is tuned.

The best idea is to get the oscillator signal to beat with a signal normally picked up on the transistor set, and when this happens a whistle will be heard in the test set speaker. That the local oscillator under test is responsible for this whistle will be determined by tuning the suspect set a little either side of its setting, causing the whistle to change in pitch and disappear when it is well off tune.

The general set-up is shown in Fig. 6. Sufficient oscillator signal can usually be coupled to the test-set's ferrite rod aerial by dressing several turns of the

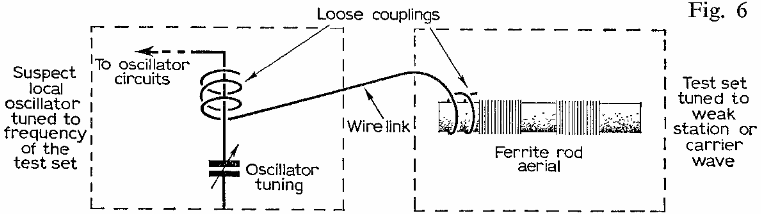


Fig. 6